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# Evaluation of Defects Incidence and Severity on Building Façade: A Case Study

**Hatice Yasemin Cakir[1], Sinem Emanet[2] and Zeynep Melis Oguz[1]**

[1]Department of Architecture, Mimar Sinan Fine Arts University, Istanbul 34427, Turkey, yasemin.cakir@msgsu.edu.tr (First Coauthor), zeynepmelisoguz@gmail.com (Third Coauthor)

[2]Department of Architecture, Istanbul Technical University, Istanbul 34367 Turkey, sinem.emanet@itu.edu.tr (Second Coauthor)

**Abstract.** *20th century buildings are referred to as modern heritage and suggested to be conserved them because they reflect the particular characteristics of the period. To conserve and sustain modern buildings against agents of degradation, such as the inherent quality characteristics, environmental agents, and operational conditions, an important consideration is the observation, from inspection, and documentation of building defects as may reflect the current condition state of the building. In the scope of the study, façade defects of one of the modern period buildings located in the Fatih district of Istanbul/Turkey – the Istanbul Esnaf Hospital was inspected and analyzed. This building was constructed between 1955-1963 with T-shaped plan which consists of eight façades, for which defects, located on six of the building's façades, were evaluated. The aim of the study is the evaluation of defects in relation to: the orientation of the façade; the location defects on the façade; the façade material, that consisted of a rendered and painted façade, incorporating a mosaic of ceramics, and; the perceived causes of defects. The study consists of three stages (i) data collection, (ii) analysis of defects, and (iii) comparative evaluation of defects. In the first stage, environmental, architectural, and material data are presented. After which, defects on the building façade were detected through a field inspection and were systematically classified. In the final stage, the findings from comparative evaluations of defects and their relation to the orientation of the façade, location on the façade, material, and causes are given. The analysis shows that the incidence of defects is primarily related to design decisions, i.e., the architectural features of the building. Dirt/stain and cracking are two of the most observed defects. Stain/dirt defects are mostly observed under windowsills and recessed areas due to architectural features typical of this modern period. Whereas it was observed that cracks were generally locate around openings and balconies. Material loss and detachment were generally related to impact from vehicles and were concentrated on two of the façades having high usage. On the other hand, biological growth, and efflorescence were principally caused by outdoor environmental conditions.*

**Keywords:** *Building Façade; Defect; Incidence; Rendered-Painted; Mosaic Ceramic; Modern Movement.*

## 1 Introduction

Buildings from 20th century are referred to as modern heritage and are recommended to be conserved since they present period's social, cultural, and economic developments, innovative materials, and construction technologies (de Jonge, 2017; Henket, 1998; ICOMOS International Committee on Twentieth Century Heritage, 2017). In the modern buildings, inherent quality characteristics, environment, and operation conditions such as usage of new construction materials and technologies affect building service life, cause defects and even failure of the material/component. (CIB W86, 1993; Donald, 1996; ISO 15686-8:2008, ISO 15686-7:2017). To conserve and sustain these buildings, documentation of the current situation and defects with

their reason is the first step to decide proper maintenance interventions (CIB W60, 1982; ICOMOS, 2017).

In the scope of the study, one of the modern period buildings was constructed between 1955-1963 (Oktay, 1964) from Istanbul, Turkey – the Istanbul Esnaf Hospital was inspected and analyzed considering façade defects. The main objective of the study is to examine the defect incidence and severity of the building façade considering different parameters such as orientation of the façade, location on the façade, finishing material (i.e., rendered-painted and mosaic ceramic), and perceived causes. In this respect, the analysis method of the defects is explained first with brief information about the building and its environmental properties. Then, findings from field inspection are presented and discussed.

# 2 Methodology

This study is based on field inspection and analysis of defects of Istanbul Esnaf Hospital in Istanbul, Turkey which serves as part of Istanbul University Medicine Faculty. Six façades of the building were examined while two of them were excluded due to accessibility problems. The study, to examine defect incidence and severity on façade, consists of three stages (i) data collection, (ii) analysis of defects, and (iii) comparative evaluation defects.

