



**INNOVATION REPORT**  
**APRIL 2024**

# Tackling Extreme Weather



**BARRATT**  
DEVELOPMENTS PLC



# BUILDING IN A WORLD OF MORE EXTREME WEATHER

Discover how innovators around the world are future-proofing homes to withstand weather extremes

Around the world, climate change is making extreme weather events more common, as well as more severe. Whether that's hurricanes, wildfires, flooding, or heatwaves, communities across the globe are needing to find ways to adapt and protect themselves.

In the UK specifically, the Met Office expects that we will see warmer and wetter winters, hotter and drier summers, and more frequent and intense weather extremes. Acute weather events are likely to include more frequent heatwaves, heavy precipitation, intense cloudbursts, and flash flooding. There are also more tentative projections that winter windstorms will increase in frequency and severity.



Photo credit: © ke-ker from pixabay

What does this mean for the UK construction industry in general, and Barratt Developments specifically? Our latest disclosure against the Taskforce on Climate-Related Financial Disclosures (TCFD) framework highlights overheating in homes, flood mitigation, weather disruption to building activities, and supply availability as the specific physical climate risks the Group faces.

As the leading national sustainable housebuilder, we are already adapting to a climate-affected world. We take a 'fabric first' approach to designing homes, using smart techniques, such as air tightness, high levels of insulation, and high-performance windows and doors to create homes that are not only energy efficient and low carbon, but economical and comfortable to live in.



Modern Methods of Construction (MMC), such as timber frame, are also allowing for parts of the construction process to occur offsite, helping to mitigate the risk of weather-related disruption. Timber frame also reduces the embodied carbon associated with a building.

Our operationally zero-carbon eHome2, built in partnership with Saint-Gobain within a climate chamber that recreates extreme temperatures and simulates wind, rain, snow, and solar radiation, is informing us how various solutions designed for sustainability, efficiency, and comfort perform within different climates.

In addition to these activities, we believe it is vital that we work collectively to research and share experiences of the growing range of climate adaptation solutions. This report therefore aims to take a broader, more global, look at how innovators across the world are rising to the challenge of extreme weather.


The initiatives – some of which are in development, others more established – have not necessarily been trialled or adopted by Barratt. They also have a consciously international, rather than UK-specific, provenance. The hope is that by exploring how other countries are already tackling extreme conditions, we can provoke further discussion about how we can prepare for a weather-disrupted world.





Photo credit: © Nikolett Emmert from Pexels


The following pages outline ideas grouped into three sections: High Temperatures, Rainfall and Flooding, and Technology and Working Practices. Throughout, we have identified how far away each one is from being commercially available. Just look out for the symbols below.


The estimated period of time before the innovation will be in use.

 TODAY

 < 1 YEAR

 RESEARCH PROJECT

 1 - 2 YEARS

 2+ YEARS

# CONTENTS

## 01 | HIGH TEMPERATURES



PAGES 5-15

## 02 | RAIN AND FLOODING



PAGES 16-24

## 03 | TECHNOLOGY AND WORKING PRACTICES



PAGES 25-29



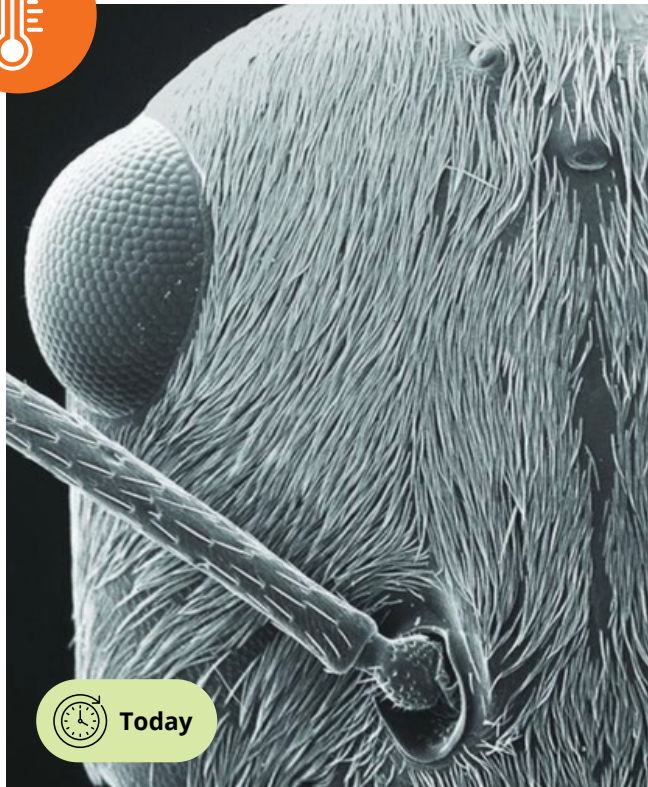


Photo credit: © dimitrisvetsikas1969 from pixabay via Canva.com

# HIGH TEMPERATURES



Photo credit: i2Cool



Today

## COOLING PAINTS INSPIRED BY SAHARAN ANTS

### The biomimicking materials reflect sunlight and emit building heat to space

Biomimicry is a design technique that emulates the models, systems, and elements of nature to solve human problems. It can be applied to a huge range of challenges, and one of these is the need to keep buildings cool during increasingly common heatwaves. Now, i2Cool, a startup linked with the City University of Hong Kong, is seeking inspiration from a species of Saharan ant to create a radiative paint and a glass film, both of which address this challenge.

The Saharan Silver Ant has a particular problem: it needs to keep itself cool even in the heat of the scorching desert sun. It solves this through a surface layer of fine hairs that internally reflect incoming sunlight and emit heat energy as infrared radiation. The wavelength of these emitted infrared rays is crucial. Because of the precise chemistry of the atmosphere, light with wavelengths in the mid-infrared band can escape into space and is not trapped by the surrounding air. As a result, the heat emitted by the ant escapes into space.

Now, the researchers behind i2Cool have found a way to replicate the ant's cooling mechanisms using a mixture of polymers and nanoparticles. The result is a paint that can be applied to exterior walls and surfaces to keep a building cool, with zero electrical input. As easily and conveniently applied as any standard architectural paint, the i2Cool paint is non-metallic, non-polluting, and complies with EU standards.

