

# The Most Common Defects on Housing Surfaces In Northern Cyprus

**Giray Ozay**

Department of Civil Engineering  
Eastern Mediterranean University, Magusa, Via Mersin 10, Turkey  
e-mail: [giray.ozay@emu.edu.tr](mailto:giray.ozay@emu.edu.tr)

**Nazife Ozay**

Department of Architecture  
Eastern Mediterranean University, Magusa, Via Mersin 10, Turkey  
e-mail: [nazife.ozay@emu.edu.tr](mailto:nazife.ozay@emu.edu.tr)

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## **Abstract**

The building sector in developing countries grows rapidly in parallel to the needs of people. From time to time, this high rate of production causes various problems on buildings depending upon conditions of a country. Economical, technological, cultural and environmental factors are the main ones affecting the buildings. Northern Cyprus is also a developing country. After 1974, an urgent housing necessity has occurred there. The building sector had to be reoriented in a relatively short period of time. Today, the housing construction works are going on in parallel to the developments taking place in the economic arena. However, it is possible to observe various defects on houses. The defects are very much related to weaknesses in the design, construction or using processes and affect people's health and comfort. Moreover, they reduce the life of a building, lose the aesthetic value and increase the maintenance expenses. The most widespread building defects observed in Northern Cyprus are: cracks, efflorescence, peeling on painting, rising dampness, corrosion of the reinforcement, etc. These failures are mostly observed on the housing surfaces. The study aims to discuss the said common defects together with their variable reasons. It also intends to present available solutions for preventing or reducing these failures in the design, construction or using stages. On this basis, it will be possible to create aesthetic, healthy, comfortable and long-lasting houses. Furthermore, this situation is seen to have a favorable effect on the country's economy as a whole.

## **1 Introduction**

The changing societies, their cultures, technologies, and living environments have all been effective on the shaping of their architecture. It is not possible to ignore technology, developments, and changing life styles as we live in a continuously changing and dynamic world. So, each country has formed its architecture layer by layer on the basis of its own features and the effects of the world. As from the beginning of the history, housing has been one of the fundamental requirements of all people for their sheltering need. It is possible to say that a house is the main living unit reflecting the general characteristic of a country. In other words, all the changing conditions such as technology, economy, political approaches, climate, life styles and their needs are all reflected directly in the housing design and the policies. If these factors work in a positive way, then the architectural product can be said to have developed positively. Architecture is not only formed by a design but it is also a kind of interdisciplinary and progressive work. Thus, the changing conditions of a country are effective on all of the stages that start with the programming and continue in the design, construction and using stages.

With its rich cultural and architectural background Cyprus is considered to be a significant island. Throughout its history, the island is known to have accommodated many communities and civilizations. The island has had a number of occasions when large settlements had to be built to accommodate its populations. Regarding its strategic position, one can say that Cyprus has had a dynamic political life. Especially, after 1974, (the partition of the island into two) as a result of the movement of the population of the two main communities, an urgent housing necessity started to take place. With the influence of urbanization and as parallel to the developing economy, the building sector began to be reoriented in Northern Cyprus. Today, the housing constructions are rapidly continued in harmony with the increasing populations both in the urban centers and rural areas. The other reason for the increase of the housing construction also in the rural areas is because of the fact that the territory of Northern Cyprus is a small scale country. Under the effects of the said rapid developments, the building construction sector inevitably faces various problems. These are partly related to the economy, climatic factors and partly related to the design faults, construction or using processes. In this study, it is intended to discuss the prevalent defects generally occurring on the housing surfaces. Cracks, efflorescence, peeling on the painting, rising dampness, corrosion of the reinforcement, etc. are some of the most widespread defects observed in Northern Cyprus. These are all seen as visually disturbing; have unfavorable negative effects on human health as well as comfort; reduce the life cycle of the housing units; and ultimately cause a lagging behind in the overall economic performance of the country. Through taking the various precautionary measures concerned, and preventing such problems, better living spaces and housing environments could possibly be achieved.

## **2 General characteristics of the housing and housing events in North Cyprus**

Before beginning to discuss the frequently occurring housing defects, it is appropriate to give some information about the general characteristics of the housing and housing events in Northern Cyprus. The modernization of the architecture in the island started around the 1950s during the British Period. The changing conditions of the world began to be adapted in that period of time. The cultural life and technological developments were reflected in the architecture. The new materials and structural systems such as concrete and reinforced concrete began to be used and practiced [1]. The easy application of the reinforced concrete structure resulted in widespread usage. On the other hand, the traditional systems and local materials started to lose their popularity. Following the British Period, the