## 2.1 Data Collection

In the data collection stage, (i) environmental, (ii) architectural, and (iii) material information was collected from literature, Directorate of Construction Affairs and Technical Department of Istanbul University, and field observation. Brief information about each of them is given below:

- Environmental data: The building is located in the Fatih district of Istanbul/Turkey and the distance from the sea is 665 m. Istanbul has a temperate climate. The average number of rainy days is 110.7 and average relative humidity is 75%. The predominant wind directions are northeast, north, and southwest, respectively (URL-1, URL-2). The building is located at the intersection of Süleymaniye and Besim Ömerpaşa street, in triangular land (Figure 1-a). The Süleymaniye Street (related to the northwest-NW façade) has a traffic load during the daytime, on the other hand, Besim Ömerpaşa Street (related to northeast-NE and southeast-SE façades) is used mostly by pedestrians. In the south direction, there is a garden on the upper level and a car parking area on the ground level. There is an additional two-storey car parking area in the corner of the land connected to the building with steel structural elements. In the southwest (SW) direction near the Süleymaniye Street, the area between the building and the dining hall of the university is used by service vehicles and it is considered that they cause accidents due to the narrowness of the area.
- Architectural features of the building: Building is one of the examples of modern architecture in terms of the rational order of the façade pattern (i.e., openings, linear balconies, projected slabs and walls, and recessed part of the walls), finishing material (i.e., mosaic ceramic, rendered-painted), and design of spaces. It has a T-shape plan with dimensions of 66 m and 42 m. The building consists of two basement floors, one ground floor, and four typical floors and the total height of the building is 22.26 m (Figure 1-b). The structural system of the building is a reinforced concrete frame system. The longest façade – NW has 1302 $m^2$ area (Istanbul University - Directorate of

Construction Affairs and Technical Department, n.d.).

- Material data: The façade finishing materials (Figure 1-c) are mosaic ceramic and render, and their composition changes according to orientation and location. In the case of NW1, NE1, SW1 mosaic ceramic was used on the two basement floors and ground floor, and render was preferred on the upper floor. While on the other façades mosaic ceramic was also used on recessed areas under the windows and the edges of the building. The surface of the render is rough, mosaic ceramic is colorful and unglazed (BSI 5385-2: 2015). For all façades, mosaic ceramic located on the two basement and ground floors were painted with white color, probably for maintenance reasons. Besides, the main entrance on the ground level of the SE1 façade was covered with marble stone. However, the exact date of these maintenance interventions is unknown.


**Figure 1: a)** Close surrounding (straight lines represent examined façades and they have numbered according to its orientation and repetition) (URL-3), **b)** Views of the façade (Authors, n.d.); NW1, SE1 and NE2, **c)** Façade finishing materials (Authors, n.d.); colorful mosaic ceramic, mosaic ceramic-painted, and rendered-painted.

## 2.2 Analysis of Defects

In the second stage, defects on the façades are detected and then analyzed systematically to understand defect severity and incidence considering orientation of the façade, location on the façade, finishing material, and perceived causes. Through the aim of the study, this stage consists of three steps (i) field inspection, (ii) identification of the defects, and (iii) detailed classification of the defects. In the scope of the study, six façades of the building were analyzed (Figure 1-a) while two of them were excluded due to accessibility problems, as aforementioned. Besides, small interventions were included to the study on the contrary total material change (marble cladding) was excluded.

### *2.2.1 Field inspection*

The building was visited between October and December of 2022 on sunny days and after rainy days. During site visits, visual observation was made with the naked eye and binoculars. A photographic record (general and detailed) was made for the six façades, and defects were marked on the hard copy of the elevation drawings.

