

Identification of moisture-related problems in Turkish buildings

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Abstract

Turkey provides various distinct climate regions that require special provisions to prevent moisture degradation due to various climatic conditions. Although moisture-related issues appear to be a long-standing source of concern for Turkish people, there is no systematic investigation in the literature. Therefore, this study intends to investigate which aspects of moisture have been addressed by researchers in the literature, to identify research gaps for future research. A systematic review was conducted and 647 published research articles were reviewed. The approaches of reviewed articles were historical structure, material of construction, occupants' health and wellbeing and indoor air quality, respectively. However, local climatic conditions, climatic design approaches in specific provinces and even occupants' the way of usage patterns may all influence the moisture resistance of structures, but more importantly, the health and well-being of their occupants. Further research on climatic design techniques and occupant behaviours is recommended in Turkish buildings, which feature a wide range of climatic conditions, local housing designs, and associatively changeable inhabitant behaviours.

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Keywords: moisture, Turkish buildings, systematic review, moisture-related problems

1. Introduction

Occupant satisfaction with indoor environmental parameters is highly important for occupants and they may have considerable impacts on their health and wellbeing. For example, poor indoor environmental circumstances can negatively affect occupants' physical health through poor air quality, extreme temperatures, excess humidity, or insufficient ventilation and psychological health through inadequate lighting, acoustics, and ergonomic design.

Moisture is one of the critical indoor environment components in buildings. Controlling moisture not only protects occupants' health and well-being, but it also protects the mechanical systems and contents of buildings from physical or chemical damage. Although there are different strategies for protecting buildings from moisture and the prevalence of mould growth, some circumstances may be challenging since several aspects must be taken into account simultaneously. Turkey, as one of the challenging cases, provides three distinct climate regions that require special provisions to prevent moisture degradation due to various climatic conditions [1]. Correspondingly, the income and living conditions survey of Turkey conducted in 2021 by TUIK [2] showed that 34.3% of Turkey's population suffers from inability of heating due to inadequate insulation in their homes, while 33.9% suffer from leaky roofs, damp walls, rotten window frames, etc. Although the percentage of people suffering from these environmental problems decreased since 2010, inability of heating due to isolation and moisture-related problems have remained the most commonly stated problems by Turkish residents (Figure 1).

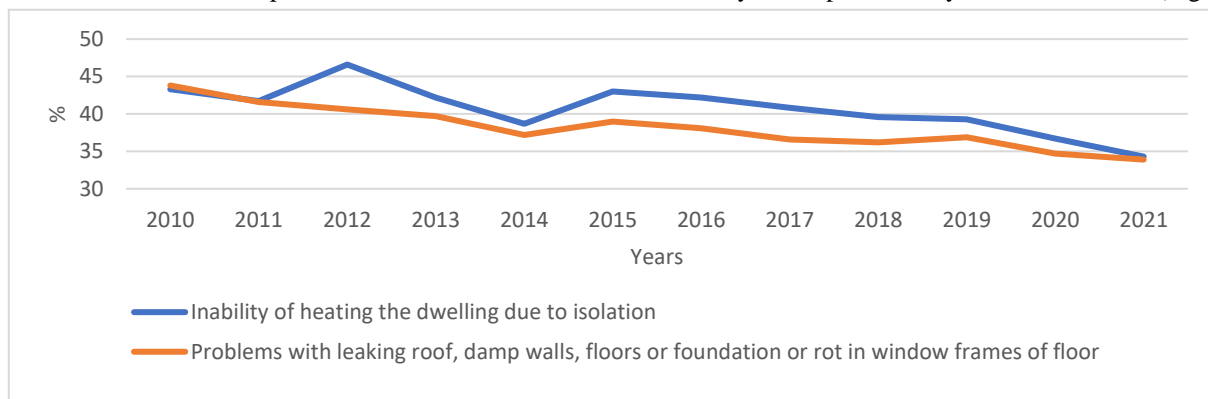


Figure 1. Changes in the percentage of people suffering from heating and moisture related problems in Turkey over time

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Despite the fact that moisture-related issues appear to be a long-standing source of concern for Turkish people, there is no systematic investigation in the literature. Therefore, this study intends to investigate which aspects of moisture have been addressed by other researchers in the literature, in order to identify research gaps for future research.

