Advantages and limitations of Personalized Environmental Control Systems (PECS)

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SUMMARY

Personalized Environmental Control Systems (PECS) with the functions of heating, cooling, ventilation, lighting, and acoustics have the advantage of controlling the localized environment at occupant's workstation by their preference instead of conditioning an entire space. This improves personal comfort, health of the occupants, and energy efficiency of the entire heating, ventilation and air-conditioning (HVAC) system substantially. Some of the major advantages and limitations of PECS are summarized.

KEYWORDS

Personalized Environmental Control System, Thermal Comfort, Indoor Air Quality, Lighting, Acoustics, Indoor Environmental Quality

1 INTRODUCTION

Personalized Environmental Control Systems (PECS) allow individuals to control different aspects of indoor environment (i.e., thermal, air quality, light, and acoustics) according to their preferences, creating a personalized indoor space. This is in contrast to conventional room-conditioning systems that aim at creating mostly uniform conditions in indoor spaces.

IEA EBC Annex 87 - Energy and Indoor Environmental Quality Performance of Personalised Environmental Control Systems has recently started and has the overall objective of establishing design criteria and operation guidelines for PECS and to quantify the benefits regarding health, comfort, energy, and cost performance. This includes control concepts and guidelines for operating PECS in spaces with general ambient systems for heating, cooling, ventilation and lighting.

2 ADVANTAGES AND LIMITATIONS OF PECS

The concept of PECS is not new, and a significant amount of research exists (Madsen and Saxhof, 1979), (Melikov, 2004), (Rawal et al., 2020), (Zhang, 2010). PECS have certain advantages and limitations, as summarized in the following.

The following are the main advantages of PECS:

- Improved occupant comfort, health, and productivity
- Higher occupant satisfaction with the indoor environment, due to
    - Improvements in the immediate indoor environment experienced by the occupants

    - Possibility of personalized control
- Potential energy and cost savings
- Possibility of addressing the individual demands and preferences towards the indoor environment
- Resilience to extreme outdoor events (both thermal and air quality)
- Pandemic-proofing of indoor environments, such as providing clean and fresh air directly to the occupants and minimizing cross-contamination.

The following are the main limitations of PECS:

- No design guide or operation manual exists
- No guide about PECS' integration in buildings exists
- Standards and building codes are not ready to accommodate PECS
- Several practical issues to be addressed
- Not at the level of a "common" solution in buildings
- Very limited application examples from real buildings
- Very few commercial products exist.

3 CONCLUSION

PECS is a very promising solution and has the potential to improve occupant satisfaction with the indoor environment and reduce energy use in buildings drastically. However, there is a need for further guidance and documentation before these potentials can be fully exploited.

There is ongoing work to develop a complete PECS focusing on the PECS itself, personalized control aspects, and the PECS' interaction with the ambient HVAC system. The main goals are to provide design, operation and control guidelines and specifications for PECS, to provide guidelines and specifications regarding the interaction of PECS with the ambient system and its effects on the design of the ambient environment and conditioning systems, to provide enough data so it can be seen as a "standard" HVAC component, and to promote the use and market uptake of PECS.

4 REFERENCES

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