SUSTaim

Decision support for building adaptation in a low-carbon climate change future

Stakeholder Comment on Outcomes

These observations on the outcomes and the value of this project are provided from the viewpoint of a construction professional and an industry participant by John Easton of SUSTaim Limited. This report is intended to identify the beneficial impacts obtained through participation in the project, gathered from input at key stages in the program, broader discussion during the final stakeholder workshop, and a review of the final reports.

At the point of initial engagement in the project John Easton was the Principal Sustainability Consultant for SMC Parr Limited and responsible for leading its specialist "Sustainable Futures" unit. SMC Parr rebranded as Archial and then was acquired by Ingenium Group during the project delivery period, throughout which it has remained one of the UK's top ten architectural practices.

Shortly before the project was concluded John Easton left Archial to establish his own consultancy business, SUSTaim Limited. John has continued his involvement in the project despite these changes of company name and role, and is able to comment on its outcomes from the viewpoint of his architectural practice, his sustainability consultancy role, and his broader involvements in academic and government lead applied research.

The building design professions in the United Kingdom have realised for some years that the British Standards and the Codes of Practice that we work to which incorporate weather data did not reflect current design conditions, let alone a future changing climate, based as they were on statistical data going back to the 1970s in some instances. While dynamic thermal simulation tools can model conditions with some reliability, these too have suffered from a lack of realistic future weather data in a reliable useable form.

Most design professionals will rely on adherence to "industry standards" as evidence of compliance with best practice as a defence against liability when building failures do occur occasionally. The elephant in the room over the last decade however, for designers and their clients, has been the seldom voiced realisation of the likelihood of a growing incidence of failure in an uncertain future climate.

The great design risk for the future will be the increasing incidence of extreme weather events brought about by climate change, whether that is extremes of rainfall, wind, or temperature. This project looked at temperature. Summertime overheat is of particular interest to designers and their clients due to the risk to comfort and health that this can present and due to the additional cost and excess emissions that could arise from supplementary mechanical cooling.

One of two scenarios tend to be adopted presently therefore:

- Either business as usual, involving simplistic compliance with outdated current standards and the use of modelling tools that rely on unreliable weather files, or
- The application of an estimated likely future worst case, insofar as that can be established

Decisions on whether to over-engineer a design solution to allow for a future worst case scenario have two potential implications:

- Increased initial cost of construction to address the worst case, where in the context of the current global financial recession additional spending is often ill afforded, particularly when even the adopted worst case may not be correctly defined

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- Premature failure resulting in the need for unplanned remedial intervention during the building's chosen design life, often leading to less efficient compromise retrofit solutions, causing increased cost and higher emissions

At the heart of making more realistic decisions at the point of initial design is the significant divergence that exists between the best case and the worst case models of the future climate scenarios that have been produced by climatologists and meteorologists. While the difference between the models is not significant in the early years, the divergence between the scenarios widens hugely over an extended time interval leading to potentially significant uncertainty over the actual outcome.

Whole Life Value (WLV) and Life Cycle Cost (LCC) assessments conducted to inform the initial design make use of accepted methods to fix an initial design life and for subsequent service life planning. BS7543: 1992 adopts the following design life categories for example:

Category	Description	Building Life for Category	Examples
1	Temporary	Agreed period up to 10 years	Non-permanent site huts and temporary exhibition buildings
2	Short Life	Minimum period 10 years	Temporary classrooms; buildings for short life industrial processes; office internal refurbishment; retail and warehouse buildings
3	Medium Life	Minimum period 30 years	Most industrial buildings; housing refurbishment
4	Normal Life	Minimum period 60 years	New health and education buildings; new housing and high quality refurbishment of public buildings
5	Long Life	Minimum period 120 years	Civic and other high quality buildings

Current future climate models enable forecasting of potential scenarios presently as far as the 2080s. Due to the time taken to bring a building project through its business case and option appraisal stages to a point of initial completion, it is likely that most of the buildings that are being contemplated today (which are those with a Normal Life as defined above) will still be in existence toward the furthest reach of the current climate projections. It is crucial therefore that designers are equipped today with reliable methods for the design modelling of these buildings based on a mathematically robust analysis of the huge amount of data that populates the climate models.

This project does just that, by producing probabilistic climate data in a useable reliable form as a basis for modelling and investment decision making.

The outputs from this project can be easily applied with dynamic thermal building modelling tools like IES-VE, TAS, and EnergyPlus. The next generation of these tools will incorporate optimisation algorithms that can dynamically evolve optimal solutions, which could be extended to optimise an initial design over an extended climate time line as well.

The project outputs could also be applied to the new generation of spatial masterplanning tools like CityCAD and Urban Designer, enabling analysis and informing decision making for estate development (for healthcare, education, etc), for larger neighbourhoods, whole urban districts, and potentially for entire cities.

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A further set of new tools are in development, based on GIS solutions, that could use probabilistic climate data to model entire regions to inform national and regional planning policy and for development control.

While the application of probabilistic climate data to building design is potentially universal, there are some niche applications where it will be of crucial value. Those applications centre on vulnerable user groups, such as the elderly or infirm, and on groups where individual occupants are afforded less personal control over their environment, such as in the healthcare and custodial sectors, or for other multi-residential use types.

The 2003 European heat wave for example, which was the hottest summer on record in Europe since at least 1540, provides a useful glimpse of more frequent potentially extreme weather conditions. That heat wave led to health crises in several countries and combined with drought to create a crop shortfall in parts of Southern Europe. Peer reviewed analysis places the European death toll at 70,000. According to the BBC around 2,000 more people than usual died in the United Kingdom during the 2003 heat wave, which more reliable modeling could possibly help to avoid.

Emerging best practice in building design now places greater reliance on the application of Adaptive Comfort techniques to maintain occupant comfort through recourse to significantly less building energy. The price of that approach however, are building solutions that are at higher risk of failure due to the fine balance that is set between heat inputs and outputs, the need for action by individual occupants to maintain personal comfort, supported by smaller heating and cooling plant.

The use of probabilistic climate data with design modelling permits a passive design approach to be taken with greater confidence, which will help to avoid needless overdesign today and costly energy hungry additions to current designs in future years.

With further work the approach taken with this project could have potentially global benefits through its application to future climate models in other countries and other continents.

It will be interesting to observe how further research and development is seeded by this important project.

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John Easton
BArch (Hons) BSc RIBA ARIAS
Managing Director

Tel: +44 (0)141 430 3139
Fax: +44 (0)871 314 0608
Mobile: +44 (0)7773 512425
Web: www.SUSTaim.com

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advice I assessment I research I knowledge transfer

9 Battlefield Gardens, Glasgow G42 9JR