### *2.2.2 Identification of the defects*

Defects were classified basically according to their orientation, material, and main type, in line with the literature review. Six façades of the building were named according to their orientation

as shown in Figure 1-a. Materials of the building are rendered-painted (R) and mosaic ceramic (C), while in the further step mosaic ceramic is evaluated separately according to the presence of painting (Ana Silva et al., 2016; BS 5385-2:2015). Identified defects were classified into six main types (i) dirt/stain – ST, (ii) cracking – CR, (iii) biological growth – BG, (iv) efflorescence – EF, (v) detachment – DT, (vi) material loss – MT (Ertemir & Edis, 2022; Pereira et al., 2020; Ana Silva et al., 2016; J D Silvestre & de Brito, 2011)

Through these decisions, each detected defect was marked on the elevation drawings with different colors as shown in Figure 2 (Bauer & Souza, 2022). Codes were given according to the orientation of façade, finishing material, and main type of defect (i.e., NW1_C_ST means stain on ceramic cladding on the north-west façade).


**Figure 2:** a) Part of the NW1 façade (Authors, n.d.), b) Defects marked on the NW1 façade (drawing taken from Istanbul University - Construction and Technical Department and adapted by authors), c) Main type of defects legend.

### *2.2.3 Detailed classification of the defects*

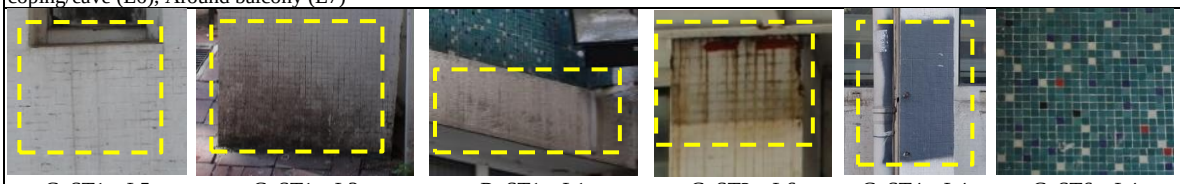
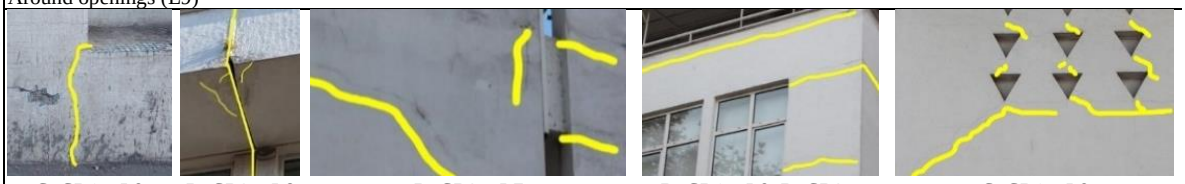
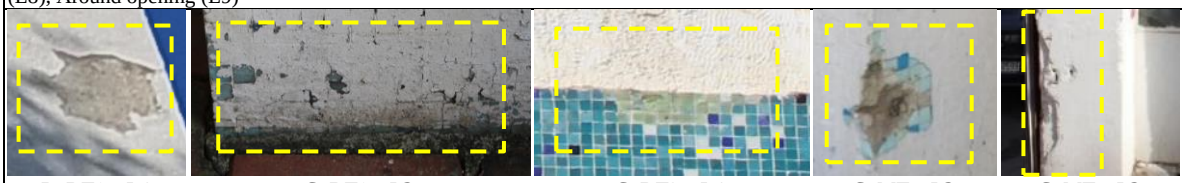
To analyze defects systematically, classification was detailed benefiting from the literature review (Ertemir & Edis, 2022; Flores-Colen et al., 2008; Pereira et al., 2020; J D Silvestre & de Brito, 2011; José Dinis Silvestre & de Brito, 2009; ISO 4628-2, 4, 5:2016). The main types of defects were divided into subtypes for both materials (i.e., rendered-painted and mosaic ceramic-painted or not) separately as given in Table 1.

Decisions on the classification of subtypes of defects are explained below:

- CR, BG, and EF on rendered-painted façade and also BG on mosaic ceramic were divided into subtypes according to their severity.
- Severity of DT on rendered-painted façade and CR and EF on mosaic ceramic cladding were classified according to layers of the cladding as paint, render, outer layer (ceramic tile and joint), and system (outer layer and mortar).
- In the case of ST on both materials, the severity was not taken into consideration.