Photo credit: i2Cool



Continued on next page >>>





Photo credit: i2Cool

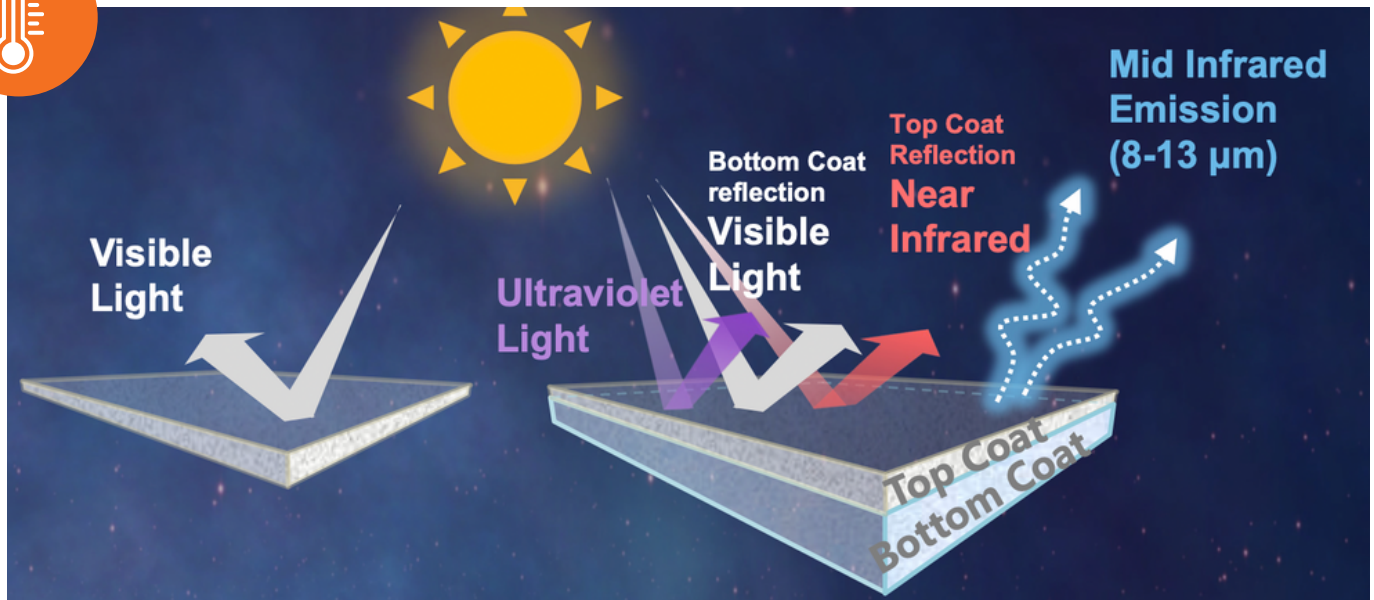
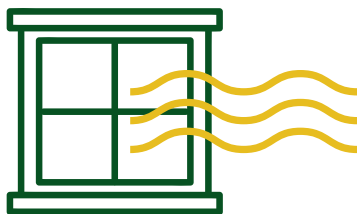


Diagram showing how i2Cool's paints work in comparison to commercially available white paint

### Continued from previous page...

In addition to its paint, the startup has also developed a film for windows and glass sheet walls that uses the same scientific principles. The film is electrostatic and self-adhesive, with the company claiming that it is as easy to apply as a protective screen is for a mobile phone. With a visible light transmittance rate of up to 80 per cent, the company claims the film has a minimal impact on indoor lighting levels while having a cooling effect similar to the paint.



# 80%

i2Cool's window film transmits 80 per cent of visible light, meaning it has minimal impact on indoor lighting

### TAKEAWAY

Although the Saharan Ant that inspired i2Cool evolved in an extreme heat environment, the cooling effect of the startup's paint and film is not limited to desert temperatures. In fact, the company's technology has already been applied in countries and regions across the globe, including the UK and the EU. According to the Met Office, by 2050, UK summer temperatures will be between one and six degrees Celsius warmer. And heatwaves like the one that occurred in the UK in 2018 are now 30 times more likely to occur than they would naturally. In a country that doesn't habitually use air conditioning, easily installed cooling solutions could play an important role in the future in preventing houses from overheating during increasingly hot summers.



INNOVATOR

i2Cool

[i2cool.com](https://i2cool.com)



Photo credit: A. James Clark School of Engineering



## A COATING MADE FROM GLASS PARTICLES THAT COOLS ANY BUILDING

**Applied like paint, the coating is strong enough to be applied to bricks and tiles**

Climate change is forecast to increase maximum temperatures in both the UK and around the world. To beat the summer heat, researchers at the University of Maryland have created a novel coating that cools any building it's applied to.

The material works in two ways. By reflecting away up to 99 per cent of incoming solar radiation, it prevents a building absorbing heat in the first place. At the same time, it also emits heat in the form of infrared radiation, dispelling it into space through a process called radiative cooling. As a result, less of the sun's energy ends up heating the building.

The microporous coating is made up of two ingredients: finely ground glass particles that act as a binder, and particles of aluminium oxide that scatter sunlight strongly and improve the coating's manufacturability.

The mechanism of radiative cooling is being leveraged by multiple solutions. However, the challenge is making coatings that are both practical to manufacture and sufficiently robust to withstand long-term weathering. The coating developed by the University of Maryland team is adaptable and scalable while also being strong and resilient enough for use on exterior surfaces – including bricks, tiles, and metal.

To commercialise the technology, the researchers created a company called Ceracool. This spinoff has further optimised the coating and applies it in the form of paints that dry at ambient temperatures. Crucially, these paints don't only come in white, but also in colours, providing flexibility on aesthetic.



# 99%

Ceracool's coating reflects up to 99 per cent of incoming solar radiation

**Continued on next page >>>**



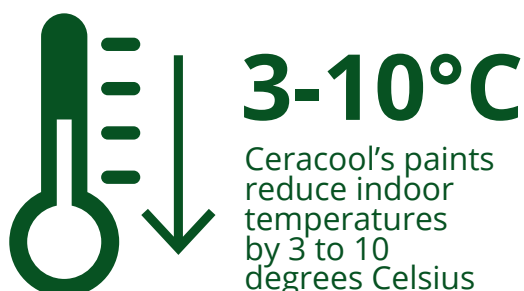


Photo credit: © RDavid Kanigan from Pexels via Canva.com

## Continued from previous page...

It has long been known that white paint can be used as a cooling technique. Ceracool's coloured paints, however, not only provide much better reflectance than standard paints of the same colour – they are also much more reflective than standard acrylic white paint, while maximising the emission of infrared radiation from the building.

Because of the robust properties of the underlying technology, the paints are resistant to UV radiation, dirt, and even flames, and can be simply wiped clean if contaminated.



