Comfort, user behavior and energy efficiency – Summary of a workshop at Windsor Conference 2014

It is widely accepted that the adaptive approach to thermal comfort may be applied to passively cooled buildings and the static approach to air-conditioned buildings.

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Though the standards (e.g. EN 15251 or ASHRAE 55) give precise definition that the adaptive approach should only applied to buildings without any kind of mechanical cooling, there is an on-going discussion on the application of the adaptive or a hybrid approach to mixed-mode buildings or low energy buildings with limited cooling capacity (e.g. mechanical night ventilation or thermo-active building systems), respectively. Workshop explored aspects of thermal comfort and user behavior especially for buildings with low-energy cooling concepts.

During the workshop several statements were presented. Workshop participants were invited to indicate (hands up) whether they agreed (YES) or disagreed (NO) with the statements. After which a few YES-voters and a few NO-voters were invited to further clarify their opinions (votes).

A total of 11 statements were discussed. Below the workshop results are presented, one statement at a time.

Statement #1: Users' expectations strongly influence the satisfaction with their thermal environment

Voting result: YES/NO: 95/5%

Arguments of the YES-voters:
- Thermal comfort is very much about the interaction between physiology and psychology, so you have to include psychological aspects like expectations and past experiences
- Adaptation can only occur when people have an idea what to expect / when people have conscious or unconscious expectations
- It's all very much about normative and mental expectations

Arguments of the NO-voters:
- The thermofysiological models, that by definition do not address the expectations aspect, (e.g. as described in ISO 7730) are still very useful

Statement #2: We know how building occupants use controls

Voting results: YES/NO: 15/85%

Arguments of the YES-voters:
- We know already some things have an influence on the use the control, like cultural background, building type and workplace culture
- Also we know that training about the use of controls helps
- And we have a pretty good understanding about how controls are used if the controls are simple and used in a relative simple context e.g. at home

Arguments of the NO-voters:
- A lot of aspects are involved in control use, in general it is a complex issue which we have limited knowledge about
- Building service systems and their interfaces are still often designed with an unclear understanding of what the end user wants and needs in terms of control over their indoor climate
- Man-environment interactions in the built environment should be studied further before we can truly say that we understand the problems and challenges involved

Statement #3: We know how overheating affects behaviour of people at home

Voting result: YES/NO: 20/ 80%

Arguments of the YES-voters:
- See above (YES answers,)
- There have been a few field studies focusing on this (overheating & behaviour)

Arguments of the NO-voters:
- See above (NO answers, second statement)
- There is limited experience with overheating and its impact on behaviour in moderate climates

Other remark:
- Preventing overheating is more difficult then preventing cold stress and due to climate changes overheating is on the rise; an extra reason to study the relation between overheating and behaviour further

Statement #4: Allowing for occupant control leads to higher energy use

Voting result: YES/NO: 20/40% | 40% neither/nor

Arguments of the YES-voters:
- Occupant control often leads to extra energy use, think e.g. of opening windows during winter

Arguments of the NO-voters:
- If buildings and building systems are designed smart, occupant use of controls does not have to lead to higher energy use
- When you allow for occupant control set points (e.g. for winter heating temperature and summer cooling temperature) can be relaxed which results in energy savings

Arguments of the neither/nor voters:
- It depends very much of the circumstances how offering or not offering occupant control affects energy use, there are just too many parameters

Statement #5: We should add 3 extra parameters to the standard 6 'Fanger parameters': i. expectation, ii. imposed variation, iii. available/ perceived control

Voting result: YES/NO: 60/40%

Arguments of the YES-voters:
- It would be a good idea to evolve further the standard physiological models with psychological aspects like expectation, variation and control
- This would be a good idea, but we first need to agree on the purpose and objectives of that new model

Arguments of the NO-voters:
- The standard Fanger model / ISO 7730 should stay as is and should be used for what it's intended for
- If we change the present model we first and for all should start talking in terms of 'predicted percentage of delighted' instead of 'predicted percentage of