Subtype categories were collected from literature and the ones that shown in light grey were not observed in the case building. Classification was further developed in terms of defect location on the façade. Location classification collected from the literature (Bauer & Souza, 2022; Dias et al., 2021; Gaspar & de Brito, 2005; A Silva et al., 2013) was detailed considering the case building façade properties. It should be noted that this classification system was made for the case building and can be increased/changed in different studies. Finally, the causes of the defects were classified considering the agent/factors (i) quality of component and design level – C1, (ii) work execution level – C2, (iii) outdoor environment – C3, (iv) usage conditions and maintenance level – C4 (ISO 15686-8:2008, ISO 15686-7:2017).

**Table 1:** Main/subtype defects, their location on the façade and reference images.

| | |
|---|---|
| **Stain (ST)** | **Defects on R:** Uniform/non-uniform dirt (R_ST1), Ghost like stains (R_ST2), Stain due to corrosion (R_ST3), Color change (R_ST4), Undesired paint (R_ST5), Bird droppings (R_ST6). **Defects on C:** Uniform/non-uniform dirt (C_ST1), Stain due to corrosion/rust (C_ST2), Color change (C_ST3), Undesired paint (C_ST4), Bird droppings (C_ST5), Wear or scratches (C_ST6). **Locations:** On the projected area (L1), Recessed area (L2), At/near ground level (L3), On continuous wall (L4), Under windowsill (L5), Under/around coping/eave (L6), Around balcony (L7) |
| |  <br>C_ST1 – L5 C_ST1 – L3 R_ST1 – L1 C_ST2 – L6 C_ST4 – L4 C_ST6 – L4 |
| **Cracking (CR)** | **Defects on R:** Cracking on paint (R_CR1), Cracking on render (R_CR2), Cracking and detachment in paint (R_CR3), Cracking and detachment in render (R_CR4). **Defects on C:** Cracking on paint (C_CR1), Cracking and detachment in paint (C_CR2), Cracking on outer layer (C_CR3), Cracking and detachment of outer layer (C_CR4), Cracking and detachment of system (C_CR5). **Locations:** On the projected area (L1), On continuous wall (L4), Under/around coping/eave (L6), Around balcony (L7), On/near structural system (L8), Around openings (L9) |
| |  <br>C_CR1 – L9 R_CR2 – L8 R_CR2 – L7 R_CR1 – L9, R_CR2 – L8/L6 C_CR1 – L9 |
| **Biological Growth (BG)** | **Defects on R:** Fungi/mold (R_BG1), Algae growth (R_BG2), Vegetation (R_BG3). **Defects on C:** Fungi/mold (C_BG1), Algae growth (C_BG2), Vegetation (C_BG3). **Locations:** At/near ground level (L3), Under/around coping/eave (L6), Around balcony (L7) |
| |  <br>C_BG1 (left side), R_BG1 (right side) – L3 C_BG2 – L6 C_BG3 – L3 |
| **Efflorescence (EF)** | **Defects on R:** Color change (R_EF1), Blistering (R_EF2), Spalling - in small pieces (R_EF3), Blistering and crack (R_EF4), Flaking in large pieces (R_EF5). **Defects on C:** Color change (C_EF1), Blistering of paint (C_EF2), Flaking of paint (C_EF3), Efflorescence of outer layer (C_EF4), Efflorescence of system (C_EF5). **Locations:** On the projected area (L1), On continuous wall (L4), Under/around coping/eave (L6), Around balcony (L7), Around opening (L9) |
| |  <br>R_EF1 – L4 R_EF2 – L7 R_EF3 – L7 R_EF4 – L1 R_EF5 – L7 |
| **Detach. (DT) and M. Loss(MT)** | **Defects on R:** Detachment of paint (R_DT1), Detachment of render (R_DT2), Material Loss (R_MT). **Defects on C:** Detachment of paint (C_DT1), Detachment of outer layer (C_DT2), Detachment of system (C_DT3), Material Loss (C_MT). **Locations:** On the projected area (L1), At/near ground level (L3), On continuous wall (L4), Under/around coping/eave (L6), On/near structural system (L8), Around opening (L9) |
| |  <br>R_DT1 – L4 C_DT1 – L3 C_DT2 – L4 C_MT – L3 C_MT – L3 |
| Reference of photographs: (Authors, n.d.). Defects that are not inspected on the façade of the case building are shown in light gray. | |