Republic of Cyprus was established in 1960. However, it continued until 1963. In 1974, the island was divided into two. The Turkish Cypriots settled in the northern part of the island and the Greek Cypriots in the southern part. In the following years, the problem regarding the housing shortage in the island, showed itself, which caused some reactive activities to take place in the construction sector. The social housing projects were initiated in 1980s, with the Social Housing Unit being formed in 1984. Various types of housing units such as two-storey row houses and apartments were constructed under the control and responsibility of this unit until 1999 [2]. Parallel to these improvements, the mass housing sector began to expand its activities in Northern Cyprus. Today, there are many construction firms which build these types of housing units and make long term time sales. These companies usually build the maximum amount of housing units with restricted budgets. Generally, these houses are preferred by the middle-income groups. In addition to these, there are also private housing constructions that are apartment type or two storey villa type houses. The most common structural system is reinforced concrete skeletal structure. Brick is the common infill material for the skeletal system. The plasterings of these buildings are usually three-coat sand and cement based plaster. Sometimes the third coat can be gypsum. The finishes are mostly done by painting.

Nowadays, the increasing number of the buildings and growth in the construction sector has brought variability in the building material area. In spite of this variability, the practiced structural system is generally similar as discussed above. Only the brands of the building materials differ depending upon their prices and qualities.

In Northern Cyprus, there are building rules and regulations, which have influence on the shaping of the projects. The three major ones that are most effective follow: The first one is the Streets and Buildings Regulations Law - Cap. 96. The second one is the Town and Country Planning Law - 55. The last one is the Law of the Union of the Cyprus Turkish Engineers and Architects. This is related to the control of the services and is known as the Visa Law. According to this procedure, the final project designed according to the mentioned laws should be evaluated by the Union of the Cyprus Turkish Engineers and Architects in the context of their regulations. Besides, the other departments such as municipality, electricity, water, town and country planning offices, etc. are also to evaluate the final project. If a project is approved from these departments, the construction process can start. Following the construction process, there is another control, which is the final one and made by the Municipality or District Governor's Office. If a building has been built according to the rules, the building would then obtain final approval. As mentioned already, there are also controls during the design process as well as at the end of construction. Besides, there is no restriction on the control of the building during its construction stage. However, due to economic reasons some building owners may ignore these controlling tasks. Simply, they don't pay their architects and engineers to control the building during its construction stage. However, this stage is considered to be as important as the design process. Thus, at the end, the owners may face various problems which occurred during construction. At later times, all these would be more likely to create defects on those buildings, which will decrease their economic value.

### **3 Classification of the most common building defects in Northern Cyprus**

The most widespread surface defects of the houses can be classified as follows:

#### **3.1 Soil and foundation related problems**

For a proper footing design, a soil test is deemed necessary. In Northern Cyprus, occasionally footings are so designed without making any soil test and with a lack of information about the characteristics of

the soil. If the soil test is not considered, sometimes, due to the differential settlements, cracking may happen. For instance, clay type soil is a problematic one in which any change in the water content results in volumetric changes in the soil. Especially during the winter time, when it absorbs the water, volume of the soil increases. Sometimes, soil lifts only at the center of the building may take place according to drying out of the edges [3]. This creates cracks on the surface of the building (Figure 1). Crack width increases by rising depth of the building. If the clay soil at the center of the building dries out, the width of the cracks may be decreased by increasing the height of the building. Cracks may also occur at the corner of the building due to local lifting of the soil in this part of the structure.



Figure 1 : Crack on the building surface (left side) and on the plain concrete on the ground (right side).

### 3.2 Formwork and compaction related problems

One of the most common defects in buildings is called honeycombing (Figure 2). It is the concrete in which mortar is not filling the spaces between the coarse aggregate particles. In Northern Cyprus, the use of ready mix concrete has been expanding recently. The reason for this problem is attributed to poorly grade concrete mix at the construction site, insufficient spaces between the bars, insufficient vibration and drainage from the gaps and connections of the timber formworks.



Figure 2: Honeycombing and compaction problems.

Insufficient compaction always creates serious problems (Figure 2). In some of the construction sites vibrators are not even used. Also, errors made at the construction site such as adding improper amounts of water to the concrete mix, are frequently observed. This creates a very permeable concrete, especially in slabs, therefore damped proof course is always necessary.

### 3.3 Corrosion of steel in concrete

Corrosion of steel results in a two to four fold increase of the volume of steel (Figure 3). Hair-line cracks or rust stain is the sign of corrosion. It gradually destroys the bond between concrete and steel and also spoils the concrete cover. Mainly, corrosion is due to chloride contamination, carbonation of concrete and intrinsic cracks and deterioration in service [4]. Water, oxygen and destruction of the passivation layer are necessary for corrosion of the reinforcement in concrete. In order to protect steel from corrosion, the quality of concrete should be increased, permeability of concrete decreased and the concrete cover of reinforcement increased.



Figure 3: Corrosion of steel.

