Smartlouvre
Technology

Built for people first:

SUSTAINABLE LIVEABLE HOMES

A designer's guide to complying with Part O

2 SUSTAINABLE LIVEABLE HOMES

Introduction

Overheating of buildings is not a new issue. Previously, it has been partially addressed with assessment tools and guidance by various bodies, but for the first time, the UK Government, in the form of the Department for Levelling Up, Housing and Communities (DLUHC) has firmly addressed the issue.

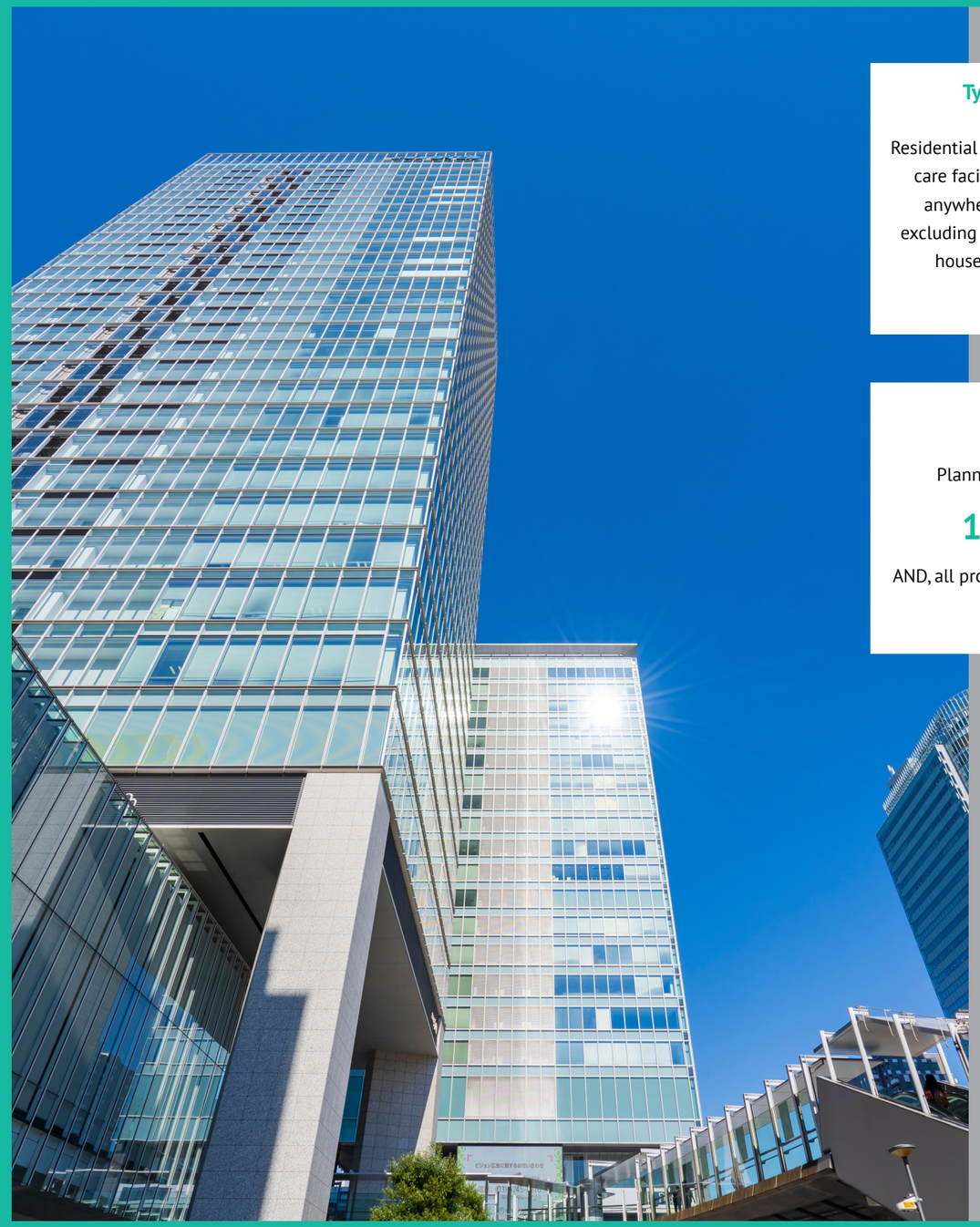
The management of solar gains in buildings is to be enforced under the revised Building Regulations 2022, specifically the new Part O, which comes into effect on 15th June 2022.