### 2.3 Comparative Evaluation of Defects

The defects on each façade were listed together with their orientation, material, location on the façade, main/subtype, and cause in a spreadsheet program. The incidence method was used for the quantification of defects (Souza et al., 2018). In the presence of defects, it was quantified only once, even if it extended more than one floor or even was located around a different window. In other words, in the case of changing one of the parameters (orientations, materials, locations on the façade, main/subtypes, and causes) it was counted as a different defect.

## 3 Findings and Discussion

The observed main/subtypes of the defect incidence on both materials (i.e., rendered-painted, mosaic ceramic) is given in Table 2. To make a more accurate assessment, mosaic ceramic material is examined under two groups in terms of being painted.

Considering main types, ST (43/122) has the highest incidence and is seen as uniform/non-uniform dirt generally. In the second line, CR (32/122) is the second most observed defect as CR on render. Although lower than others, DT (20/122) is third in line and generally observed as DT of paint on the painted mosaic ceramic. Main/subtype of the defects are explained in terms of (i) orientation of façade, (ii) location on the façades, (iii) finishing material, and (iv) perceived causes, in the following:

- Orientation of the façade: SW1 (26/122) façade is the most degraded one, then follows by NW1 (24/122), NE1 (23/122). On the other hand, SE2 (7/122) has the lowest degradation incidence. ST (43/122) is mostly seen on the SW1 (10/43) and NW1 (8/43) façades in different subtypes. CR (32/122) is generally seen on the NE1 (8/32) and NW1 (6/32) façades. SW1 façade is near the dining hall and exposed to heavy vehicle and pedestrian traffic thus, it causes DT defects. NW1 and NE1 façades are located on the predominant wind direction, and they are quite open to the soluble salts which causes mostly EF defects. BG is almost located all façade at/near ground level; thus, the meaningful relationship could not be obtained with the orientation.
- Location on the façade: Locations related to the openings i.e., around openings and under windowsill have the highest incidence (L9, L5 – 13+9/122). It is followed by under/around coping/eave (L6 – 21/122) and at/near ground level (L3 – 18/122). Recessed areas have the lowest incidence of the defect (L2 – 9/122). ST (43/122) is generally seen under windowsill and recessed area with the same incidence (L2, L5 – 9/43) since water leakage and window/door frames located inside from the façade, respectively. The inferences are also consistent with the study of Gaspar & de Brito (2005), it is highlighted that poor detail of windowsill causes water leakage and in turn ST under windowsill. CR (32/122) is observed principally around opening (L9 – 9/32) due to the façade design and on/near structural system (L8 – 8/32) since their slender dimensions. Most of the BG (9/122) is observed at/near ground level (L3 – 7/9) as vegetation (C_BG3) related to rainwater accumulation at the junction of the floor and the wall and rising ground moisture. Almost all types of EF (15/122) are mostly located around balcony (L7 – 6/15) especially around waterpipes and under/around coping/eave (L6 – 5/15) on NW1 and NE1 façades. DT (20/122) is observed on at/near ground level and on continuous wall with the same incidence (L3, L4 – 5/20) related to traffic load and the rainwater splash from the ground. A meaningful relationship could not be obtained between MT and location.