Ceracool's paints  
reduce indoor  
temperatures  
by 3 to 10  
degrees Celsius

## TAKEAWAY

Ceracool claims its paints reduce indoor temperatures by between 3 and 10 degrees Celsius, which can make a significant difference in helping to prevent homes from overheating during increasingly common heatwaves. Homes in the UK typically don't use air conditioning today, and the paint offers an attractive alternative solution as temperatures rise as a result of climate change. While air conditioning units simply expel heat back into the urban environment, which adds to the urban heat island effect, the novel paint dissipates it to the atmosphere. And, in addition to homes, the startup claims the paint can be applied to other surfaces in housing developments, such as roads and pavements, further cooling the local environment.



INNOVATOR

Ceracool

[cera.cool](https://cera.cool)



Photo credit: © anaterate from pixabay via Canva.com



## 'SMART WALLS' FOR MANAGING HEATING, COOLING, AND HUMIDITY

### **An absorbent material provides 'active insulation' to control indoor conditions**

When water evaporates, it stores energy, creating a cooling effect. In fact, this is how sweating cools the human body. On the other hand, when water vapour is absorbed, the opposite happens, and heat is generated.

Israeli startup ThermoTerra is taking advantage of this phenomenon to develop a novel solution for maintaining comfortable conditions within a home. During the day humidity falls, while it rises at night. The startup's technology takes advantage of these fluctuations to store potential energy, which can then be used to manage the temperature of a building with relatively low energy input.

Using its core technology, the company is testing a 'smart wall' system that can be retrofitted onto building exteriors. This system consists of an absorbent material packed into a prefabricated wall, a series of fans and ducts, and a control panel.

To provide cooling during the day, the fan draws in the ambient warm and dry air from outside. Humidity 'stored' in the absorbent material evaporates into this warm air, absorbing energy and cooling it. The now-cool air is then flown across the exterior wall of the building, cooling the interior. To provide heating at night, the opposite takes place. The cold and humid outdoor air is drawn in and the moisture it contains is absorbed by the material, warming the air which is then flown across the exterior wall to heat the building. Finally, the system can further be used to provide cooling at night. Here, the cold and humid air is flown across the exterior wall first, which cools the building. Its moisture is then absorbed by the material to 'charge up' the system and the now-heated air is expelled back to the outdoor environment.

**Continued on next page >>>**





Photo credit: © Fabio Partenheimer from Pexels via Canva.com

## Continued from previous page...

During 2023, the company demonstrated its technology at a Ben-Gurion University facility. In the test, a structure equipped with ThermoTerra's prototype walls maintained a comfortable indoor temperature of around 24 degrees Celsius – even as the ambient outdoor temperature reached 35 degrees Celsius.

Energy-efficient cooling solutions like these are important as one of the key priorities identified in the Climate Change Committee's (CCC) advisory report to the government for the third Climate Change Risk Assessment is building resilience to extreme heat in the UK. According to the CCC, the UK is currently not prepared to deal with extreme heat among other climate change impacts.

## TAKEAWAY

If successfully scaled, the smart walls could help to manage indoor temperatures in increasingly extreme weather. In countries that use air conditioning, the system promises to supplement existing cooling systems to save money and energy. But in the UK, where air conditioning is not common, systems like ThermoTerra's could provide a cooling effect during increasingly common summer heat waves. Although the technology is early-stage, systems that leverage humidity power could offer a relatively low-energy cooling solution that prevents homes from overheating while also helping to maintain a comfortable temperature in winter.

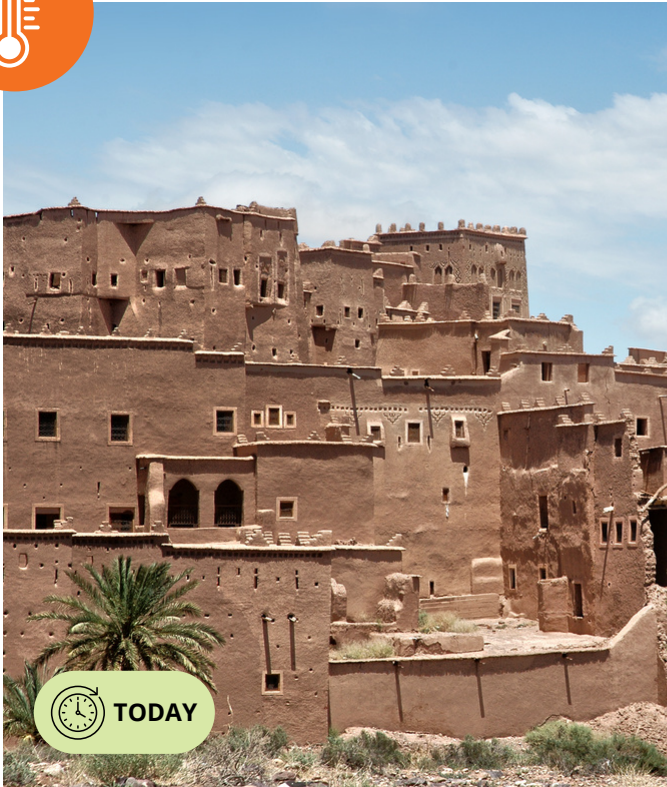


INNOVATOR

ThermoTerra  
[thermoterra.com](https://thermoterra.com)



Photo credit: © Moussa Idrissi from Pexels via Canva.com



## ENERGY-EFFICIENT EARTHEN HOMES

**Blocks made from compressed materials offer temperature regulation and mould resistance**

With the built environment causing around 40 per cent of global energy-related carbon emissions, how do we create more climate-resilient structures without increasing their carbon footprint? Instead of turning to energy-intensive technologies, the key is using smarter, and more efficient materials.

One company doing just that is US-based Colorado Earth. Inspired by ancient techniques, the startup creates earthen blocks – that is, blocks made from compressed natural materials – which are resistant to high winds, water, fire, and mould, as well as being effective acoustic insulators.

And, to help inhabitants cope with the changing climate, the thermal mass of the blocks can keep internal temperatures more consistent, even with changing weather outside. When heated by the sun, EcoBlox – and most masonry walls in general – can store a significant amount of heat, which is then released gradually. This slow heat transfer helps to keep EcoBlox homes at a stable temperature all year round, from hotter summers through to the colder winter months.

To make the EcoBlox, the company uses waste sand and clay from a local granite quarry less than a mile away. This waste is then combined with hydrated lime to boost the material's strength and water resistance, before being shaped into blocks by a hydraulic press. EcoBlox walls then just require a simple finish or sealer. Because the EcoBlox don't need to be fired and are made from waste materials that only need to travel less than a mile to the manufacturing plant, their embodied carbon is substantially lower than traditional bricks.