Importantly, and in difference to many other updates to the Building Regulations, Part O will be **applied retrospectively**, regardless of when a planning application was submitted or approved, if projects have not actually started construction before 15th June 2023 they will be required to comply with Part O. This 12-month transition period allows for designers and developers to make changes to planned projects to ensure they comply before their construction commences.

Make no mistake, this is a significant change that will need to be acknowledged and adopted by all developers and designers with immediate effect, to avoid the risk of new homes failing to pass building regulations.

What is Part O?

Approved Document O covers the overheating mitigation requirements of the building regulations; **designing and constructing buildings to limit unwanted solar gains in summer and provide an adequate means of removing excess heat from the indoor environment.**



Types of buildings covered

Residential and institutional dwellings, including care facilities and student accommodation, anywhere you would stay overnight (but excluding hotels), ranging from a single storey house to a high-rise apartment block.

Commencing

Planning applications approved after

15th June 2022

AND, all projects commencing construction after 15th June 2023

Summer

Defined as 1st May to 30th September

Overheating

Generally defined as exceeding 26° Celsius at set times of night OR, an operative temperature of not more than 1Kelvin over the maximum adaptive temperature (see glossary for definition)

About this paper

Since December 2021 when Part O was released, we have been gathering feedback from those affected including house builders and housing associations. We wrote this paper to respond to this feedback, with input from designers, building physicists, simulation experts and members of **CIBSE**.

We have been in contact with the Department of Levelling Up, Housing and Communities to ensure what we create is a rounded document, which de-mystifies the regulation and provides unbiased advice, whilst giving thought provoking comment as to how we in the construction sector can design in consideration of user comfort and health as a primary consideration.

What we're looking to do with this paper is to 'simplify the complex' for those affected. To give you guidance, and more importantly, inspiration to build better. To design new dwellings that meet the regulatory requirements, without compromising on design intent.

Contributors

Professor Derek Clements-Croome
University of Reading

Offering strategic advice to clients, designers and facilities managers on attaining and managing healthy and sustainable environments in buildings of all types. He researches, writes and lectures on these issues for companies and wider audiences nationally and internationally in China, Australia, New Zealand, South Africa, Poland and Finland particularly. Some of his books have been published in Chinese and Russian. He edits and founded the Intelligent Buildings International Journal published by Taylor and Francis and is a Coordinator of CIB Commission W098 Intelligent and Responsive Buildings. He is a Fellow of Royal Society of Medicine. He was Vice President of **CIBSE** 2007-2009.

Professor Darren Woolf
Head of Building Physics, Wirth Research
Chair of **CIBSE**'s Building Simulation Group

Supporting building physics and fluid dynamics applications in most building sectors for over 25 years. He's also been leading urban microclimate and nature-based design solutions as well as supporting our response to the climate emergency and pandemic (www.airbods.org.uk). Wirth Research deliver high fidelity CFD and innovative building physics solutions using their zero-carbon supercomputer located in Iceland powered by geothermal energy.

Tim Elen
Technical Manager, Fernham Homes

An award-winning house builder based in Kent, delivering quality housing for over 20 years. Tim has almost 20 years' experience of delivering energy efficient housing to help Fernham Homes grow and continue to deliver ever more sustainable and aspirational housing.

Brad Hadaway
Senior Architectural Technician, OSG Architecture

An award-winning commercial architectural practice, working across many sectors including residential, commercial, leisure and education. Their goal is to achieve first class design to the client's brief, budget and program, taking pride in creating future-focused architectural designs that enhance built environments across the South-East of England.

Alex Hill
Managing Director, Whitecode Consulting

The leading Building Services Consultancy in the large residential and mixed-use housing developments in the greater London area. As a practice they have worked on many high-rise schemes of residential apartment blocks requiring specialist design elements.

