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Evaluation of traditional architecture in terms of building physics: Old Diyarbakír houses

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Abstract

Diyarbakır is located in the southestern part of Turkey. Traditional Diyarbakır houses are successful examples of buildings adapted to a hot dry climate. This is achieved by conforming to an old style of living and by the requirements and the use of local materials. In this study, the general architectural properties of the traditional houses of Diyarbakır, their layouts, plan types, building envelope and facade elements are evaluated in terms of building physics criteria. Today, in spite of new technological advances, techniques and materials, identical buildings are still being built, and climatic design is not considered important in Diyarbakır. As a result these buildings do not provide shade and cool spaces, and thus cause thermal discomfort, or increase in the use of energy. The aim of this study is to emphasize the importance of the features of traditional buildings in terms of designing energy efficient, to provide appropriate buildings for the environment.

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1. Introduction

Investigation of the traditional architecture in terms of heat-humidity, air movements, light and sound elements in the physical environment puts forward interesting and useful examples for consideration. The familiar elements of regional architectural styles (sun rooms, porches, balconies, courtyards, shutters and such) were created to use the sun for warmth and to create shade and breeze for cooling. Climatic design lessons can be learned and inspired by observation of the long tradition of indigenous architecture.

With technological advances in heating, air conditioning and illumination, a high degree of comfort of buildings was achievable even in adverse climates. But as a result, the wisdom of designing with climate was too often ignored. If in a hot climate, one would use more air conditioning, in a cold climate, one would just call for an oversized heating system. The design of the building itself could be the same, it seemed, whether placed in the arid desert or the snow-bound mountain. With the energy emergencies and shortages of the 1970s, high energy use to create comfort in buildings became apparent, thus making climatic design and energy efficiency important once again. It appears that architects and builders traditionally had to design with respect for nature and local climate. This approach also decreases environmental pollution and energy consumption [1–6].

The old houses of Diyarbakır are typical examples of buildings adapted to a hot dry climate. This study attempts to evaluate the old settlement in Diyarbakır in terms of building physics criteria. The basic characteristics of Diyarbakır's climate are presented, followed by an examination of the general architectural properties of the traditional houses and evaluation of the old settlement and houses in terms of physical environment elements such heat, humidity, air movements, light and sound.

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2. Climatic data and the general architectural properties of traditional architecture

2.1. Climatic data

The basic characteristics of Diyarbakır's climate are high temperatures and dryness (low humidity). The large variations between night-day and summer-winter temperatures make adaptation to the climate difficult. Strong wind may raise dust and create a dust haze. Collected climate data for Diyarbakır is shown in Table 1 [7]. The hot season (from April to November) is rather longer (about 8

Table 1 Climatic data for Diyarbakır, latitude: $37^\circ 55'$ North, longitude: $40^\circ 12'$ east

Climatic variable		Unit
Temperature	Mean summer months	30.5 °C
-	Mean winter months	3.7 °C
R. humidity	Mean yearly	53%
	July-August	24(min)%
	December-January	77(max)%
Precipitation	Winter	$71.4 mm/m^2$
	Spring	$59.8 \mathrm{mm/m^2}$
	Summer	$3.9\mathrm{mm/m^2}$
	Autumn	$28.3 \mathrm{mm/m^2}$
Wind	Winter (S–NW)	33.8 m/s
	Spring (W–NW)	21.6 m/s
	Summer (SW–NW)	23.1 m/s
	Autumn (NW)	20.6 m/s
Solar radiation	Mean yearly total radiation on horizontal plane	16 MJ/m ² day
	Mean yearly direct radiation on horizontal plane	$10.4MJ/m^2day$

months) than the cold season in Diyarbakır. Therefore the hot- period conditions should be dominant in the design of the buildings [8–10].

2.2. The general architectural properties of old settlement and houses

As seen in Fig. 1, Diyarbakır city is bounded by city walls and divided into four main parts by the streets located on NS and EW axes. In every part of the city, generally streets are located on the principal axes and are full of twists and turns, therefore clustered courtyard buildings alleys constitute organic planning (Fig. 2) [11].

Old houses are formed with a courtyard (square, rectangle, and trapezoid plan type) surrounded by buildings oriented on the main directions such as east-west and north-south. Blocks surrounding courtyards are usually perpendicular to each other whatever the plot geometry is (Fig. 3) [12]. Spaces in the plan types of the old houses are defined as living rooms and service rooms. A function diagram of a traditional house is given in Fig. 4.

Living spaces are open spaces (courtyard), semi-open spaces (termed "eyvan") and closed spaces (room, boxroom, built-in cupboard). Service rooms are kitchen, bathroom, depot, pantry and toilet. The number of blocks changes according to the size of the plot of land and constitutes a different plan type. Every block in the courtyard has one or two storeys. It is generally constituted as a ground floor, first floor and basement. Living rooms such as semi-open spaces with a pond (eyvan) and summer rooms are on the ground floor beside the service rooms such as the kitchen, toilet, bathroom and stable. Rooms and semi open spaces are also on the first floor. A basement



Fig. 1. The map of the old settlement.

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