# 40%

of global energy-related carbon emissions are caused by the built environment

**Continued on next page >>>**





Photo credit: Elizabeth Hurtado



### Continued from previous page...

The EcoBlox are 12 inches long, 4 or 6 inches deep, and typically 3.5 inches high, although the height can vary from 2 to 5 inches. On average, they weigh about 15.85 pounds (7.2 kilogrammes) each, and Colorado Earth works with customers to decide the most suitable size, number, and design of the blocks for any given project.

As well as EcoBlox, Colorado Earth uses the same mixture to create screened mortar and earth plaster.



# 2023

Was the world's hottest year on record

## TAKEAWAY

With 2023 being the Earth's hottest year on record, and the second hottest for the UK behind 2022, EcoBlox can help buildings to passively regulate inner temperatures, without homeowners having to turn to expensive and energy-intensive cooling technologies. The breathable materials have a pH that creates an unfavourable environment for mould, and the masonry walls and plaster also absorb and release pollutants and water vapour. This creates a healthier indoor environment that's free from damp even in humid or rainy weather.



INNOVATOR

Colorado Earth  
[coloradoearth.com](https://coloradoearth.com)



Photo credit: Respyre

## MOSS-FRIENDLY CONCRETE FOR GREENER CITIES

**The concrete is made from waste materials and offers cleaner air, natural insulation, and better water management**

Urban greening has many potential benefits for cities that are seeking to adapt to climate change. [Research](#) shows that greening 35 per cent of the EU's urban surface would avoid up to 55.8 million tonnes of CO<sub>2</sub> equivalent emissions per year, while having additional cooling benefits and reducing water runoff and flooding. Tree planting is the most obvious means of adding greenery to cities and towns, but now Dutch startup [Respyre](#) has a new solution – upcycled, bioreceptive concrete with a coating of moss.

Using 90 to 95 per cent recycled materials, such as granulate rubble and reactivated cement, the company creates its concrete mixture, which provides an optimum environment for moss to grow on thanks to its enhanced porosity and textured surface. The surface is then coated with a biogel that the moss spores can attach to, and which provides water, nutrients, and shelter. This results in a uniform moss layer that changes colour with the seasons to create a pleasing aesthetic. Initially, a temporary irrigation system is required to support the moss, which becomes self-sustaining, even in harsh conditions, when it is fully grown.

Respyre's technology will be delivered in two ways. First, the startup provides prefabricated facades for newly built walls. Alternatively, existing structures can be retrofitted using a ready-to-mix mortar that is suited to brick-and-mortar surfaces and prefabricated and in-situ concrete.



**55.8 MILLION  
TONNES**

of CO<sub>2</sub>  
equivalent  
emissions per year  
would be avoided  
if just 35% of the  
EU's urban surface  
was greened

**Continued on next page >>>**





Photo credit: Respyre



## Continued from previous page...

Adding moss to vertical structures has several benefits. The moss layer's ability to trap water and moisture reduces heat transfer through walls, meaning that it acts as effective natural insulation. This same ability to retain water means that the moss walls act like a 'sponge', helping to tackle problems with runoff and nuisance water. What is more, there are additional benefits to public health thanks to improved air quality and the stress-reducing effects of greenery. Finally, the living moss captures CO<sub>2</sub>, which reacts with the calcium in the material to form calcium carbonate, an effective store of carbon.

Respyre is currently working on large-scale pilots of its technology across the Netherlands. In one project, the technology is being tested as part of a 'green village' project, which will assess their insulation value and impact on urban heat.

## TAKEAWAY

The moss walls can be applied to a broad range of vertical structures, meaning they have several potential applications. They can be applied to homes and buildings, but also to other structures in housing developments and the urban environment. For example, they have been tested on sound barriers alongside roads and on bridges and overpasses. Moss can grow in many conditions, but it prefers wet and shaded areas. Respyre's moss walls can grow in the sun or during dry spells, however, as moss has in-built mechanisms to sustain itself during drought. For example, in prolonged dry periods, it enters a hibernation-like state where it turns its leaves inwards to preserve moisture. The moss is then revitalised when moisture returns, and Respyre has further developed a technique to fill in any gaps in the wall if needed.



INNOVATOR

Respyre

[gorespyre.com](https://gorespyre.com)



Photo credit: © Sorapong's Images via Canva.com

# RAINFALL AND FLOODING





Photo credit: © Sorapong's Images via Canva.com



 **1 - 2  
YEARS**

## ADVANCED, LOW-CARBON POROUS CONCRETE

### Concrete made from upcycled waste that tackles stormwater and flooding

According to government data, the UK is experiencing increased levels of rainfall – with the period 2012 to 2021 experiencing two per cent more mean annual rainfall than the previous decade, and 10 per cent more than the latter half of the 20th century. At the same time, cities in the UK, and in the rest of the world, have expanded rapidly and are expected to keep growing in the coming decades. That means a growing volume of concrete.

When rain meets concrete, it doesn't get absorbed, instead collecting in large puddles on the ground. And when the rain is heavy enough, this poses serious flood risks, particularly in spaces like cities that don't have large areas of grass to soak up excess water.

US-based AquiPor believes it may have a solution: a permeable material that can directly replace concrete on curbs and pavements. The patented technology allows water to filter down and reach the soil underneath, while keeping larger particulates and pollutants on the material's surface for easy cleaning. This prevents contaminants from reaching the earth or running off into drains towards the ocean.

What's more, AquiPor's concrete is far more sustainable than existing nonporous alternatives. Made from upcycled mining by-products, AquiPor's solution contains no Portland cement. This material is the main culprit for concrete's large carbon footprint, which stands at roughly eight per cent of global CO<sub>2</sub> emissions, according to data from the think tank Chatham House.

**Continued on next page >>>**



Photo credit: Aquipor



### Continued from previous page...

The innovative technology is suitable both for the construction of new infrastructure and retrofits, with the company optimising its materials depending on the desired use case. And, unlike normal concrete, which often takes days to harden enough to be stripped from forms, Aquipor's alternative is ready within hours.



# 10%

The UK is experiencing 10 per cent more rainfall than the latter half of the 20th Century

## TAKEAWAY

As well as posing a risk to building integrity – and life, in extreme situations – heavy rainfall also spreads pollution. As it flows over the ground towards storm drains, stormwater gathers various pollutants, including litter, fertiliser, petrol, and bacteria. And when this stormwater reaches the ocean, it contaminates marine environments, potentially harming or killing sea life. With Aquipor, this pollution can more easily be stopped before causing any damage, all while keeping flooding risk to a minimum, even with increasingly heavy rainfall.