Statement #6: Building occupants want control over their indoor climate at all times

Voting result: YES/NO: 20/80%

Arguments of the YES-voters:
- Generally people like to be in control over their thermal environment, local air quality etc.
- Many people want to know that they are in control even though in practice they might not really use their controls
- Building occupants normally do not like automated control of their indoor climate, people just want to be able to override central control

Arguments of the NO-voters:
- In many situations (e.g. in corridors or in hospital environments) people in fact do not have a need to control their indoor climate
- It depends very much from person to person; quite a few people prefer the indoor climate to be just right without them having to (re)adjust it all the time
- The advantage of a centrally controlled environment is that people can focus on their work and just be productive

Statement #7: HVAC engineers want control over building occupants at all times

Voting result: YES/NO: 30/70%

Arguments of the YES-voters:
- Engineers are trained to be deterministic; the standard engineering approach is to think in terms of cause and effect but that does not really work in systems that include building occupants
- Heating, cooling and ventilation systems are becoming more and more complex, so it is tempting for engineers to keep (often irrational) occupant behaviour out of the calculation

Arguments of the NO-voters:
- Good system design by definition is only possible if one also designs for people-environment interactions
- In recent years, engineers have become more aware of building occupants' wishes and needs

Statement #8: Operable windows should be mandatory

Voting result: YES: 100% for dwellings, 80% for schools, 60% for offices | NO: rest

Arguments of the YES-voters:
- From a public health point of view it is important that building occupants have access to operable windows, especially at home
- Operable buildings in dwellings should be obligatory; people should not be totally dependent upon the functioning of mechanical systems
- Both from a physiological and a psychological point of view it is important that building occupants have control over their fresh air supply and room temperature

Arguments of the NO-voters:
- Sometimes (e.g. in offices) it is quite difficult to use operable windows for example in relatively high buildings or with open floor plans
- Allowing for operable window use might lead to higher energy use

Other remark:
- Too much focus on energy efficient buildings could lead to situations where building occupant will be deprived of their operable windows (or where occupants are told that the use of operable windows is prohibited); this should be avoided, buildings should be designed for health and comfort, adequate options for end user control are an essential part of that

Statement #9: Adaptivity and usability in buildings needs to be safeguarded in building codes

Voting result: YES/NO: 95/5%

Arguments of the YES-voters:
- Adaptivity and usability are essential qualities from the end users perspectives so these should be safeguarded in building codes
- Already in the UK proposals have been made to add "usability" in terms of performance criteria in British standards (see e.g. also some of the BREEAM requirements)

Arguments of the NO-voters:
- In general it is difficult nowadays to include extra demands in building codes; partly because most governments in and outside the EU are about less central rules

Statement #10: New building designs should be tested beforehand for adaptivity and usability

Voting result: YES/NO: 90/10%

Arguments of the YES-voters:
- There are six standard criteria for evaluation of usability (according to Fionn Stevenson) that can easily be tested for during the design and construction phase, so why not test it for those 6 criteria?
- Adaptivity and usability should get more attention during the design process; contractors should be forced to also deal with end user's expectations and perspectives
- "Soft qualities" of building designs get in general to little attention and any initiative that tries to change this is welcome

Arguments of the NO-voters:
- An alternative approach could work too; specifically a performance based approach where adaptivity and usability is tested upon delivery and not during the construction phase

Other remark:
- It would be better in this context to talk in terms of "to evaluate" than in terms of "to test"

Statement #11: We should have way more interaction with environmental psychologists

Voting result: YES/NO: 95/5%

Arguments of the YES-voters:
- Building scientists, architects and building system engineers lack quite a bit of knowledge on man-environment interactions and therefore should interact more with environmental psychologists
- Human factors and 'soft qualities' of buildings need to be defined further at conferences like the Windsor conferences and therefore more input from social scientists would be beneficial

Arguments of the NO-voters:
- There are already many studies that deal with people effects of buildings available; we should just start to apply them in practice