Workshop 7

Behaviours, opportunities and expectations as thermal defences

Chairs: Jessica Fernández-Agüera and Susan Roaf

Three papers were presented in this workshop. The first was on the subject of the *Wintry Thermal Environment and Domestic Energy Use in Nepal*. It was presented by **Pokharel Ram and co-written with Hom Rijal and Masanori Shukuya** from Tokyo City University (CATE 2019 Proceedings, pp.377-382). This paper introduced several unique elements to the discussion if climate and comfort. The most glaring was that of altitude, that in Nepal dictates to a large extent the climate of a settlement. The verticality of the country offered a new insight into the impact of elevation on comfort.

The second paper was on *Indoor air quality, cold stress and thermal comfort in multi-family timber frame buildings* by **Timothy O. Adekunle**, University of Hartford, Connecticut, USA (CATE 19 Proceedings, pp383-394). The paper provided an overview of environmental conditions measured in the homes in winter and provided an interesting contrast to the Nepalese study. The mean temperatures measured in the homes we above this measured in the Nepalese ones and there were recorded complaints about the stuffiness and the occasional smells and measurements did show theoretically high levels of humidity and CO2 in the occupied homes. However, these may seem insignificant when set against the Nepalese data where in some homes up to a dozen people may sleep in the same room. Clothing and life styles as well as expectations of what is required as a bare minimum for comfort may affect researchers thinking in such studies.

The third paper in the workshop was on the surface of it very different. It was given by **Kheira Anissa Tabet Aoul** of the Architectural Engineering Department, United Arab Emirates University, UAE. It was on the subject of *Sustainability, Literacy and Higher Education: Paradigms and Challenges in the Built Environment of the Gulf Region* (CATE 19 Proceedings, pp395-406). In this paper Aoul raises the really important question of how best to transform our educational systems into high impact mechanisms for delivering to student's vital education on how they can survive and thrive in a rapidly changing world, with it changing climate. She looked at ways in which her own taught courses address this changing world and shared with the workshop her own endeavours to integrate essential and often basic sustainability and resilience lessons into her education and training programmes.

Based on these three experiences and discussion followed, one essential factor that should be understood when analysing comfort in built environments is that not everyone can afford or has access to the energy resources that would enable them to sustainably apply mechanical solutions to thermal control problems. Such problems are particularly acute in developing

regions with extreme climates where the population uses the energy sources within most immediate reach, essentially biomass, to ensure survival.

In the absence of sufficient and reliable electricity grids in many such places, especially remote rural or mountainous areas (such as in Nepal), timber is the primary heat-generating resource. There the need to condition dwelling interiors is often met to the detriment of indoor air quality, attributable both to system inefficiencies and highly sporadic ventilation to save energy. The approach also leads to local pollution, with direct implications for human health and urban ecosystems. The adverse impact on plant cover and concomitant erosion in the areas affected compounds other environmental problems. In other cases, electric supply and grid fragility and the existence of power shortages due to political or economic situations or geography necessitate the use of immediately available energy resources (biomass, diesel generators…) or induce long periods of inappropriate conditions in housing, workplaces, schools, medical facilities and so on.

Resorting to the use of external energy sources for environmental control, the solution of choice in today's scenario even where energy efficiency is well developed, may not be accessible in many areas of the planet. Particularly in the most extreme situations, that may carry high human costs.

Against that backdrop another significant challenge, particularly in cities in developing regions, is the optimisation and improvement of building envelope and passive system performance a pressing need. The aim is to reduce the dependence on external energy, ensuring buildings' role as life support systems in extreme episodes by enhancing both their capacity to serve as shelter and the duration of their autonomous operation in free-running mode with no external support.

One important measure in this regard is to raise inhabitants' awareness of the most suitable and efficient use of resources and handling of set point temperatures, an understanding of buildings' response times and the reestablishment of traditional adaptive solutions. Buildings should, then, accommodate user interaction, enabling them to adjust and control environmental conditions by opening windows (outdoor conditions allowing), controlling solar protection, scheduling thermostats and similar. These circumstances tend to overlap with cultural implications and customs in developing regions as well as with acquired habits of consumption and use, often as an expression of rejection of tradition and a sign of higher social status and personal success.

In many of the planet's extreme climates, in response to the perception of more or less recent 'country wealth', a significant proportion of the population has not had to tackle (or even be unaware of) the issues around maintaining indoor comfort, with solutions often poorly adapted to regional needs. In cities in such areas, mechanical environmental control systems (HVAC) tend to be in permanent operation, maintaining conditions unrelated to climate realities and an artificially supported way of life, even giving rise to paradoxical circumstances

such as uncomfortably cold indoor temperatures in the summertime in extremely warm climates.
As a rule, the political use of energy precludes any awareness of energy vulnerability or of societies' need to improve their climate resilience in buildings and urban agglomerations. Sensitisation measures are required to harmonise environmental concern and the responsible use of resources and disassociate both from the notion of prosperity and societal dynamics in terms of consumption and national reality building, without being presented as a weakness or a limitation imposed on social groups. Certain educational, particularly university-level, initiatives merit mention in this connection, with their invitation to social actors and users to deliberate on the future ecological footprint of today's actions. Sensitisation, education and reflection on different scales in societies facing extreme situations would appear to be the most effective tools to generate change for a less uncertain future.

It really is interesting reading these papers side by side. What they show in effect is an excellent geopolitical cross section from the global poor, through the global middle classes to the global rich. It is a cross section through buildings, through behaviours and perhaps most important, through attitudes. What is striking is that the most un-resilient and vulnerable population in this cross section appears to be the very rich. When the lights go out in the mountain communities of Nepal, it really makes little difference. When they do so in the American timber homes, people are much more likely to suffer during extreme events but it is in the home of the very rich in the Gulf where they are most vulnerable during extreme events, like the failure of a power grid during an extreme heatwave there. Behaviours evolve in a society, hand in hand with the money and energy available to result in building types and societies. The weaker the behavioural link between the natural environment, the climate and the occupants of buildings and the lifestyles they adopt is, the more vulnerable they are to the catastrophic failure of the their artificial life support systems. Aoul is right, we need urgently to educate the young on these physical and behavioural links between our life in buildings and the state of the natural climate and environment outside them, if for no other reason than to help them when the artificial systems fail.

This was a very insightful workshop indeed. The socio-economic expectations of a society or local population frame their buildings, the lifestyles and in turn their manifestation in behaviours. It appears in these three case studies that different societies are more or less connected to the environment around them. The less connected to their environments they are, the less resilient they appear to be, to extreme events. If those connections between nature and populations are woven in threads of behaviours, then it may be possible to transpose behaviours between populations to enhance the resilience of societies less able to survive extreme events. The understanding and harvesting of useful behaviours may well provide a major adaptive opportunity, but only within the context of an understanding of those behaviours within different building types.