2. Materials and Methods

In order to investigate components of moisture addressed by other researchers, a systematic review was reported following the PRISMA Checklist. The inclusion criteria were: (a) including at least one aspect of moisture-related problems in the built environment, (b) published in English, peer-reviewed journal articles and reviews excluding conference proceedings and books in any subject area, and (c) published during any year from 1990 to January 2023. The search was done in either title, abstract, or keywords of the papers in Scopus database using the following keywords and Boolean search terms: TITLE-ABS-KEY ((“Turkish” OR “Turkey’s” OR “Anatolian” OR “Turkey”) AND (“building*” OR “construction” OR “home*” OR “house*”)) AND (“moisture” OR “humidity” OR “relative humidity” OR “damp” OR “mould” OR “indoor air quality” OR “condensation” OR “leak” OR “dry”).

In the first stage of the screening phase, the titles and abstracts of the journal articles were reviewed and manually excluded if they did not meet the criteria mentioned above. The second stage was the assessment of the full-text articles for eligibility based on the method outlined in PRISMA. The results of the eligible studies were exported to Mendeley, which identified 647 published research articles. Then the duplicates were removed (n=7). Next, if the title or abstract did not provide appropriate information or meet the selection criteria, they were removed (n=499). These papers were mostly related to poultry, plants and animals. Finally, the exclusion resulted in 158 relevant journal papers that were content-analyzed further.

3. Results and Discussion

A content examination of the relevant publications (Figure 2) showed that the most widely addressed aspect of moisture-related problems in Turkish buildings (47 papers, 30%) by other academics is historical structure. Some of the studies focused on measuring the water absorption of historic building stones to prevent rapid destruction, while others looked into the use of restoration stone with different properties from the original rock, which could lead to differences in solar radiation and moisture absorption. Similarly, several of them focused on restoration strategies for preventing destruction in historic buildings. Some also explored the impact of specific elements of historic buildings, such as external walls and building design, on internal air quality. Following the historical structure, 42 of those papers (27%) were related to material of construction. The majority of them focused on the impact of insulating materials on mold growth, while others aimed to identify the best alternatives for building materials based on user comfort, physical performance, cost and contribution to indoor air quality. A significant number of papers (38) were also related to the health and well-being of occupants (24%). Mold or moisture in the home was identified as a substantial risk factor for certain illnesses such as asthma, allergic rhinitis, eczema, viral infections, wheezing, sleep disordered breathing and

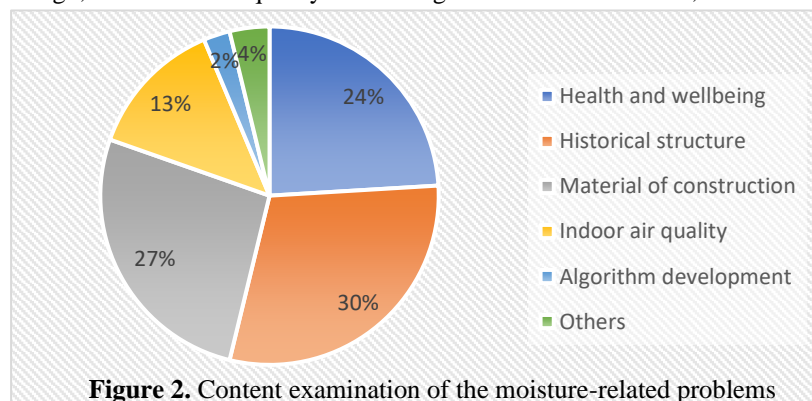


Figure 2. Content examination of the moisture-related problems

Sjogren's syndrome in these investigations. Except for a few exceptions, the subjects of the research were largely children. 21 of those papers (13%) were also related to evaluate the link between moisture conditions and building indoor air quality, with the remaining papers (4%) aiming to design an algorithm to improve HVAC control systems.

4. Conclusion

The purpose of this study was to characterise the features of moisture-related problems in Turkish buildings that have been addressed by other researchers in the literature. Even though all studies focused on the moisture-related problems in the built environment, they all approached the topic differently. Their approaches were historical structure, material of construction, occupants' health and wellbeing and indoor air quality, respectively. However, local climatic conditions, climatic design approaches in specific provinces and even occupants' the way of usage patterns may all influence the moisture resistance of structures, but more importantly, the health and well-being of their occupants. As a result, further



research on climatic design techniques and occupant behaviours is recommended in Turkish buildings, which feature a wide range of climatic conditions, local housing designs, and associatively changeable inhabitant behaviours.

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