INNOVATOR

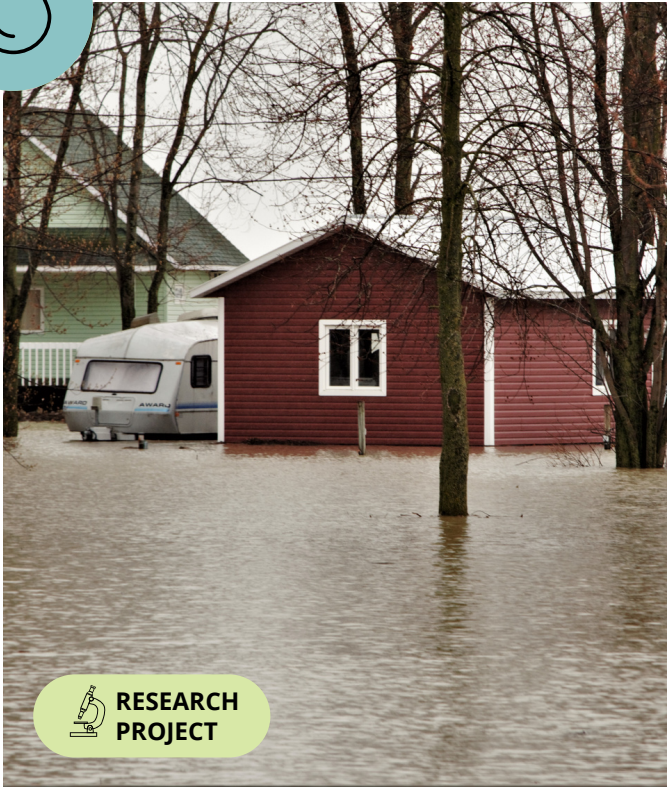
Aquipor

[quipor.com](https://www.aquipor.com)





Photo credit: © Serge Lavole from Pexels via Canva.com



**RESEARCH  
PROJECT**

## FLOOD-RESISTANT HOMES THAT STAY WATERTIGHT

### The design addresses four 'vulnerabilities' homes face during a flood

In 2015, Japan suffered severe flooding as a result of heavy rainfall from a tropical storm. The experience of this extreme event spurred Japanese homebuilder Ichijo to design a fully flood-resistant house.

The experimental home tackles what the company identifies as the four 'principal vulnerabilities' facing a structure during a flooding event: inundation, backflow, submersion, and buoyancy. Although not all the features are relevant to the UK market, the company's flood-resistant homes provide an interesting insight into how the challenge of increasing rainfall is being addressed in a country that is also facing heightened flood risk.

A first key feature of the design is that it ensures that the entire home is watertight so that it doesn't become inundated. This involves technological innovations like vents that snap shut to prevent water from entering the underfloor, waterproof sheeting for external walls, special doorframes inspired by car doors, and insulated glass for patio doors. To prevent backflow of wastewater, special valves on the sewage pipes automatically close during a flood.

Electronic appliances and power outlets on the exterior of the house are strategically placed as high as possible to minimise their chance of being submerged. Although Japanese homes tend to have electronic systems not common in the UK (like air conditioning units), this element of the design will be increasingly relevant as UK homes implement heat pumps, and Ichijo has developed a bespoke system for raising external heat pumps when floods occur.



# 68%

of house floodings  
in Japan are  
caused by  
overwhelmed  
drainage systems

**Continued on next page >>>**



## 3,000 TONNES

of water were used to test the flood-resistant home in a specialist facility

### Continued from previous page...

The final element of the design addresses the fact that during major floods, Japanese homes have a tendency to become extremely buoyant and float away from their foundations. The company's design has two alternative methods for addressing this. In the first, water is strategically let into the underfloor to anchor the structure with water weight. The water purposefully let in can then be easily drained through special openings after the flood. In the second, anchored poles at the four corners of the house 'moor' the structure so that it can float in the case of a massive flood before returning to almost exactly the same position once the waters recede.

### TAKEAWAY

Like the UK, Japan is facing an increased frequency of heavy rainfall events, and Ichijo highlights that 68 per cent of house floodings in Japan are caused by overwhelmed drainage systems, rather than floods from rivers or streams. Surface water flooding also poses the biggest risk to property in the UK. The purpose of the flood-resistant house project was to demonstrate the possibility of creating a home with near-total water resistance, even when exposed to severe flooding. The design was tested in a full-scale experiment at a specialist facility, which involved a manufactured flood involving 3,000 tonnes of water. The flood-resistant home was unharmed by the test, and the underfloor was even spared. While some of the features of the house are not new to the UK, it includes others, such as the adjustable heat pump, that could be increasingly relevant as homes in the UK adapt to climate change.



INNOVATOR

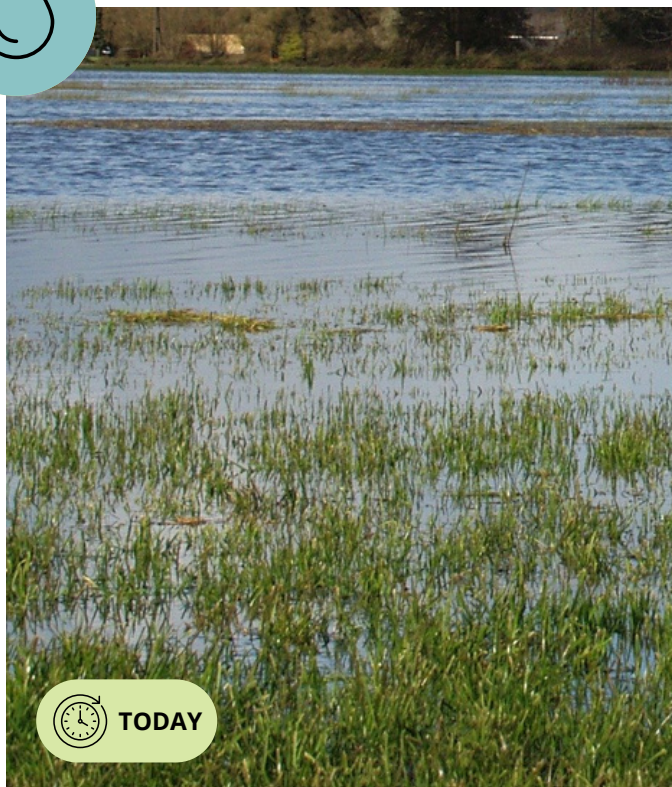
Ichijo

[ichijo.co.jp](https://ichijo.co.jp)





Photo credit: © Noi from pixabay via Canva.com



## HEAVY-DUTY, WATERPROOF CLOTHS THAT PROTECT HOUSES FROM FLOODING

**This French system could benefit the UK, where more than 3 million homes are at risk from surface water floods**

Surface water – or ‘pluvial’ – flooding occurs when heavy rain overwhelms drainage systems causing water to flow overground and threaten housing and infrastructure. In the UK, more than 3 million properties are already at risk of this type of flooding, which is more than those threatened by flooding from rivers or the sea. And, as climate change causes rainfall to increase, the risk of surface flooding is only set to increase.

