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Environmental Deterioration Factors in Metal Claddings and GFRC Panels Implemented on Facades: An Assessment through Two Cases in Istanbul

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1 Introduction

Performance of a building deteriorates in time depending on environmental effects, usage, maintenance, detail design, and type of materials which are used in building envelope. Defining the probable causes of deteriorations is important to propose appropriate solutions. Environmental agents are divided into natural (wind, rain, freeze and throw, and solar radiation), and chemical and biological problems, issued by air pollution (Norvaišienė *et al*., 2003). This paper investigates environmental agents which can affect performance of façade. Mechanisms are generally examined in three categories: physical, chemical, and biological (Dickinson *et al*., 1999).

This study examines environmental agents especially on facades through two case buildings where are located in Istanbul. Istanbul has mild-humid climatic characteristics. The dominant wind direction in the district is North – North East.

In this research, there is an approach from macro to micro scale, which begins with defining the surrounding of the buildings and continues with the building facade components. The methodological framework of the study is based on visual observations and literature review. Firstly, façade deterioration factors have been defined in detail through literature. For the field observation, two data sheets have been prepared. The first datasheet contains the general information such as age and primary use of the building and construction process. The second datasheet involves atmospheric exposures such as wind, rain, sun which affects the building façades, climate data in the observation days, deterioration/anomaly types. After collecting data, anomalies on building façade have been detected and shown in façade mapping. Afterward, probable causes of these anomalies have been determined via literature review and visual observations.

The first case building facade mainly has six components. These are; 4 mm thickness white colored aluminum composite panel, siliconized glass system with an aluminum frame, structural steel columns, natural stone cladding, silver-gray colored aluminum mesh cladding and white colored aluminum dynamic vertical and fixed horizontal shading elements. In the

case, it has been focused on metal claddings since metal has the most deterioration in comparison with other materials on the selected building façade. Deteriorations are classified into five categories. These are; uniform dirt, corrosion, joints degradation, mechanical impact, and delamination. Uniform dirt has been mostly seen on the aluminum composite panels and shading elements. Especially the North and East facade are the dirtiest facades of the building. Two structural columns on the West façade of the building have been deteriorated by corrosion effect. The waterhole has been observed below the feet of the column after the rain. Joints degradations have been detected on the North façade, which has covered with aluminum mesh cladding. This deterioration may be the consequence of stiff breeze coming from the North and North-East direction. A mechanical impact has been detected on the North façade overhang, which is covered with aluminum composite panels. Delamination is seen on the North and East overhangs. Probable cause is thought to be the storm water runoff with the wind which is coming from the dominant direction.

Materials that have been used on façade for the second case building are (most to least); glass fibre reinforced concrete (GFRC), clinker-based facade panels, and aluminum. In the second case, it has been focused on GFRC since it has the most deterioration in comparison with other materials on the selected building façade. According to the observations, anomalies detected on the selected building facades are classified into three categories. These are; biological staining, moisture rising, and joints degradation. The building is exposures to the prevailing wind, which changes the direction of raindrops. As the most deteriorated part of the façade is the N/E, lack of sunlight slowdowns the procedure of drying after it had been wetted and results as biological staining. As N/E façade is directly in contact with ground and grasses, continues dampness, mage the façade stained. As a result, mould growth appeared. Also, panel joints and sealants on a façade provide for drainage of run-off on the facade. Joints affect runoff can locally rinse away deposited dirt stains at areas where a file of vertical joints is broken and where joints are slanted.

In this study, field observation has been done for two case buildings, and probable causes on façade deteriorations have been examined with the help of literature. The district of both cases has air pollution due to high urbanization and heavy traffic intensity. Especially in the first case, some deteriorations have been observed after only three years of usage on the North, East, and West façades which are close to the main road and the viaduct. This paper helps to understand the expected behavior of GFRC panels and metal claddings for Istanbul province and similar climatic conditions. More data and laboratory analysis is required for this method to produce more reliable façade degradation mapping.

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