### 3.4 Craze, plastic shrinkage, drying shrinkage, thermal and moisture movement cracks

Craze, plastic shrinkage, drying shrinkage, thermal and moisture movement cracks are commonly observed on cementitious surfaces (Figure 4). The following are common causes of concrete cracking: failure in proper control; carelessness made on to the points of stress concentration (e.g. around openings); excessive cement and water content; inadequate or no curing; temperature rise; and inadequate provisions in the design (e.g. related to thermal movements).



Figure 4: Craze type of cracks.

### 3.5 Rising and penetrating dampness related problems

This originates mostly from the ground or other sources that draw the moisture up through the permeable masonry. Rising dampness is the other factor that creates several problems on housing surfaces. It is effective both on the exterior and interior finishes. It creates staining on the surfaces and

crumbling of the render (Figure 5). Due to rising damp, soluble salts are carried up to the surface layer where the damp evaporates (Figure 6).



Figure 5: Render damage due to rising damp.



Figure 6: Efflorescence due to rising damp

Penetrating dampness also creates very significant problems on concrete surfaces. Depending on the departures from the material specifications (e.g. inadequate cement, excessive water), the penetration of dampness and lack of periodic maintenance, result in deterioration of the concrete surfaces (Figure 7). If deficiency in the workmanship of the brick walls exists, the thickness of the render is increased to have better surfaces. This creates cracks and even sometimes detaches the render.



Figure 7: Deteriorations on the concrete surfaces.

### 3.6 Efflorescence



Figure 8: Efflorescence on the concrete surfaces.

This refers to the white calcium carbonate deposit on the concrete surfaces. During the drying process, permeable concrete continuously leaches the calcium hydroxide to the surface. Its reaction with the carbon dioxide in the air creates the calcium carbonate deposits on the surface [5] (Figure 8). Efflorescence can usually be removed by brushing or washing.



### 3.7 Paintwork related problems

Defects on the paintwork mainly occurs because of the problematic painting surfaces, climatic conditions and painting methods. Periodic maintenance is important. The defects occurring on the paint gradually spread to the other layers of the surface. Therefore, if the problem is not solved at the start, a series of problems continue to happen in consequence causing the maintenance expenses to increase. The most commonly observed defects related to paintwork are: flaking, blistering of the paint, peeling, cracking, brush and other marks and mildew on the paint (Figure 9 & Figure 10). They are due to loss of adhesion between paint film and the surface, presence of moisture on the surface, presence of trapped air, differential movement, application of thick paint coat, un-dried undercoat, poor workmanship, and humidity and temperature that lead to fungal growth.



Figure 9: Blistering on a painted surface.



Figure 10: Fungal growth on a painted surface.

## 4 Conclusion and remarks

The argument discussed above indicates the most commonly observed defects in Northern Cyprus, which occur on the housing surfaces. These are discussed with their general reasons. In this way, some of the precautionary measures against these problems are also given. In addition, the general characteristics of the housing units and the housing events in Northern Cyprus are also discussed. The legislative frame, construction sector, main structural systems and building materials are some of the issues concerned. These have all formed a foundation for the study and give some clues about the reasons for the defects. Through conducting observations and interviews, the most common defects on the housing surfaces have been determined. During this study, it was possible to find various types of housing defects. These have been evaluated and the most widespread ones from among them have been chosen. When they were duly evaluated, the main reason was found to be mostly connected with the lack of a control mechanism during the construction process. The other reasons are generally related to the outcomes of the said reason. As mentioned before, until the beginning of the construction stage the processes of the projects are followed according to the current rules and regulations. However, the rapid and uncontrolled developments in the construction sector have brought together such kind of problems. Owners of the building constructions generally pay no attention to this controlling process due to economic reasons. However, on the contrary, in the following stages they pay more towards repairing the defects occurred. The rate of increase of the mass housing sector in particular has become an influential component of this uncontrolled sector. These kinds of firms have the intention of building the maximum amount of housing units with a restricted budget though also seeking maximum profit. Poor workmanship is therefore part of these speedy construction processes. Sometimes this poor workmanship is as a result of the limited time and lack of qualified workers. It is possible to extend further the reasons for the defects such as: lack of quality of the building material used, environmental effects, lack of the periodic maintenance, etc. Not only do they reduce the quality,

aesthetics and health and safety, but they also increase the maintenance expenses. However, the most significant reason identified is the lack of control mechanisms during the construction process.

According to the arguments above, it is possible to reduce the effects of these defects on the buildings under construction through taking particular precautionary measures. First of all, it is necessary to make the owners more aware of the importance of the controlling system. Unless the project is implemented successfully it does not carry any meaning at all. The legislative restrictions regarding the controlling system can also be added to the existing rules and regulations. By these revisions, the prevention of other consecutive problems could possibly begin. Furthermore, it will be possible to improve the quality of the constructions and the housing environments through avoiding the defects and deteriorations.

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