In France, startup FloodFrame has developed a novel patent-pending system that automatically deploys to protect homes from floodwater without negatively impacting the aesthetics of the property in normal times.

At the core of this system is a type of heavy-duty, waterproof cloth that is rolled around a light pipe, and pre-installed in a ground-level concrete box one metre away from the walls of the house. Beneath the cloth is a plastic tube, and when the water level rises, the tube inflates, lifting the cloth out of its container and onto the ground. The motion of the advancing water then unfurls the cloth, rolling it towards the house and up the sides of the building. Because the cloth is extremely waterproof and closely tailored to the specific shape and measurements of the house, this has the effect of protecting the structure from the rising water.



### 3 MILLION PROPERTIES

in the UK are at risk of pluvial flooding

**Continued on next page >>>**



Photo credit: © Hermann from pixabay via Canva.com



# +13-23%

The annual cost of UK flooding could increase by 13 to 23 per cent over the next century

## Continued from previous page...

The system requires no electricity to operate and is completely hidden when there is no flooding. It is not triggered by heavy rainfall from above. Instead, the auto-release system is only activated when the sensor is flooded from below, which avoids unnecessary deployments. What is more, the company claims that its system can withstand high winds and deploys in seconds, activating successfully even if water arrives very quickly.

Focused specifically on surface-water flooding, the system does not guarantee protection against other types of flooding. For example, customers will need to separately install sewage plugs if sewage flooding is a problem.

## TAKEAWAY

Surface water flooding is particularly difficult to accurately forecast, and often happens with very short notice. While there are emerging forecasting tools – such as a Loughborough University spin-out that provides hyper-local forecasts of flood risk, including from surface water – solutions that protect houses from pluvial flooding will become increasingly important as heavy rainfall becomes more common. And what is more, the FloodFrame system can also be customised and installed to protect other forms of infrastructure in addition to houses, such as electrical substations.



INNOVATOR

FloodFrame  
[floodframe.com](https://floodframe.com)





Photo credit: © Erik Shafiev from Pexels via Canva.com

## A SELF-CLOSING FLOOD WALL FOR PRIVATE HOMES

### A Dutch system that requires no power or human input

The Netherlands has the highest flood risk of any country in the world, with 59 per cent of the population exposed to flooding. Given this specific challenge, the country has unsurprisingly been a leader in developing anti-flooding technologies. And, in addition to large-scale civil engineering projects like dikes, drainage systems, and canals, it has also pioneered smaller-scale solutions.

One of these is the Self-Closing Flood Barrier system produced by Dutch company HYFLO, which can be applied to defend individual private homes. The system is composed of buoyant flood walls that are placed around a property at points of vulnerability, such as doors, driveway entrances, and garages.

In normal times, the wall is stored underground, where it remains out of sight. The container for the wall is connected to an underground steel storage basin that is adjacent to it, which is filled by an inlet pipe during a flooding event. The water flooding into the basin then 'floats' the wall into position, where it is locked in place. As the water rises further, the wall prevents it from entering the protected area.

The system requires no power or human input to operate effectively and has already been tried and tested in projects around the world. It can deploy very quickly, which means it can provide protection even in fast-developing flood situations.

**Continued on next page >>>**





Photo credit: © Jill Burrow from Pexels via Canva.com



**Continued from previous page...**

In addition to its system for private homes, HYFLO also has products for primary and secondary flood defences based on the same design principles and underlying technology.

The technology of self-closing flood barriers has been established for some time but could become increasingly important in the UK as climate change increases flooding risk.



**40%**

Heavy rainfall events have been made 40 per cent more likely by climate change

**TAKEAWAY**

Research shows that the likelihood of heavy or intense rainfall is increasing, which in turn raises the risk of surface water and river flooding. For example, Met Office analysis of the period 2010 to 2019, shows that our summers were 13 per cent wetter and winters 12 per cent wetter than the period 1961 to 1990. And, at the same time, additional research shows that specific heavy rainfall events have been made 40 per cent more likely by climate change. With this rising risk, there are opportunities to take inspiration from solutions developed in countries, like the Netherlands, where flood risk is higher than it is today in the UK.



INNOVATOR

HYFLO  
[selfclosingfloodbarrier.com](https://selfclosingfloodbarrier.com)



