



Measuring people's perception towards Earth-sheltered buildings using photo-questionnaire survey



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ABSTRACT

The earth-sheltered buildings started to be known as an alternative passive energy design technique. This research is trying to measure people's acceptance, to live in or deal with these buildings, whom had no previous experience, using the photo-questionnaire survey and interviews with a purposive expert sample (n = 164) at Egypt and Japan.

Using the chi-square test, to generalize the results, the inferential statistics showed that 48.8% from the whole sample had a little knowledge, which means that it started to be recognizable among experts. In addition, 55.5% from the sample chose the application at a touristic city with mild climate. Moreover, 43.3% chose the residential usage, and 40.0% chose the touristic one. Which infers that the only bias of applying those buildings was psychological, according to its name related with "Earth". However, when people had experienced the questionnaire through videos and pictures, they showed good reaction about those buildings. The significant results recommended for architects and urban planners to use this kind of buildings first at a touristic city with mild climate as a beginning, to give the public a chance to try it for short time as a resort or hotel. Afterwards, they can apply it at the residential sector.

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1. Introduction

This research used a statistical method to prove the hypothesis. The introduction consists of the research issues, the literature review, and the research purpose, scope and objectives.

1.1. Research issues

One of the most innovative passive thermal comfort systems through history is the Earth-Sheltered construction type. Although it is very effective from the thermal comfort and energy savings perspectives, people do not tend to apply it as a first choice, especially at harsh climates, where it has the best thermal performance.

The researcher thinks that it is because of several reasons:

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- Insufficient knowledge between experts, and the public, about the great thermal benefit of this kind of buildings.
- The historical experiences of the Earth-sheltered buildings are not attractive architecturally and aesthetically.
- The modern Earth-sheltered examples are still not widespread, and still in the uncommon corner of the architecture styles.
- The psychological background image settled in the minds with negative associations about underground buildings (dark, damp, clod, cave, full of insects, etc.).
- Those buildings are usually called in a misleading name "Underground Buildings", which we think it is the main bias that gives the previous negative attitudes in which these buildings are located "under the ground level". Although, most of the modern examples are located "above the zero level" or "on the hillside". Therefore, this research is using the term "Earth-Shelter", which implicates that they are like conventional buildings, while "Sheltered" by an "Earth" cover somewhere. Therefore, every "Underground Building" is "Earth-Sheltered", while it is not a condition for the "Earth-Sheltered Building" to be "Underground".
- Another special concern about the term "underground" at the Middle East, especially the Arab countries, where most of the hot-

harsh climate is located, is that people are buried in tombs, which are very similar in features to the negative background image of the term “underground”. An obvious example “Gebel-el-mowte”, (The mountain of the dead) Egypt (Heba, Akashi, Aly, Arima, & Sumiyoshi, 2012).

The previous reasons were the motivators for this research. Besides, the background at Egypt from “Hassan Fathy” buildings’ style experience. A great Egyptian architect whom was honored outside Egypt. At the same time, his village at “Gourna” Egypt was abandoned, until many calls raised nowadays to save it from complete demolition, although his building style had proved high thermal performance.

Therefore, to apply such kind of buildings at a wide sector; it is of utmost importance to measure people’s attitudes towards living or dealing with it, the subject that is not sufficiently covered in literature. Although some researches spotted the light on it, but they recommended not to generalize their outcome to the public.

Still the occurrence of another problem, which is there is no real experience of interaction between people and the modern style of Earth-Sheltered buildings at a wide range, especially at hot-arid climates. Therefore, their reply to a questionnaire will not be a complete reflection about their opinions.

Hence, the researcher used a photo-questionnaire, which shows pictures about the modern style. Besides, displaying a short video to give the interviewees an appropriate idea about these buildings. Moreover, conducting the questionnaire at the experts’ level to be able to imagine and understand the purpose of the research questions. We gained the advantage of hosting experts interviewees, and asked them, not only about their attitudes, but also about their recommendations for urban and design implementation guidelines.

The researcher believes that from differences, things is got to be clearer. Regarding the future implementation, it should be “site-specific”. Therefore, we chose the interviewee sample to be from Egyptian experts as a hot-dry climate developed country, and Japanese experts as a cold-humid climate advanced country. We tested both attitudes and implementation recommendation.

This paper is a part of a larger research about testing the suitability of the Earth-Sheltered buildings’ application at hot-arid climates, especially at Egypt as a case study.

1.2. Literature review

This part would be organized according to the relativity of the research topic, thus inside each topic would be chronological order.

