

# Transitional zone design in the desert environment of Abu Dhabi: Vernacular vs. modern



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## ABSTRACT

This paper describes the transitional zones of vernacular and modern buildings in Abu Dhabi. A transitional zone is described as non steady-state spaces like entrance lobbies, corridors, lift-lobbies and landings, which allow occupants to transition through to more steady-state spaces. In particular, this paper draws from literature the effect vegetation-based microclimates may have on the vicinity of a dwelling, which may reduce the indoor cooling load. This study will involve a summary history of earlier transitional zones in vernacular architecture in Abu Dhabi, which uses little energy and purely by design, creates a comfortable environment. Passive designs in particular, allow a comfortable environment for occupants in high-heat desert conditions. This paper discusses the use of vernacular designs for present-day Abu Dhabi to create intermediate non-steady state spaces for relief from the heat. The Kansara Transitional Zone Survey was used to ask occupants (guests or otherwise) how their behaviour, comfort, satisfaction and productivity were affected in the transitional zones. The questions were asked upon immediate entry into the transitional zone. This paper discusses the format and content of the questions. The results of the survey are displayed followed by a discussion.

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## 1. Introduction

Thermal comfort is the human psychological sense of satisfaction in ones physical environment. Research bifurcates into subjective (satisfaction, productivity, health and wellbeing) and objective factors (Temperature, Humidity, Air speed, CLO and MET). Much research is available on the physical aspects of the building, primarily through the form of Predictive Mean Vote<sup>1</sup> (PMV) and Predicted Percentage Dissatisfied (PPD) (Fanger, 1972). Whereby assessments take place on a seven-point thermal sensation scale (Fig. 1.1).

Calculations on what percentages of the occupants are dissatisfied are judged next to formerly agreed percentages of allowable dissatisfaction amongst occupants. For example, steady-state environments, subject to MET and CLO<sup>2</sup> must conform to a 6%, 10% or 15% PPD, in other words, 94%, 90% or 85% satisfaction in the environment.

Standards using Fanger's research on thermal comfort suggests specific characteristics of design for steady-state environments.

American Society of Heating, Refrigerating and Air-Conditioning Engineers – ASHRAE (Turner et al., 2010) as well as the British Standard/European Standard/International Standards Organization – BS EN ISO 7730, both define comfort conditions for steady-states. However, lacking in current literature and standards is the transient, non-steady state criteria, which calls for procedures to design for occupants transitioning through from the outside – in.

These transition zones are described by Hwang, Yang, Chen, and Wang (2008) as impossible to “achieve a thermally steady state”, a place where the physical environment bridges between the interior and exterior environment—a modified climate characterized by highly variable physical conditions (Chun, Kwok, & Tamura, 2004). The question arises thus, what are the criteria for the design of such spaces?

Over 40 years, the Emirate has developed its urban form to rival that of international cities not to mention its local rivals, such as Dubai. Abu Dhabi's standards for the built environment, the Pearl Rating System (PRS), introduced in 2010 by Emiri Decree predominantly follows the Leadership in Energy and Environmental Design – LEED, without much alteration. LEED mainly uses ASHRAE, ISO and CIBSE<sup>3</sup> standards for designing buildings. These rating systems

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<sup>1</sup> It was verified that PMV cannot be used for transitional space thermal comfort predictions because of its unstable and dynamic physical and MET value (Chun et al., 2004: p. 1187).

<sup>2</sup> MET: Metabolic Rate; CLO: Clothing Factor.

<sup>3</sup> Chartered Institute for Building Services Engineers.

+ 3	Hot
+ 2	Warm
+ 1	Slightly warm
0	Neutral
– 1	Slightly cool
– 2	Cool
– 3	Cold

Fig. 1.1. Thermal sensation scale.

as well as the local statutes lack any transitional zones-specific comfort conditions or design parameters.

To aid the PRS in creating thermally comfortable transitional zones, this paper will discuss the design of such spaces with the use of vernacular architecture. Explaining what aspects of the vernacular form was specific to the microclimate's benefit. The discussion on vernacular architecture is not to accept and proclaim the authority of the past, rather to recognize its authenticity and so its value as a resource for the present. There is a lack of analytic studies on the traditional ecology of the Emirate. There is hope this research will open a discussion on the importance of testing vernacular architecture in terms of thermal comfort during the seasonal variations.

The implications of borrowing Western models of construction are visible in the Urban Heat Island – UHI-effect. To reduce this negative impact on the microclimate, an introductory description is given discussing the aspects of building exteriors that can help reduce solar insolation utilizing vegetation.