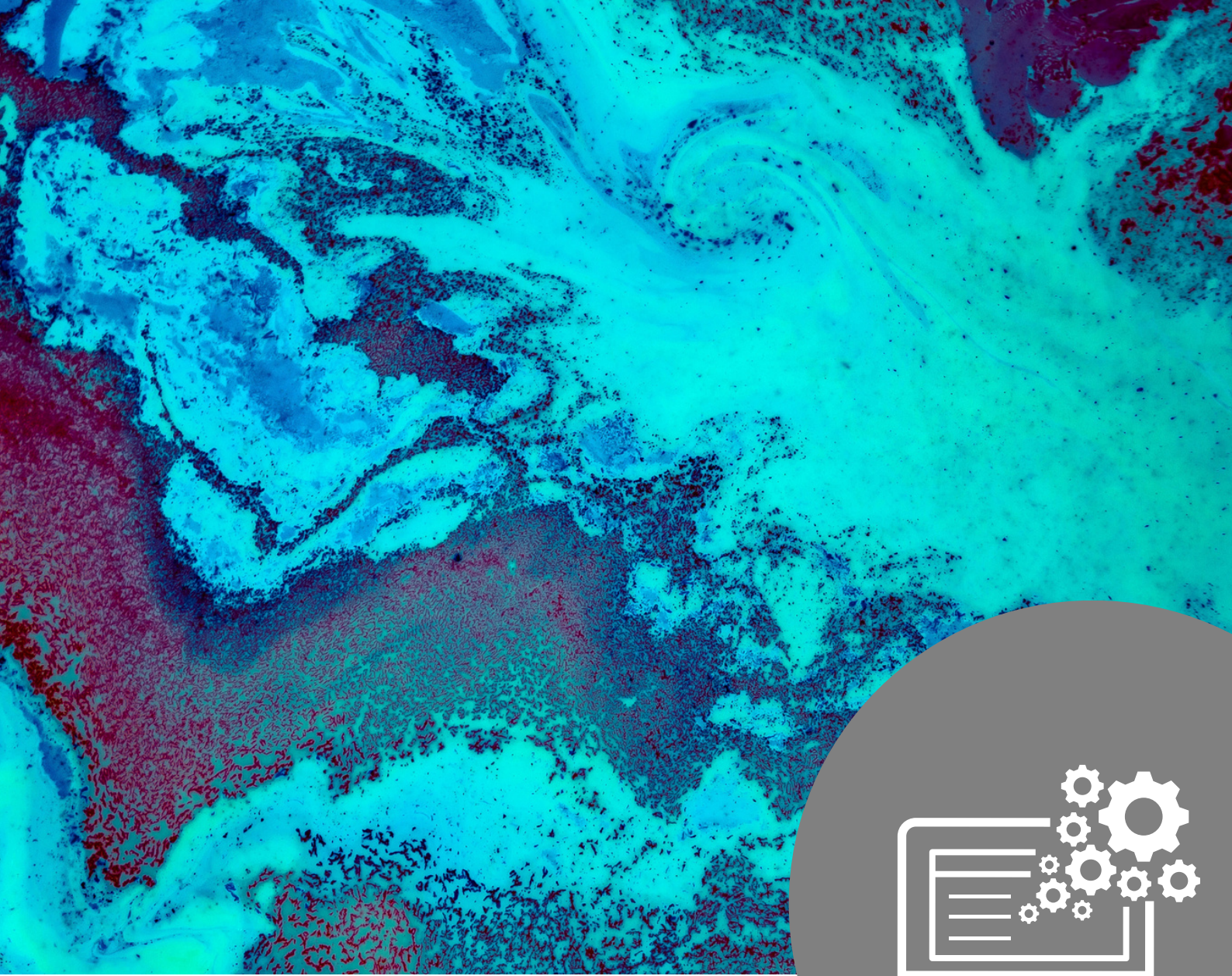


Photo credit: © StockSnap from Pixabay via Canva.com

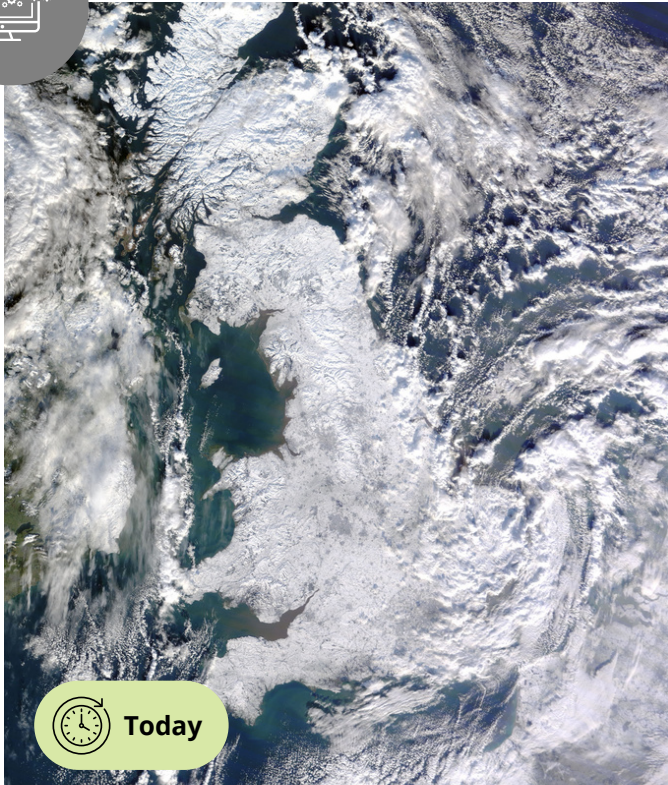


# TECHNOLOGY AND WORKING PRACTICES





Photo credit: © Pixabay via Canva.com



## AI-POWERED WEATHER INTELLIGENCE THAT AVOIDS CONSTRUCTION DOWNTIME

### A US startup provides a tailored solution for construction using proprietary satellite data

Around the world, adverse weather delays 45 per cent of construction projects, with extreme temperatures, precipitation, and high winds having the biggest impact on operations. As climate change makes extreme weather more common, the race is on to provide technological tools to help construction crews optimise operations in the face of increasingly common weather disruptions – and artificial intelligence could have an important role to play.

Advances in weather modelling and simulation, facilitated by machine learning, have enabled significant improvements in general weather forecasting in recent decades. And, today, there are AI-powered solutions that are specifically focused on providing weather intelligence to the construction sector. One of these is provided by US startup Tomorrow.io.

Serving several industries, the company processes a wide range of weather parameters using machine learning algorithms and AI, generating insights that can inform operations. The company even uses its own satellites, which are equipped with a special type of radar, to collect proprietary next-generation weather data.

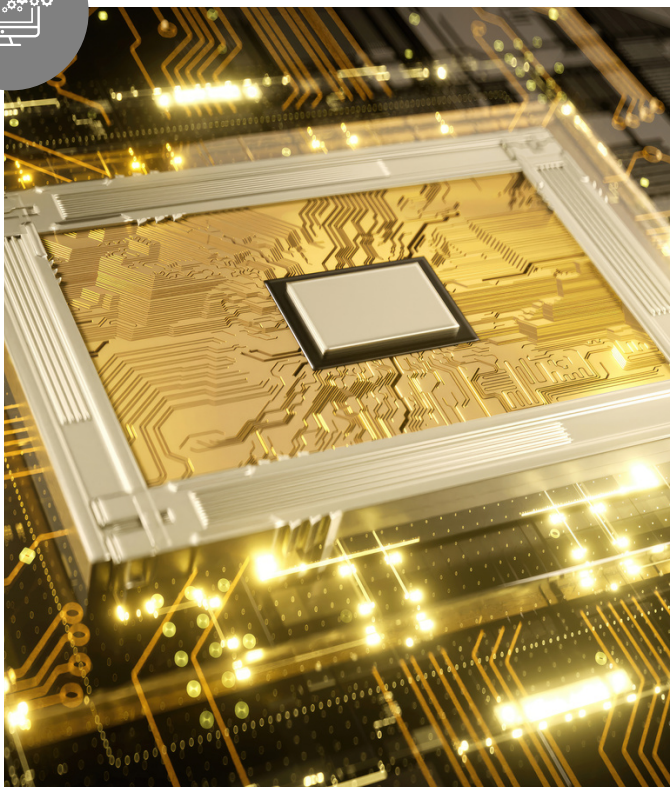
Specifically, the startup's construction solution provides detailed, hyper-local forecasts, timely alerts about potentially hazardous conditions, and access to historical weather data to inform planning decisions from the outset. The technology helps companies to make better resource allocation decisions, implement smarter scheduling, and improve worker safety by predicting weather-related hazards, such as high winds for crane operators. It can also provide valuable input into the best time for concrete pouring and other activities.