**Table 2:** Incidence of the main/subtype of defects according to orientation, location on the façade, material, and cause.

| Main/sub type of defects | Orientation of Façade | | | | | | Location on Façades | | | | | | | | | Causes | | | | TOTAL[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NW1 | NE1 | NE2 | SE1 | SE2 | SW1 | L1 | L2 | L3 | L4 | L5 | L6 | L7 | L8 | L9 | C1 | C2 | C3 | C4 | |
| R_ST1 | 2 | 1 | 5 | 4 | 1 | 2 | 2 | 4 | - | 1 | 4 | 3 | 1 | - | - | 7 | - | 2 | 6 | **15** |
| R_ST4 | 1 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | 1 | - | **1** |
| **R_ST** | **3** | **1** | **5** | **4** | **1** | **2** | **2** | **4** | **-** | **1** | **4** | **3** | **2** | **-** | **-** | **7** | **-** | **3** | **6** | **16** |
| R_CR1 | 1 | - | 1 | 1 | 2 | 2 | - | - | - | - | - | 1 | 2 | 1 | 3 | 1 | - | 2 | 4 | **7** |
| R_CR2 | 1 | 6 | 3 | 3 | - | - | - | - | - | 1 | - | 5 | 2 | 3 | 2 | 9 | - | 2 | 2 | **13** |
| R_CR3 | 1 | - | 1 | - | 1 | 1 | 1 | - | - | 1 | - | 1 | - | 1 | - | - | - | 1 | 3 | **4** |
| R_CR4 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - | **1** |
| **R_CR** | **4** | **6** | **5** | **4** | **3** | **3** | **1** | **-** | **-** | **2** | **-** | **7** | **4** | **6** | **5** | **11** | **-** | **5** | **9** | **25** |
| R_BG1 | - | - | 1 | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | 1 | **1** |
| R_BG3 | 1 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - | **1** |
| **R_BG** | **1** | **-** | **1** | **-** | **-** | **-** | **-** | **-** | **1** | **-** | **-** | **-** | **1** | **-** | **-** | **1** | **-** | **-** | **1** | **2** |
| R_EF1 | - | 2 | - | - | - | 1 | - | - | - | 1 | - | 1 | 1 | - | - | - | - | 3 | - | **3** |
| R_EF3 | 1 | 1 | - | - | - | - | - | - | - | - | - | 1 | 1 | - | - | - | - | 2 | - | **2** |
| R_EF4 | 1 | 2 | - | 1 | 1 | 1 | 2 | - | - | - | - | 1 | 3 | - | - | 1 | - | 2 | 3 | **6** |
| R_EF5 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | 2 | 1 | - | 1 | 1 | - | - | 3 | **4** |
| **R_EF** | **4** | **6** | **1** | **2** | **1** | **2** | **2** | **-** | **-** | **1** | **-** | **5** | **6** | **-** | **1** | **2** | **-** | **7** | **6** | **15** |
| R_DT1 | 1 | - | 1 | 2 | - | 3 | - | - | - | 2 | - | 1 | - | 1 | 3 | 2 | - | 2 | 3 | **7** |
| R_DT2 | - | - | 1 | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | 1 | **1** |
| **R_DT** | **1** | **-** | **2** | **2** | **-** | **3** | **-** | **-** | **-** | **3** | **-** | **1** | **-** | **1** | **3** | **2** | **-** | **2** | **4** | **8** |
| **R_MT** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **-** |
| **R_TOTAL[2]** | **12** | **13** | **14** | **12** | **5** | **10** | **5** | **4** | **1** | **7** | **4** | **16** | **13** | **7** | **9** | **23** | **-** | **17** | **26** | **66** |
| C_ST1 | 3/- | 3/- | 1/1 | 2/1 | -/- | 3/- | 1/- | 2/- | 4/- | -/- | 3/2 | 2/- | -/- | -/- | -/- | 4/2 | -/- | 5/- | 3/- | **12/2** |
| C_ST2 | 1/- | 1/- | -/- | 1/- | -/- | 2/- | -/- | 1/- | 1/- | 2/- | -/- | 1/- | -/- | -/- | -/- | 2/- | -/- | -/- | 3/- | **5/-** |
