

Investigation and Evaluation of the Thermal Environment of Traditional Alleys in Kyoto during Summer and Winter

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ABSTRACT: To evaluate the thermal environment of traditional Narrow-alleys, surveys of thermal environment and the thermal comfort of 252 pedestrians were conducted in the streets of Kyoto during summer and winter. In summer, the air temperature of Narrow-alley was 0.2 to 0.3 K lower than that of the Middle-street and the Wide-street, which shows that the Narrow-alley effectively moderates temperatures in urban areas. However, in winter, the air temperature in the Narrow-alley was 0.1 to 2.4 K lower than in the other streets. The proportion of thermal sensation votes cast for 'slightly cool' to 'slightly warm' in the Narrow-alley was from 16 to 24% higher than those in the other streets in summer. Moreover, the proportion of the thermal comfort votes cast as 'comfortable' for the Narrow-alley was from 14 to 26% higher than that of the Wide-street, in either summer or winter. The findings reveal that the thermal environment of the Narrow-alley is more comfortable than that of the Middle-street or the Wide-street.

Conference Topic: 02 Sustainable Urban Design and Planning
Keywords: traditional narrow-alley, SET*, thermal comfort survey

1. INTRODUCTION

In an historical Japanese city such as Kyoto, city blocks often have traditional Narrow-alleys called Ro-ji. The characteristics of Ro-ji are as follows: narrow width, low building height, and wooden building surfaces (Fig. 1). These features are different from Middle-streets and Wide-streets, which are called Ko-ji and O-ji respectively. According to the inhabitants of Narrow-alleys, they are cooler in summer because of these characteristics, which decrease direct solar radiation, and warmer in winter by reducing wind speed. Research focusing on streetscape and the structure of community regarding Ro-ji has been carried out extensively, although few studies have been carried out on the thermal environment and thermal comfort. Thermal comfort surveys in outdoor spaces have been completed for open and semi-open spaces [1][2], however, little research has been done in the street.

To evaluate and improve Narrow-alleys in urban planning, the thermal environment was measured and thermal comfort surveys of pedestrians were conducted in a Narrow-alley, Middle-streets and Wide-streets during the summer 2004 and winter 2005.

The objectives of this research are: 1) to evaluate the thermal characteristics of a Narrow-alley by drawing a comparison with those of a Middle-street and a Wide-street; 2) to evaluate the thermal environment using physical and subjective thermal indices; and, 3) to compare the physical indices in summer and winter.



Figure 1: The scene of a Ro-ji (Narrow-alley)

2. SURVEY OUTLINES

2.1 Study area

The measurement site is located in the Nishijin district in Kyoto (Fig. 2). This district is made up of city blocks with Narrow-alleys. The form of each street is shown in Table I. The ground surfaces of all streets are asphalt, with the exception of the pedestrian walkway of the Wide-street, which is made of concrete tiles.