Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 134 (2017) 29–39

Procedia Engineering

www.elsevier.com/locate/procedia

9th International Conference on Sustainability in Energy and Buildings, SEB-17, 5-7 July 2017, Chania, Crete, Greece

Preliminary study of the condition of social housing in the city of Durango, México

Claudia Karelly Romero-Pérez[a], Norma Alejandra Rodríguez-Muñoz[a,b]*, María Guadalupe Alpuche-Cruz[c], Ignacio Ramiro Martín-Domínguez[a]

[a] *Centro de Investigación en Materiales Avanzados, Calle CIMAV 110, Durango, Durango, 34147, Mexico.*
[b] *Consejo Nacional de Ciencia y Tecnología CONACYT, Av. Insurgentes Sur 1582, Mexico, D.F 03940, Mexico.*
[c] *Universidad de Sonora, Blvd. Luis Encinas y Rosales SN, Hermosillo, Sonora 83000, Mexico.*

Abstract

Buildings in general, housing and specifically social housing in Mexico, have high demand of energy as a consequence of the use of heating and cooling systems; mainly due poor design and the use of thermally inefficient construction materials. An analysis of the thermal behavior and energy consumption was demanded by the local housing development chamber. One of the first steps towards the accomplishment of this objective is to complete a diagnostic of the condition of social housing in the city of Durango in México. Diagnostic not only including thermal comfort and thermal behavior of the dwelling, but a complete diagnostic consisting on: location, urbanization history and a climatic analysis. The study was focused towards housing intended for low income families, which are candidate to be financed by federal housing organizations, meaning that there is an important limitation on budget. It is thought that the final cost of such dwellings limit the quality of design and materials. This housing has to comply with NOM-020-ENER-2011 (Mexican norm of energy efficiency in buildings: residential dwellings) and the calculation of energy demand through the DEEVi tool (Calculation of energy efficient dwellings). This requirements need to be fulfilled so they can become candidates to be financed by the federal housing organizations. There are several previous studies analyzing the thermal behavior of social housing in Mexico that have been focused on hot or warm regions of the country, where the air conditioning needs are predominant. However, the weather of the city of Durango is ranked as BS in the Köppen classification, where the minimum and maximum ambient temperatures require the use of cooling and heating systems. The results shown in this preliminary study include: the identification and delimitation of the historic growth of the urban sprawl from 1775 to 2010 and a preliminary evaluation of the impact of passive strategies. The comfort hours provided by the passive strategies were calculated and design guidelines were enunciated. The considered parameters were: housing location, local weather conditions and the characteristics of the social housing construction (material and building systems).

* Corresponding author. Tel.: +52-614-439-4898.
E-mail address: norma.rodriguez@cimav.edu.mx

Peer-review under responsibility of KES International.
10.1016/j.egypro.2017.09.594

Peer-review under responsibility of KES International.

Keywords: social housing; housing regulations; bioclimatic design.

1. Introduction

The current main challenges which threaten medium and long term sustainability are climate change and water scarcity. Inefficient and pollutant practices at daily life place at risk economic, environmental and social stability in our planet. As humankind we have the opportunity and challenge to deal with the important issues, diminishing greenhouse gas (GHG) emissions and water usage. New and efficient technologies, green energy sources together with the adjustment of consumption and production habits are some of the actions to be implemented. Strategies to face climate change have been discussed and countries have proposed themselves through conventions and global events, to reduce the production of GHG which promote the global warming phenomena. Global warming is mainly due the use and burning of fuels like oil, gas, carbon and wood. According to the International Energy Agency (IEA), the economic sector that causes approximately 80% of GHG in the world is the energy sector [1]. Similarly, excessive use of electricity and inefficient systems and equipment in various activities in our daily lives promote global warming [2].

According to the population census from INEGI (National Institute of Statistics and Geography) in 2010, Mexico has 112 million inhabitants in 28 million houses with a mean of 3.9 persons per housing. Also, it is expected that in 2050 there will be 122 million of habitants [3]. From this significant growth in population and dwellings, great challenges are expected at three key sectors: housing, energy and water. At the national energy balance from 2011, housing in México was responsible for 16.2% of the final energy consumption; which represents 4.9% of GHG national emissions [4]. The use of energy in a household mostly accounts for heating and air conditioning systems operation, according to both SENER (Mexican Secretariat of Energy) and CONUEE (National Commission for Energy Efficiency), today about 30% of the electric consumption in the residential sector in Mexico is to reach thermal comfort. Nevertheless, this figure accounts only for the use of cooling equipment [5]. As a consequence, the use of air conditioning and heating in dwellings also account for large amounts of CO_2 emissions.

In Europe more than 80% of the population lives in cities, meanwhile in Latin America the figure is 70%. However, the dedication of design and construction specialists it is only addressed to 10% of the world population. Meaning that the other 90% is without professional advice in regards with the bioclimatic and general construction; therefore housing has been developed out of control and without habitability. In principle, social housing is destined to satisfy basic habitability needs of low income population. However, the functionalist thinking reduced the social housing concept to minimum housing; coming to low-priced housing. With the decrease in quality of space and the use of inadequate materials lowers the habitability conditions [6].

In México in the 40's and 50's with the appearance of the state housing institutions, strategies to improve the situation and satisfy the amounts of new constructions were created. This first approach incorporated a whole methodology, where housing, education, commerce and recreation were included. In the last years, development problems increased, especially the urban sprawl and inefficient planning drove the generation of new housing, construction and financing programs. In Mexico housing construction programs are currently under modification, the main goals of this projects is changing from only increasing the number of constructions to promote the sustainable housing development.

The sustainable housing intends to lower the operation costs and the reduction of GHG emissions. Another key aspect is that the implementation of such programs have encouraged research, innovation and the development and use of new technologies [7]. Nevertheless, there are still some locations in Mexico where housing is designed and built with little to no regard of the weather of the location. Therefore, the extensive use of air conditioning and heating is required to maintain comfort levels during many hours of the year.

Within Fondo de Sustentabilidad Energética Conacyt-SENER S0019-2009-01 project 118665, a consortium of researchers were called to study passive systems in different climate zones of Mexico and quantify its percentage of use in social housing. Unfortunately, the results show a low practice of passive systems. This studies also describe the