Most of the previous researches were concentrated on measuring people’s attitudes with buildings, about windows proximity with classrooms and office buildings. All of which had proved the hypothesis that productivity, psychology, and physical comfort had increased with direct windows contact (Aries, Veitch, & Newsham, 2010; Barrett, Davies, Zhang, & Barrett, 2015; Carmody, Sterling, & Sterling, 1993; Nagy, Yasunaga, & Kose, 1995; Niroumand, Zain, & Jamil, 2013; Yildirim, Akalin-Baskaya, & Celebi, 2007). As this research is mainly predicting and measuring about something still not applied, we used the photo-questionnaire technique. Previous researchers used it with buildings and urban planning, in different topics, for predicting about preferences and attitudes (Hammitt, Patterson, & Noe, 1994; Santosa, Ikaruga & Kobayashi, 2013; Sullivan, Anderson & Lovell, 2004).

Valuable researches about assessing the suitability and attributes of Earth-Sheltered buildings at hot-arid climates were introduced (Al-Temeemi & Harris, 2004; Sheta, 2010). They are depending on the theoretical analysis, and created an organized guidelines and Earth-Sheltered attributes. Although the Earth-Sheltered buildings had proved very high level of thermal

comfort experimentally (Benardos, Athanasiadis, & Katsoulakos, 2014; Derradji & Aiche, 2014; Hassan, Arima, Ahmed, Sumiyoshi, & Akashi, 2014; Tundrea et al., 2014; Van Dronkelaar, Costola, Mangkuto, & Hensen, 2014;), but still the application is not widespread through the world. Even many architects think that it is only limited to basements or underground structures (Bobylev, 2010; Kaliampakos, Benardos, Mavrikos & Panagiotopoulos, 2014). Two recent books where Basil and Akubue talked about the Earth-Sheltered construction on its modern form, regarding the energy savings potentials, benefits and drawbacks, construction typologies, and the structural integrity (Hoyle, 2011; Anselm, 2012), in a rich details for deep seekers about the system.

The relative researches to this work were since the eightieth; no further researches on the acceptability of Earth-Sheltered buildings using a questionnaire survey analysis had been published, until the pilot study of this research at 2013 (Ismail, Arima, Ahmed, & Akashi, 2013).

At Japan, there are two recent researches about the acceptability of living at the basements (Kazumori & Yuske, 2004; Mariko, Tomoda, & Taguchi, 1999), but it is not recommended to do so.

The research team at Oklahoma university 1980, gained results from 34 questionnaire from people who already participated in designing their earth-sheltered houses. The majority felt satisfied by the energy savings, whether 40% felt dissatisfaction about their energy consumption, Boyer thought it might be because of over expectations from users (Boyer, Grondzik & Weber, 1980). Because, they already measured the energy savings inside these buildings around the year, and gained a noticeable energy savings (Boyer & Grondzik, 1980; Boyer, Grondzik & Fitzgerald, 1981).

At South Carolina, another research done by Stewart and his group (McKown & Stewart, 1980). The sample farm (n = 250), were interested volunteers had been hosted in an earth-sheltered house, and had been asked the questionnaire about their attitudes, to gain their reactions towards selected design features Ex.: (size, special arrangement, lightening, privacy, access, expected maintenance costs, and energy efficiency. . .) (Kay Stewart, McKown, & Newman, 1981). That research proved the visitors desire to live in a similar house was related with three main attributes, every architect should consider about them when designing such a house; community acceptance, accessibility, and lightening. That study should not be generalized beyond its limitations.

In 1981, Baggs conducted a valuable research at Australia (Baggs, 1981). He performed a postal survey at the beginning with 88 respondents, and then he conducted interviews with 53, both of which aboveground and underground dwellers, in an attempt to explore user attitudes before and after occupying an underground dwelling. He used the random number tables’ statistical method to equalize both samples. He advised to conduct a photo-questionnaire at future researches similar to that one, because during his interviews, most of the respondents had changed their passive reactions into positives, after seeing photos of modern earth-sheltered houses. Again, this research outcome could not be generalized; it is only limited to that community.

Combs conducted a questionnaire at Nebraska, Lincoln, mailed to 182 sample of homebuilders, to gain their expertise about their acceptability of the constructed earth-sheltered houses (Combs, 1985). He obtained the result that, those homes that were built within existing neighborhoods, were less accepted by public than those were built at rural areas. The research was only concentrated on the psychological acceptance point.

At Minneapolis, St. Paul, Minnesota. Bartz conducted a post occupancy questionnaire (n = 39), regarding the level of satisfaction after a real experience of this kind of buildings (Bartz, 1986). He found that residents were very satisfied with their internal thermal comfort and psychologically.

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