**Continued on next page >>>**





Photo credit: © Jiefeng Jiang from Getty Images via Canva.com



### Continued from previous page...

A significant element of the solution is its ability to automate decision-making. For example, companies can set up centralised rules and protocols, such as automatically shutting down operations when a lightning strike is detected near the site. Automated decision-making also reduces the risk of human errors that arise from interpreting complex weather information.

To facilitate easy adoption of the technology, Tomorrow.io has set up pre-made dashboard templates that provide insights for a range of different needs. These include separate dashboards for roofing and construction operations, and a dashboard for heatwave management.



# 45%

Adverse weather delays 45 per cent of construction projects around the world

## TAKEAWAY

While there are innovators in the UK looking at construction weather risk for applications like planning, insurance, and smart contracts, Tomorrow.io's solution is at the cutting edge of what is possible in AI-powered weather intelligence. This is, in part, because its constellation of radar-equipped satellites gives it access to unique, proprietary data to feed its models. The technology is an example of how AI can help to solve age-old problems impacting the industry, even as climate change adds to the complexity of working in an outdoor environment. And a particular benefit of this system is its timeliness and hyper-locality. Its real-time alerts can prevent situations where everything suggests that the weather will be benign, only for crews to find adverse conditions once they have been deployed to the site.



INNOVATOR

[Tomorrow.io](https://tomorrow.io)



Photo credit: ICON Build



## DISASTER-PROOF CONCRETE FOR 3D-PRINTING

**The 'printable' concrete is designed to cope with extreme weather conditions and resist mould**

Projections suggest that climate change will increase the frequency of a range of extreme weather phenomena in the UK, including heatwaves, flooding, and wind storms. In the US, one Texan startup, ICON Build, is 3D-printing homes that are designed to be more resilient than traditional buildings when faced with these extreme events.

The secret ingredient in these homes is 'Lavacrete', a concrete-like material that is weather and mould resistant. Lavacrete is made using a proprietary mix of locally sourced raw materials. It is based on Portland cement but contains additives that give it enhanced properties, such as high compressive strength. The material is also water-repellent and retains both heat and cool air well. This makes it easy to control the temperature of the home, even in extreme conditions.

The dry Lavacrete is ingested on-site by a portable factory called 'Magma', which hydrates it, adjusting the formula in real time depending on the site's particular needs and on-site weather conditions. Magma then pumps the Lavacrete to an extremely large 3D printer, called 'Vulcan'. This creates wall structures by extruding the Lavacrete in layers that dry in around 15 minutes. A suite of software tools, known as BuildOS, help control the robotic system, and the whole process of completing the walls takes only around three weeks.



**15  
MINUTES**

The time it takes  
for layers of  
Lavacrete to dry

**Continued on next page >>>**





Photo credit: ICON Build



## Continued from previous page...

The extremely strong wall structures exceeded existing US building standards by 350 per cent in structural tests, meaning that they can withstand high wind speeds and other extreme events.

The startup, founded in 2017, is one of the US leaders in 3D printing for home building, and has successfully built whole neighbourhoods of 3D-printed homes.

The startup continues to invest in refining its technology. In March 2024, it unveiled a new suite of technology, including a multi-story robot capable of printing an entire building enclosure, including roof and foundations. It has also developed an AI system for designing and building homes, and launched CarbonX, a next-generation, lower-carbon formula for printable concrete.

## TAKEAWAY

One advantage of Lavacrete and the approach taken by ICON is that it helps to tackle the growth of mould and mildew, which thrive in damp, warm environments, and are supported by the organic material that may be found in housing. Icon homes have no structural wood framing near the foundation, and Lavacrete does not contain the organic material necessary to support mould growth by itself. Including printed interior walls helps to further reduce the organic material available for mould in the home. In addition to creating homes that are resistant to mould and extreme weather, ICON's technology offers further benefits, such as reduced waste and faster build times. The US Department of Housing and Urban Development also highlights that there could be worker safety benefits to 3D concrete printing, as it replaces dangerous tasks in traditional concrete formwork construction.



INNOVATOR

ICON Build

[iconbuild.com](https://iconbuild.com)

# DIRECTORY

## High temperatures

### **Ceracool**

Website: [cera.cool](http://cera.cool)

### **i2Cool**

Website: [i2cool.com](http://i2cool.com)

Contact: [info@i2cool.com](mailto:info@i2cool.com)

### **ThermoTerra**

Website: [thermoterra.com](http://thermoterra.com)

Contact: [intro@humiditypower.com](mailto:intro@humiditypower.com)

### **Colorado Earth**

Website: [coloradoearth.com](http://coloradoearth.com)

Contact: [admin@coloradoearth.com](mailto:admin@coloradoearth.com)

### **Respyre**

Website: [gorespyre.com](http://gorespyre.com)

Contact: [info@gorespyre.com](mailto:info@gorespyre.com)

## Rainfall and flooding

### **AquiPor**

Website: [aquipor.com](http://aquipor.com)

### **Ichijo**

Website: [ichijo.co.jp](http://ichijo.co.jp)

### **FloodFrame**

Website: [floodframe.com](http://floodframe.com)

Contact: [ra@floodframe.com](mailto:ra@floodframe.com)

### **Hyflo**

Website: [selfclosingfloodbarrier.com](http://selfclosingfloodbarrier.com)

Contact: [info@hyflo.nl](mailto:info@hyflo.nl)

## Technology and working practices

### **Tomorrow.io**

Website: [tomorrow.io](http://tomorrow.io)

Contact: [sales@tomorrow.io](mailto:sales@tomorrow.io)

### **ICON Build**

Website: [iconbuild.com](http://iconbuild.com)





**BARRATT**  
DEVELOPMENTS PLC

## INNOVATION REPORT

# TACKLING EXTREME WEATHER

This report has been  
compiled by Barratt Developments

## ABOUT BARRATT

Barratt Developments is the nation's leading housebuilder, creating great new places to live throughout Britain.

Our business is acquiring land, obtaining planning consents and building the highest quality homes in places people aspire to live. This is supported by our expertise in land, design, construction and sales and marketing.

Our vision is to lead the future of housebuilding by putting customers at the heart of everything we do.

<https://www.barrattdevelopments.co.uk/>