| C_ST4 | 1/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | 1/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | 1/- | **1/-** |
| C_ST6 | -/- | -/1 | -/1 | -/1 | -/1 | 2/1 | 1/- | -/2 | -/- | 1/3 | -/- | -/- | -/- | -/- | -/- | 1/4 | -/- | -/- | 1/1 | **2/5** |
| **C_ST** | **5/-** | **4/1** | **1/2** | **3/2** | **-/1** | **7/1** | **2/-** | **3/2** | **5/-** | **4/3** | **3/2** | **3/-** | **-/-** | **-/-** | **-/-** | **7/6** | **-/-** | **5/-** | **8/1** | **20/7** |
| C_CR1 | 1/- | 1/- | 1/- | 1/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | 4/- | 3/- | -/- | 1/- | -/- | **4/-** |
| C_CR2 | 1/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | 1/- | -/- | -/- | -/- | 1/- | -/- | **1/-** |
| C_CR3 | -/- | -/1 | -/- | 1/- | -/- | -/- | -/- | -/- | -/- | -/1 | -/- | -/- | -/- | 1/- | -/- | 1/1 | -/- | -/- | -/- | **1/1** |
| **C_CR** | **2/-** | **1/1** | **1/-** | **2/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/1** | **-/-** | **-/-** | **-/-** | **2/-** | **4/-** | **4/1** | **-/-** | **2/-** | **-/-** | **6/1** |
| C_BG1 | 1/- | -/- | 1/- | -/- | -/- | -/- | -/- | -/- | 2/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | 2/- | -/- | **2/-** |
| C_BG2 | -/- | -/- | -/- | -/- | -/- | 1/- | -/- | -/- | -/- | -/- | -/- | 1/- | -/- | -/- | -/- | -/- | -/- | -/- | 1/- | **1/-** |
| C_BG3 | 1/- | 1/- | -/- | 1/- | -/- | 1/- | -/- | -/- | 4/- | -/- | -/- | -/- | -/- | -/- | -/- | 1/- | -/- | 3/- | -/- | **4/-** |
| **C_BG** | **2/-** | **1/-** | **1/-** | **1/-** | **-/-** | **2/-** | **-/-** | **-/-** | **6/-** | **-/-** | **-/-** | **1/-** | **-/-** | **-/-** | **-/-** | **1/-** | **-/-** | **5/-** | **1/-** | **7/-** |
| **C_EF** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** | **-/-** |
| C_DT1 | 1/- | 1/- | 1/- | 1/- | -/- | 2/- | -/- | -/- | 5/- | -/- | -/- | -/- | -/- | 1/- | -/- | -/- | -/- | 1/- | 5/- | **6/-** |
| C_DT2 | -/- | 1/- | -/- | -/- | -/1 | 3/- | 1/1 | -/- | -/- | 1/- | -/- | 1/- | -/- | 1/- | -/- | 1/1 | -/- | -/- | 3/- | **4/1** |
| C_DT3 | -/- | -/- | -/- | 1/- | -/- | -/- | -/- | -/- | -/- | 1/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | -/- | 1/- | **1/-** |
| **C_DT** | **1/-** | **2/-** | **1/-** | **2/-** | **-/1** | **5/-** | **1/1** | **-/-** | **5/-** | **2/-** | **-/-** | **1/-** | **-/-** | **2/-** | **-/-** | **1/1** | **-/-** | **1/-** | **9/-** | **11/1** |
| **C_MT** | **2/-** | **-/-** | **-/-** | **-/-** | **-/-** | **1/-** | **1/-** | **-/-** | **1/-** | **-/-** | **-/-** | **-/-** | **-/-** | **1/-** | **-/-** | **-/-** | **-/-** | **2/-** | **1/-** | **3/-** |
| **C_TOTAL[2]** | **12/-** | **8/2** | **4/2** | **8/2** | **-/2** | **15/1** | **4/1** | **3/2** | **17/-** | **6/4** | **3/2** | **5/-** | **-/-** | **5/-** | **4/-** | **13/8** | **-/-** | **15/-** | **19/1** | **47/9** |
| **TOTAL[3]** | **24** | **23** | **20** | **22** | **7** | **26** | **10** | **9** | **18** | **17** | **9** | **21** | **13** | **12** | **13** | **44** | **-/-** | **32** | **46** | **122** |

