

## Sounds and sound preferences in Han Buddhist temples

Dongxu Zhang<sup>a</sup>, Mei Zhang<sup>b</sup>, Daping Liu<sup>c</sup>, Jian Kang<sup>c,d,\*</sup>

<sup>a</sup> JangHo Architecture College, Northeastern University, Shenyang, 110819, China

<sup>b</sup> School of East Asia Studies, University of Sheffield, Sheffield, S10 2TD, United Kingdom

<sup>c</sup> School of Architecture, Harbin Institute of Technology, Harbin, 150001, China

<sup>d</sup> Institute of Environmental Design and Engineering, The Bartlett, University College London, London WC1H 0NN, United Kingdom



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### ABSTRACT

This study recorded various sounds heard in Han Buddhist temples and analysed their acoustic parameters. Subsequently, it investigated the factors that influence sound preferences in these temples using a questionnaire survey. The results indicate that the physical acoustic and psychoacoustic parameters of various sounds correspond to the roles they play at the temple. Buddhism-related man-made sounds dominate the sound environment in temples. In addition, signal and soundmark are prevalent. In the case of sound preferences, natural sounds are preferred, and age and religious beliefs have a significant effect on the respondents' preference for the sound of a temple bell. Signal and Buddhism-related man-made sounds are affected by a variety of respondent demographic characteristics, while Buddhism-unrelated man-made sounds and keynote sounds are rarely affected by these characteristics. The education level of the respondents affects their preferences for various types of sound, and the respondents' evaluations of Buddhism and acoustic environment are related to their preferences for Buddhism-related man-made sounds, soundmarks, and keynote sounds. Among the assessed physical acoustic and psychoacoustic parameters, only sharpness is closely correlated with sound preference in Han Buddhist temples.

### 1. Introduction

Buddhism is one of the world's three major religions, and it has been an important part of Chinese culture for the past 2000 years. Among the three major sects of Chinese Buddhism, Han Buddhism has the largest number of adherents. According to a 2012 survey, in the Han Chinese population, the proportion of Buddhists was the highest (6.7%), and the number of Buddhists was approximately twice that of the adherents of other religions [1]. Over Buddhism's long history, the various sounds that are heard in Buddhist temples have played a key role in creating the religious environment for Buddhist followers.

Studies on sound in Han Buddhist temples have primarily focused on the sound of temple bells and Buddhist music. The distinctive sound of the temple bell has been noted by observers since antiquity. "The Records of Qielan at Luoyang", a Buddhist classic of the Northern Wei Dynasty, states that as early as 1500 years ago the characteristic sound of a bell was regarded as the soundmark of the temple [2]. In recent years, investigators have used modern methods to study temple bell sounds. For example, Chen studied the acoustic characteristics of the Yongle Bell of Juesheng Temple, and the results showed that the lowest of frequency of Yongle Bell is 16 Hz [3], and Zhang et al. suggested that

as a part of traditional Chinese Buddhist culture, the bell soundscape has played an irreplaceable role in the temple sounds environment since ancient times [4]. Regarding music in Han Buddhist temples, Yang Yinliu investigated the folk Buddhist music of Beijing's Zhihua Temple and of Hunan Province [5]. Yuan conducted an in-depth study on the origin and development of Han Buddhist music, and recorded a large number of music scores and other materials of Buddhist music [6]. Although these studies were conducted from the point of view of musicology, many of them provided a way to understand the sound and cultural characteristics of Chinese Buddhism. Scholars have also studied the Church acoustic environment [7]. In addition to traditional acoustic research methods, in recent years, investigators have analysed the relationship between human perception and the internal and external acoustic environments of churches from the perspective of soundscapes. Soundscape research examines the relationships among human hearing, the acoustic environment, and society. A soundscape can be defined as the sound environment of a given location as perceived by an individual, group or community [8]. It was first proposed by Schafer and is still under development today [9,10], and thus includes a relatively broad scope of study [11–14]. Kang measured reverberation time and conducted questionnaire surveys to analyse how several churches in

\* Corresponding author. Institute of Environmental Design and Engineering, The Bartlett, University College London, London WC1H 0NN, United Kingdom.  
E-mail address: [j.kang@ucl.ac.uk](mailto:j.kang@ucl.ac.uk) (J. Kang).

Sheffield create a comfortable acoustic environment [15]. Kiser and Lubman analysed the important role played by the sound of traditional church bells in community identification in London [16]. Garrioch studied the effect of church bells on the soundscapes of early modern European towns [17]. Brink et al. conducted a study to analyse church bell noises and sleep disturbances of nearby residents [18]. Soeta et al. researched the effects of sound source location and direction on the acoustic fields of Japanese Buddhist temples [19], and Westermeyer's studies focused on the soundscape of churches from the perspective of the typical sounds from inside a church [20]. Burgess and Wathe worked on ancient English church music and soundscape maps [21]. Zhang et al. analysed the acoustic environment of Han Buddhist temples from the perspective of soundscape evaluation [22,23]. Jeon et al. adopted social surveys and soundwalks to compare the soundscape around a Catholic church with that of a Buddhist temple in South Korea [24]. The above research provided a comprehensive baseline for understanding the acoustic environment of religious sites from the perspective of sound and soundscape.