Finally, there is a framework for the subjective responses of occupants to these transition zones, using a survey whilst present in the transition zone, developed in 2011 and tested in 2012 with 20 buildings randomly sampled from the Urban Planning Council's database of buildings on the Island of Abu Dhabi.

## 2. Literature review

Buildings, the most lasting of human artefacts, have always been the expressions of faith, wealth and power of rulers and elites. Surviving styles in Abu Dhabi are thus, a style seen in palaces, expressing imperial greatness: pleasure pavilions set amidst gardens and running water, emblems of secluded paradise, and official palaces, centres of government and justice as well as princely life. This type of construction was prevalent amongst the leaders of the tribes, merchants and the Sheikhs, or ruling families. In the course of 50 years, however, buildings have changed shape from mud/mud brick with palm fronds to high-rise complexes.

Changing with the construction type are the transition zones that occupy neither the outside nor the inside. In traditional huts, using resources available in the locale, occupants would resolve this conflict by necessity. Keeping open-plan spaces, increasing ventilation and decreasing solar insolation by shading. In modern buildings over-specified HVAC systems do this, not mindful to the rising costs of energy.

The following review determines the use of vernacular designs of transitional zones. It then evaluates literature on transitional zones/non-steady states and the use of vegetation to reduce temperature in Abu Dhabi.

### 2.1. Transitional zones

Within a timeframe of 20 min, humans can readjust their thermal sensations to a more steady-state adjusting to a different

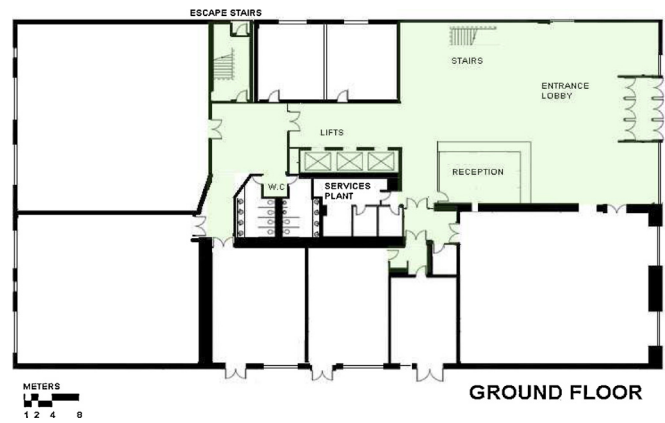


Fig. 2.1. Ground floor transitional space.

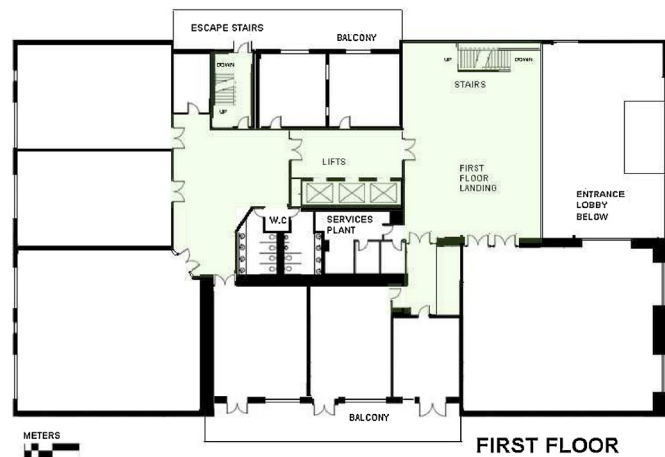


Fig. 2.2. First floor transitional space.

environment effectively (De Dear & Ring, 1993; Hwang et al., 2008; Nagano, Takaki, Hirakawa, & Tochihara, 2005). The transition zones are psychologically and physically half-way between the outdoors and indoors. A transition zone in contemporary buildings is defined as an environment which connects one steady-state environment to another with corridors, atria, stairwells and lobbies. These areas are often constructed as mechanically cooled environments that are controlled through Heating Ventilation and Air Conditioning.

A typical mixed-used building was mapped out displaying the transition zone in green, see Figs. 2.1 and 2.2. These show current layouts for transition zones of a mixed-use building.

The design of such places should be congruent with the patterns created with the surrounding building, all to aid the relationship with the external elements (Alexander, 1979: p. 89). Designs particularly for these transitional zones do not exist. There are however energy estimates completed using software to analyze the loss of heating/cooling in these areas. In many cases, when isolated from the rest of the building, it was found that these urban transition zones use three times the energy per unit area compared to the inside of buildings, (Miura, 1991). In this case heating of an atria in an underground shopping mall showed a very high energy bill.

### Vernacular design

Archaeological excavations led by Geoffrey King found some of the first urban structures in Abu Dhabi. Some of these structures

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