Richard Tibenham
Business Development Manager, IES

Working in the development and application of powerful software simulation tools and consulting services for architects, engineers and others involved in the design, development and management of truly sustainable buildings. IES' mission is to advance the sustainability of the world's buildings through the use of integrated building performance modelling technology which more intelligently and assuredly determines the measures required to mitigate climate change and conserve our natural resources for future generations.

Designing homes and other dwellings in compliance with Part O

There is growing evidence that newly built homes are at risk of overheating, of how this affects our health and wellbeing and, of course, that this will only increase with climate change.

Builders and designers are under immense pressure to meet targets set by the Government to tackle the housing crisis and to meet the Future Homes Standard of reducing carbon emissions. Now they are also being faced with the release of two new building regulations and two updates to existing regulations (Parts F, L, O and S) in June 2022.

The most dramatic change is the introduction of Part O, which requires significant adjustments to be made in the planning stage for new homes, to ensure compliance.

Building physicists and other industry experts are welcoming the issue of overheating being addressed as a regulation rather than as design guidance. To date, guidelines produced in the interest of mitigating overheating have predominantly been focused on the detailed design stage, other than that which was produced by the **Good Homes Alliance** in 2019. The 'Overheating in New Homes' document gives fundamental consideration of early-stage decisions such as site and dwelling layout.

This paper provides a comprehensive approach to overheating and compliance with Part O, including interaction with other building regulations and issues such as ventilation, noise pollution and security, or considering neighbouring aspects, such as adjacent buildings and green space. It is aimed at all those affected in the development of new homes and institutional dwellings, including local authorities, to prompt dialogue between project teams, with disciplines including building services consultants, energy assessors and acousticians.

What is fundamental now, given that Part O is a legal requirement, is the need to assess overheating risk, prior to planning submission and approval. Building simulation and thermal modelling are the obvious choices when needing to ensure compliance and avoid the need for potentially significant changes at later stages (e.g. to openings).

ML-S-WP-04

"We need to design a lot smarter, particularly with energy consumption considerations at the fore. Part of the issue is the mindset of the industry with regard to sustainability, how it can have a focus on clean energy and renewables, for example, rather than what we know is at the top of the sustainability hierarchical tree which is passive design."

*Darren Woolf - Head of Building Physics at Wirth Research and Chair of **CIBSE** Building Simulation Group*

London Plan 2021

The Greater London Authority released the London Plan in 2018. Policy SI4 'Managing Heat Risk' is now in force, ensuring all London developments look at fabric, glazing and orientation in their planning stages, to minimise heat generation through design, and to deliver natural ventilation and passive methods of expelling heat, before considering active cooling systems as a last resort.

All the principles of the London Plan can be aligned to those of Part O. However, in difference, Part O is a regulated requirement and applies to the whole nation, rather than just to London.

CIBSE's TM59 (and TM52 before it)

Part O refers to TM59 for guidance when carrying out thermal modelling of a dwelling but goes on to set limits against the identified risk that the design methodology produces.

A key difference between TM59 and Part O is that the new regulation will not allow for the effect of internal blinds to be considered when assessing the risk of overheating, nor will dynamic shading be deemed acceptable. Only fixed and passive shading devices are compliant.

Part O in summary

In order to comply, developers are given two options; The 'simplified method' or to use 'dynamic thermal modelling'. The simplified method consists of a compliance checklist, dictating how much glazing you are allowed, relative to the location, orientation and floor areas of each dwelling, and taking into consideration whether there is the ability to cross-ventilate. For those dwellings considered the highest risk (based on set criteria), you must have openable windows that comply with Part K and Part Q (protection from falling, and security) as well as using external fixed and passive shading devices.

The alternative to the manual, simplified method described above, is to use dynamic thermal modelling. Whilst this may be considered cost prohibitive in the past, it is now the only way to enable consideration and evaluation of all the design choices to avoid the need to reduce glazing area and ultimately, provides better solutions to keeping buildings cool.

In fact, Part O directs designers who are choosing the dynamic thermal modelling method of compliance, to the BRE report 'Solar Shading of Buildings' (BRE 364). This report provides key guidance regarding shading choices and includes a decision table to help find the best solution for a particular building application, which firmly encourages against reducing glazing!