In terms of sound preferences, the literature has primarily focused on the sounds of public buildings, residential buildings, and the rural environment [25–28]. Researchers have argued that the human preference for natural sounds and aversion to mechanical sounds indicates that natural sounds can improve human mental health [29–31]. Several have analysed the sonic features and acoustic environments of religious sites. However, research on the sounds and sound preferences of visitors to Han Buddhist temples is rare.

In this study, we analysed the acoustic parameters of various sounds heard in Han Buddhist temples, and the sound preferences of visitors to these temples. First, we selected a group of Han Buddhist temples that could be considered representative. We then determined which sounds were typical at these temples and made recordings. Next, we analysed the physical acoustic and psychoacoustic parameters of the recordings. We subsequently administered a survey questionnaire regarding visitor sound preferences and the temple acoustic environment. This approach was used so that we could combine the objective acoustic parameters and the subjective questionnaire survey results to analyse the various factors that affect sound preferences in the temples. Specifically, we conducted correlation analyses between the sequence of objective parameters of various sounds and the evaluation of subjective sound preferences.

## 2. Methods

### 2.1. Selection of research temples

In a preliminary study, we investigated the temple acoustic environment and distributed the questionnaires in Puji Temple. The Puji Temple is the largest Buddhist temple on Mount Putuo, one of China's four best-known Buddhist shrines. The subsequent formal investigation included four representative Han Buddhist temples: Xiantong Temple on Wutai Mountain (Shanxi Province), Longquan Temple on Qianshan Mountain (Liaoning Province), Ci'en Temple in Shenyang (Liaoning Province), and Xiangguo Temple in Kaifeng (Henan Province). These temples are located in three different regions in China (the north, centre, and south), and each has substantially influenced the history of Chinese Buddhism.

The selected temples generally adopt a traditional Chinese courtyard-style layout, with main halls on an axis that are flanked by side halls and corridors. Fig. 1 (a) shows the layout of Xiantong Temple, an urban temple, with the Grand Hall as the tallest structure on the central axis. Fig. 1 (b) shows the plan of Longquan Temple on Qianshan Mountain, a mountain temple that has a dispersed layout to accommodate the mountainous terrain.

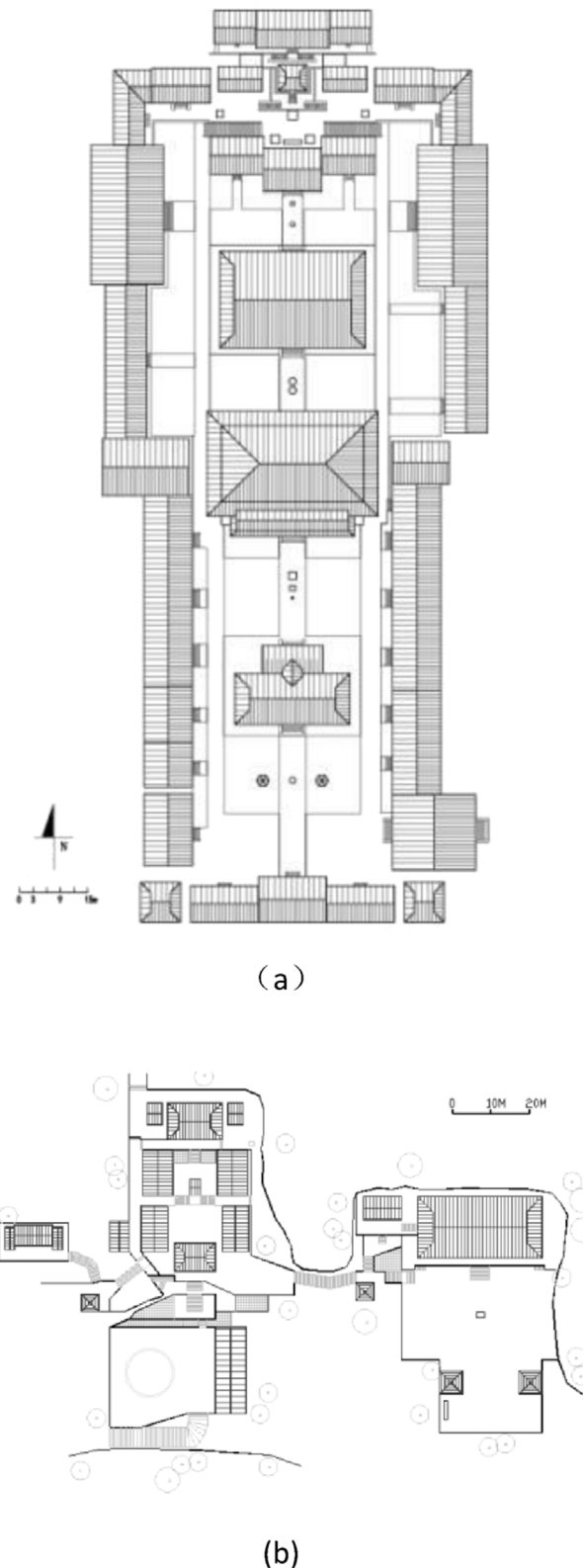


Fig. 1. Site plan of Chinese traditional temples.

### 2.2. Sound classification

Field surveys revealed that there were various kinds of sounds encountered in Han Buddhist temples. These sounds were divided into natural and man-made sounds, based on their source. Natural sounds can create a religious atmosphere in a temple by masking unwanted

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