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Theoretical analysis of the performance of different cooling strategies with the concept of cool exergy - DTU Orbit (08/11/2017)

Theoretical analysis of the performance of different cooling strategies with the concept of cool exergy

The whole chains of exergy flows for different cooling systems were compared. The effects of cooling demand (internal vs. external solar shading), space cooling method (floor cooling vs. air cooling with ventilation system), and the availability of a nearby natural heat sink (intake air for the ventilation system being outdoor air vs. air from the crawl-space, and air-to-water heat pump vs. ground heat exchanger as cooling source) on system exergy performance were investigated. It is crucial to minimize the cooling demand because it is possible to use a wide range of heat sinks (ground, lake, sea-water, etc.) and indoor terminal units, only with a minimized demand. The water-based floor cooling system performed better than the air-based cooling system; when an air-to-water heat pump was used as the cooling source, the required exergy input was 28% smaller for the floor cooling system. The auxiliary exergy input of air-based systems was significantly larger than the water-based systems. The use of available cool exergy in the crawl-space resulted in 54% and 29% smaller exergy input to the power plant for the air-based and water-based cooling systems, respectively. For floor cooling, the exergy input to the power plant can be reduced by 90% and 93%, with the use of ground, and use of the ground and the air in the crawl-space, respectively. A new approach to exergy efficiency was introduced and used to prove that the exergy supply from the ground matches well with the low exergy demand of the floor cooling system.

General information

State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Tokyo City University
Authors: Kazanci, O. B. (Intern), Shukuya, M. (Ekstern), Olesen, B. W. (Intern)
Pages: 102-113
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information

Journal: Building and Environment
Volume: 100
ISSN (Print): 0360-1323
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 2.015 SNIP 2.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 2.093 SNIP 2.49 CiteScore 4.37
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.938 SNIP 2.797 CiteScore 4.14
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.581 SNIP 2.602 CiteScore 3.57
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.331 SNIP 2.875 CiteScore 3.06
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.144 SNIP 2.255 CiteScore 2.76
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.235 SNIP 2.001
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.028 SNIP 1.865

Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.924 SNIP 1.38
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.788 SNIP 1.778
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.03 SNIP 1.63
Scopus rating (2005): SJR 0.955 SNIP 1.225
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.548 SNIP 1.266
Scopus rating (2003): SJR 0.948 SNIP 0.921
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.998 SNIP 1.39
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.777 SNIP 1.098
Scopus rating (2000): SJR 0.526 SNIP 1.14
Scopus rating (1999): SJR 0.564 SNIP 1.175
Original language: English
DOIs:
10.1016/j.buildenv.2016.02.013
Source: PublicationPreSubmission
Source-ID: 121018741
Publication: Research - peer-review › Journal article – Annual report year: 2016