The authors of Part O, the Department for Levelling Up, Housing and Communities seem to be directing the industry to dynamic thermal modelling to find the solutions to mitigating overheating. In truth, it is the only way you can prove that a dwelling isn't going to overheat in advance of its construction. Following the checklist of measures outlined in Part O's 'simplified' method to mitigate overheating, will seriously limit your design options. With modelling, we can manipulate the data to identify the best solutions and ensure compliance.

Overheating factors

Glazing alone cannot be considered the culprit for overheating. More importantly, the 'quick fix' of reducing glazing is not the answer, it will just create new problems. For a start, limiting daylight and vision out will negatively affect our health and drive up our energy consumption.

Façade type, overall building design and means of ventilation should be part of your strategies for managing internal temperatures as well as conserving energy.

Thermal mass is not talked about enough in construction. External solar gains are not only transferred through glazing but the building fabric itself. A good thermal mass design strategy can help buildings to stay cool during the summer months and keep a good balance on space heating requirements.

"Unfortunately, poor ventilation design is massively prevalent as a result of the energy saving mindset. We need to design homes in consideration of all elements of health and wellbeing, not just keeping cool. We need to be much better at designing for ventilation and overheating, as well as indoor air quality and any associated risks." - Darren Woolf

Last but not least, internal heat gains from human beings and appliances inside a building are sometimes a big problem. This is another strong argument for utilising dynamic thermal modelling which can assess all contributing factors.

"The value of architecture in the process of delivering low energy buildings is largely overlooked. Only air tightness and insulation are considered. We need to move away from designing for compliance and instead, design for performance."

Richard Tibenham – Business Development Manager, IES

"Mitigating overheating should inherently be bound in with your ventilation strategy. By linking Parts F, L and O, those who aren't already, are being forced to move towards fully considered building design, with a focus on comfort. Ultimately, the residential sector needs this change in mindset. We shouldn't be striving to 'just comply' but to an aspirational standard that all new builds should be like this."

Tim Elen – Technical Manager at Fernham Homes

Building better

The building regulations are there to control design, they're set by a committee decision on a range of metrics, much like damage limitation.

Early engagement is essential. Working collaboratively and multi-disciplinary, incorporating architecture and building services rather than working in silos is key to better designs.

Good holistic design should apply building physics principles, adapting to orientation and exposure to the sun at all times of the year. In fact, we need flexibility of building design here in the UK where we have four distinct seasons, and a crucial aspect is the continuous change of the sun's direction (azimuth) and angle (zenith) but we're not set up to receive angular selective products.

"Design should be science led. Science should lead the engineering and therefore the performance, then minimum compliance checks should follow to ensure you're exceeding the minimum rather than engineering by numbers to meet a minimum and not understanding how you've got there because you haven't grasped the physics. These legislations should support creative engineering design."

Darren Woolf - Wirth Research

"Housebuilders seem to want a house type that is Part O compliant irrespective of which orientation it's in. But they're not designing them to be oriented in a way to benefit from passive solar heat gain. They just want flexibility. Even just a simple change in building orientation can reduce heat load by up to 60%."

Richard Tibenham - IES

Problem hotspots for compliance

Acoustics is seemingly only a very small part of the Part O requirement, but it's a very important one and will no doubt cause most issues for developers. The Acoustics Ventilation and Overheating Residential Design Guide (the AVO Guide) was produced back in 2020 but Part O is the first ever regulatory criteria which covers acoustics.

A recent residential scheme attracted interest from Environmental Health. An acoustics assessment found that when windows were opened, the noise inside some of the plots was unacceptable. The developers were then required to carry out an overheating assessment and failed. Whilst the scheme featured trickle vents on all windows, this did not provide sufficient ventilation for cooling. In order to resolve the overheating issue, the developer was required to introduce MEV extract (whole house) systems as well as using solar glass on all affected plots. And that's just one example.

Opening windows may not only be an issue for noise pollution but air quality concerns, and also, safety and security.

And another factor which gives favour to dynamic thermal modelling over Part O's simplified method is that it is only through the modelling method that you are able demonstrate that windows can remain closed (the simplified method relies on open windows).

For obvious reasons, apartments and high-rise buildings are the subject of most risk assessments. The lack of cross ventilation being a key factor, as well as their high levels of human occupation.

