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# A comparison of winter indoor thermal environment and thermal comfort between regions in Europe, North America, and Asia

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## Abstract

Along with the improvement of living quality, indoor thermal comfort has been drawing increasing attentions. In this paper, a comparison between South Europe, North America and Asia on winter indoor thermal environments, occupants' clothing insulations and their thermal sensations was conducted. The compared regions all locate in similar latitude range of temperate climate zone (northern latitude 39°54'~53°31'). Field study data representing 10 cities chosen from ASHRAE RP-884, SCATs and China thermal comfort databases were used for the comparative study. It was observed that the indoor operative temperature and relative humidity varied from regions. European and North American cities had higher temperature while temperature of Chinese cities was the lowest. Among the three regions, indoor environments in Europe and China met well with the comfort requirements in their own regional or national standard, while North America had the highest ratio of matching the comfort zones no matter in which standard. Most of the off-comfort-zone conditions in Europe were due to overheating, contrary to those in China were mainly overcooling. Clothing insulation of Chinese was the highest and had a wider range. The winter neutral temperature for Europe, North America and China were 23.4, 22.7 and 21.7°C respectively. A comparison between TSV and PMV was made and obvious deviation features were discovered. Europeans tend to feel colder than predicted when indoor temperature is out of the neutral zone. Chinese TSVs were closer to neutral than they were predicted by PMV, while North Americans showed an opposite result.

**Keywords:** temperate zone; thermal environment; thermal comfort; clothing insulation; winter

## Nomenclature

$T_a$	Air temperature
$T_r$	Mean radiant temperature
$T_g$	Globe temperature
$Rh$	Relative humidity
$V$	Air speed
$I_{cl}$	Clothing insulation
$Met$	Metabolic rate

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