Main/subtype of defects and location codes are given in Table 1. Causes codes are given in the last paragraph of the section 2.2.3. Incidence related about mosaic ceramic (C) refers "mosaic ceramic-painted" and "mosaic ceramic", respectively. TOTAL[1] means total number of the sub defects. R_TOTAL[2] and C_TOTAL[2] mean total number of defects on each material. TOTAL[3] means total number of the defects.

- Finishing material: Since the rendered-painted is used at a high rate on the façade, the render has the highest incidence of the defect (66/122), mosaic ceramic-painted (47/122) is the second in line, and mosaic ceramic (9/122) is the third in line. ST (43/122) is mostly seen on the painted mosaic ceramic (20/43) as uniform/non-uniform dirt (C_ST1). CR (32/122) is generally observed in the render (25/32) as cracking on render (R_CR) principally. It is considered that the painting layer on the mosaic ceramic might be acting as a protective or preventive layer. Most of the BG (9/122) is located on the painted mosaic ceramic (7/9) as vegetation (C_BG3). EF (15/122) is observed on rendered-painted surfaces (15/15) on the upper floors. DT (20/122) is mostly observed

on the painted mosaic ceramic (11/20) as DT of paint (C_DT1) which are directly open to the impact of the vehicles and pedestrians on the basement and ground floors. MT (3/122) is only observed on the painted mosaic ceramic (3/3).

- Causes: Usage condition/maintenance (C4 – 46/122) and quality of component/design level (C1 – 44/122) are two of the main causes of the defects and rest of them (32/122) are caused by the outdoor environment – C3. On the other hand, the association between work execution level and defects could not be obtained as a result of lack of archival materials about the construction period. Considering the construction year of the building (1955-1963) some maintenance and repairing had been made on the façade through the years which caused some defects (DT, ST and EF). ST (43/122) and CR (32/122) are resulted from the quality of component and design level (20/43, 16/32, respectively), mainly related to modern characteristics of the building and the presence of many windows. As in this study, Ertemir & Edis (2022) also mentioned that characteristics features (i.e., projected element) of the modern movement buildings causes defects. BG (9/122) and EF (15/122) are essentially related to the outdoor environmental conditions (C3 – 7/15) such as wind, rainwater, etc. Although it is very rare, the MT (3/122) is also caused by outdoor environmental factors i.e. vehicle and pedestrian traffic load.

## 4 Concluding Remarks

In this study, the defects on the six façades of the Istanbul Esnaf Hospital were determined by visual observation. The defects were evaluated in terms of incidence and severity level.

Based on the findings, ST is the dominant defect on the painted mosaic ceramic, under windowsill, and recessed area essentially due to poor detail design and water leakage. CR is the second most observed defect, and it is mainly located on rendered parts around the openings and balconies (under copings and parapet walls). The reasons are the design decisions about façade characteristics (i.e., the presence of many windows), and slender structural elements. BG is mostly observed at/near ground level due to rainwater accumulation and rising ground moisture. On the other hand, EF is located on upper floors of the building i.e., around balcony and under/around coping/eave and especially on the façades (NE1 and NW1) which have waterpipes and are located on predominant wind direction. DT and MT are principally detected on the façades (NW1 and SW1) which are open to impact caused by vehicle and human traffic. The quality of the component/design level and usage condition/maintenance are two of the critical causes of the defects related with the modern characteristic of the building. On the other hand, outdoor environment is more effective on the BG and EF than the other causes.

In further studies, the severity of the defects might be examined in detail considering area of the defect (i.e., intensity). The findings of the study might be useful for preparing maintenance plan to conserve and extend the service life of the building.

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**ORCID**

Hatice Yasemin Çakır: https://orcid.org/0000-0001-8354-1459
Sinem Emanet: https://orcid.org/0000-0003-4463-6759

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