In fact, the simplified method can be discounted as an option for almost all high-rise residential buildings. Not only is cross ventilation generally not possible, but most are communally heated. Both these factors are not permitted and so exclude these builds as being assessed for overheating under the simplified method.

"With climate change, we have to look at buildings being resilient, which links to our comfort, the wider context of the senses and how we react to systems. All our senses interact with each other. We often forget that and think of only one sense, like being too warm or keeping cool.

Human health and wellbeing is very much dependent on natural light. A reduction in glazing will have a detrimental effect on us therefore. Windows positively affect us physiologically. A view outside has much heavier value than we have ascribed to it. Neuroscience research has taught us that our brains need 'micro breaks'. Whilst we focus on our environmental comfort – the steady background state in a building, transients is very important too."

Derek Clements-Croome - University of Reading

Fixed and passive solutions

Although natural ventilation brings many benefits and should be incorporated in dwellings wherever possible, the fact is, it's not always possible, and even the best ventilation strategies are unlikely to solve all heat gain independently.

The DLUHC has explained why they have specified only fixed and passive shading be used, and the basic reason is that in order to calculate requirements accurately and consistently, solar shading devices must be completely predictable. They also recognise that dynamic/mechanical systems require maintenance and when not operational or simply time expired, they are not fit for purpose.

External shading is proven to be the most effective, having the potential to reduce solar gains by up to 100%. Some options can be moveable (for example, sliding, or hinged), some allow through ventilation, and some can help with winter heat retention.

Protection from solar gains can even be achieved through a building's architectural features. A balcony overhead, or some types of façade design for example, can provide shading.

Rather than fixed shading becoming a necessity at late design or even at building regulations stage, early consideration of it at the concept design stage can ensure it is integrated architecturally, even becoming a key feature whilst contributing to, or becoming the whole solution to, an overheating risk.

Controllable comfort

The preferred shading device is one which is movable, allowing a level of adaptation by occupants. Better still, one that can be just as effective whilst windows are open to ensure optimum levels of ventilation and some level of security.

As well as controlling shading, all dwellings must meet the minimum purge ventilation requirements of Part F. However, purge ventilation requirements must not be confused with ventilation as a method of cooling. The two are not always the same.

At the bottom of the cooling hierarchy should always be active cooling, or mechanical cooling and before comfort cooling is considered, MVHR.

More consideration for the user

We need to invest in designing differently, better, looking to the future and thinking about the users first. We need to invest in our future homes and our future generations, rather than simply complying with regulations or following guidance.

Part O hasn't gone as far as it needs to, but it's certainly a good start in the right direction. Whilst it may, at first sight, seem to be a box ticking exercise, rather than encouraging us to design to the needs of the user, it is forcing us to address critical issues for the future. However, we require a mindset change in the industry. We can't just comply. We need to model, plan and design with solar gains in mind.

But, we have to have more long-term thinking. We must stop thinking that everything aside from the norm is not affordable. We should have a whole life value approach. We don't want to be redressing the situation in 20 years-time, berating ourselves because we should've built with a different material or modified materials, or for the fact that we should've built with more glazing because we now have a depressed nation.

"We're all now looking for a solution to the problem where the only one seems to be to add mechanical cooling units to HA flats. The residents often struggle to afford to run their homes as it is. How will they afford 45p an hour for 3,000 hours a year? They won't, they'll just turn them off."

Alex Hill – Managing Director, Whitecode Consulting

"This is going to have a huge impact on the industry. Modelling will provide multiple solutions and strategies but the cost to model is huge and therefore not justifiable for every project. Housing schemes generally have 4 or 5 designs to plan for, but this regulation will remove the ability to have continuity. We could be planning for and having to design 50 variations on one scheme. You have to think, particularly when it comes to HA properties, at what point is a home not affordable?"

Brad Hadaway – Senior Architectural Technician, OSG Architecture

The future

In short, we need to focus on maximising building performance, and not doing 'just enough' for regulatory compliance. 'Just enough' is not enough.

We need more accuracy and for modelling to become more realistic if we're going to make decisions based on simulations, but the technology is already there. It's not our limiter anymore. It's just the will, the procurement and the education standing in our way.

