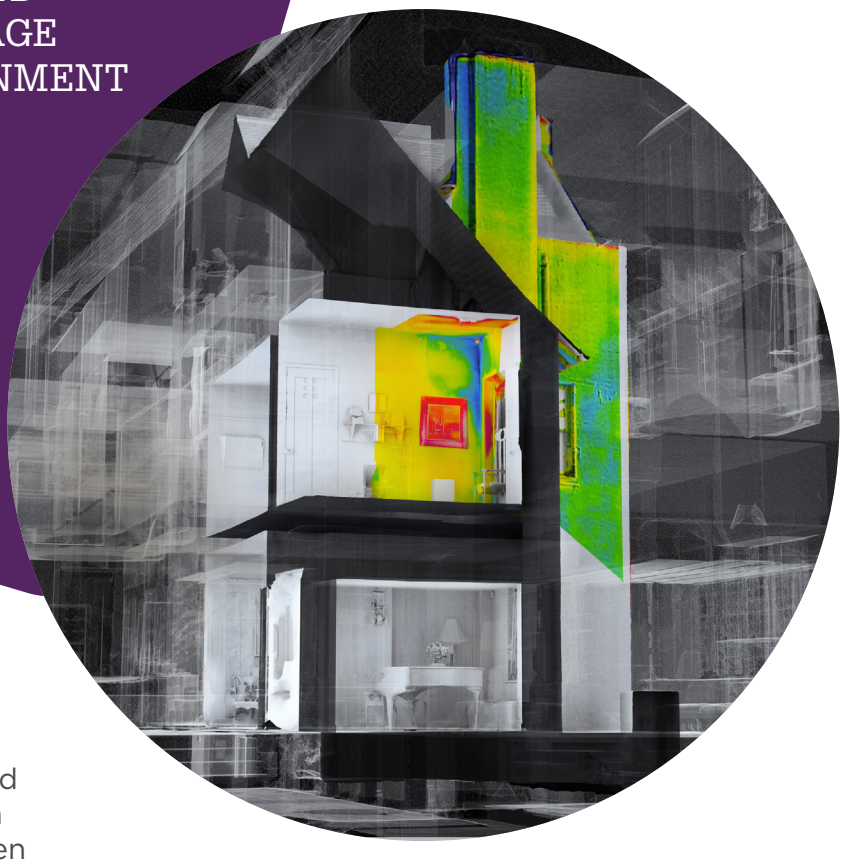
DIGITAL CONNECTIVITY

THE USE OF DIGITAL TECHNOLOGIES HELPS PROTECT HISTORIC PLACES AND OFFERS NEW AND SUSTAINABLE WAYS TO ENGAGE WITH OUR HISTORIC ENVIRONMENT

CASE STUDY: The Hill House

A joint partnership with Historic Environment Scotland and the National Trust fo Scotland



Thermal imaging combined with the 3D dataset highlighting areas of damp located on the South Column of the Hill House

Cutting edge technology used to monitor the condition of a vital piece of Scotland's heritage.

The Hill House in Helensburgh, designed by architect Charles Rennie Mackintosh and artist Margaret Macdonald, has been subject to damp ingress nearly since its construction in the early 20th century. The experimental early cement harling which contributes to the iconic grey façade is the primary contributing factor to this ingress, trapping the Scottish wind driven rain in the fabric of the building, something only exacerbated by the changing climate.

In an attempt to combat this, in 2018 the National Trust for Scotland built a protective box of steel chainmail to allow the house to dry out slowly over a number of years. Around the same time, the Digital Innovation, Digital Documentation, and Conservation Science teams at Historic Environment Scotland undertook surveys of Infra-red thermography and microwave moisture monitoring, as well as documenting in 3D the entire interior and exterior of the building through laser scanning and photogrammetry.

Laser scanning is a form of digital documentation that records the geometry of a surface in 3D space to create a digital model of buildings, objects, sites, and landscapes. It works by emitting a beam of laser energy onto a surface up to a million times per second, creating highly accurate virtual points representing the surface geometry. Each measurement point has an XYZ coordinate in 3D space, which come together to create what's known as a point cloud.

Laser scanning works only through line of sight, so multiple scans from overlapping positions of the interior and exterior were tied together using specialised software back in the office.

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Top: South elevation showing thermographic point cloud (left) and photorealistic model (right)

Bottom: photorealistic 3D model from the SW of the Hill House

To fill in any gaps the laser scanner missed and to texture the model with photorealistic imagery, the scan was supplemented with **photogrammetry**, a technique of taking overlapping high-resolution photography run through software to create a 3D model.

A novel addition to the workflow for this project was the addition of a thermal camera attached to the scanner, capturing a 360 panorama of infrared information applied to the point cloud.

Recording thermographic data in 3D space is a holistic way to visualise how moisture could be moving throughout the building because of the changing climate. For instance, being able to directly see how the water penetration from a chimney relates to a patch of damp in the corner of an interior room seems simple enough but visualising that in three dimensions is incredibly powerful in understanding how the house functions as a single unit.

This 3D data can be post-processed in multiple ways, aiding in everything from conservation and site management to interpretation and education. Digital access to these models allows individuals and communities the opportunity to experience heritage in unique and innovative ways, creating virtual connections between our society and our heritage.

These digital and scientific tools will not stop climate change in its tracks. What they can offer are the tools to understand how the changing climate is affecting our historic environment and inform how we might work to care for and communicate in a smarter way the complex story of our unique and valuable heritage.

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Point cloud of Hill House