"Why do we model? We model because our brain is not able to comprehend so many elements when we use all our different experiences. Built into a model we can have such things as glazing spec and shading device spec, but why not go further and focus on external surface reflectivity? And if you were able to put vegetation on a wall or roof within a model, it could show the benefits internally of reducing your outside surface temperature by over 10 degrees."

Darren Woolf - Wirth Research

"But, models don't take into account human behaviour. They tend to concentrate on certain aspects rather than giving you a systems view of how everything works together."

Derek Clements-Croome - University of Reading

Glossary

Adaptive comfort temperature - recent standards and guidance advise that comfort temperatures vary through the year as people adapt to changes in outside temperatures. Adaptation takes the form of changes in dress, opening windows etc. As comfort temperatures vary, heating and cooling set-points should be adjusted in harmony to maintain optimum comfort.

Operative temperature - in design, operative temperature can be defined as the average of the mean radiant and ambient air temperatures, weighted by their respective heat transfer coefficients.

Free area (Afree) - the geometric open area of a ventilation opening. It is quite simply the height and width of the opening multiplied to give the open area. W x H = A or Afree. 'This area assumes a clear sharp-edged orifice that would have a coefficient of discharge (Cd) of 0.62'.

Effective area (Aeff) - the area through which air flows after the resistance of airflow has been taken into account. The effective area is the free area described above multiplied by the discharge coefficient (Cd). Afree x Cd = Aeff. The discharge coefficient includes the angle of the opening as one of its factors.

Equivalent area (Aeq) - a measure of the aerodynamic performance of an opening. It is the area of a sharp-edged circular orifice through which air would pass at the same volume flow rate, under an identical applied pressure difference, as through the opening under consideration. This is the effective area divided by the orifice discharge coefficient (Cd0) which assumes a clear sharp-edged orifice would have a coefficient of discharge (Cd) of 0.62 or Aeff / Cd0 = Aeq).

Discharge coefficient - in practice, a constant value of discharge coefficient is often used for simplification, this is basically a ratio of the actual discharge to the ideal discharge. However, a constant value of discharge coefficient can lead to deceptive airflow estimations in different window designs.

References

CIBSE TM52 - The limits of thermal comfort: Avoiding overheating in European buildings - https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q20000008I7f5AAC

CIBSE TM59 - Design methodology for the assessment of overheating risk in homes (2017) - https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q0O000000DVrTdQAL

CIBSE AM11 - Building performance modelling (2015) - https://www.cibse.org/Knowledge/knowledge-items/detail?id=a0q20000008JeYXAA0

GLA SI4 (London Plan 2021) - Managing heat risk - https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf

AVO guide - The Acoustics, Ventilation and Overheating Guide - https://www.association-of-noise-consultants.co.uk/avo-guide

Good Home Alliance - Overheating in New Homes - https://goodhomes.org.uk/overheating-in-new-homes

Building Regs Part F - Ventilation - https://www.gov.uk/government/publications/ventilation-approved-document-f

Building Regs Part K - Protection from falling, collision and impact - https://www.gov.uk/government/publications/protection-from-falling-collision-and-impact-approved-document-k

Building Regs Part L - Conservation of fuel and power - https://www.gov.uk/government/publications/conservation-of-fuel-and-power-approved-document-l

Building Regs Part Q - Security in dwellings - https://www.gov.uk/government/publications/security-in-dwellings-approved-document-q

Further reading

Designing Buildings for People - Derek Clements-Croome

https://www.amazon.co.uk/dp/1785007092/ref=cm_sw_r_api_i_X5665M3MMZBQVB0XW5KB_2

Naturally Ventilated Buildings: Building for the senses, the economy and society - Derek Clements-Croome

https://www.amazon.co.uk/dp/0367400499/ref=cm_sw_r_api_i_ARVPEPM3HVEE28VZZ4HM_0

This whitepaper was commissioned by Smartlouvre Technology to educate and inspire those affected by the introduction of Part O.

Smartlouvre manufactures MicroLouvre®, a passive and fixed window covering which, with 3D angular selective properties, including low sun angle capability, meets Part O requirements. MicroLouvre® can be woven bespoke to your building facade's needs, or retrofitted.

For more information visit **www.smartlouvre.com**.