Chapter 9

Façade Failures, Diagnostics, and Retrofitting Strategies:
Targeted Approaches for Sustainable and Extended Service Life

Arkar Htet
http://orcid.org/0000-0003-1301-3604
Lincoln University College, Malaysia

Theingi Aung
http://orcid.org/0009-0003-5063-575X
Lincoln University College, Malayisa

Nay Win
Mullion Facade Engineering School, Myanmar

Moe Min Min
Mullion Facade Engineering School, Myanmar

ABSTRACT

Façade deterioration affects energy performance, durability, comfort, and long-term building value. This chapter examines four recurring failure mechanisms-thermal bridging, sealant degradation, structural fatigue, and water ingress and explains how they develop through the interaction of exposure, detailing, material aging, and maintenance conditions. It reviews three practical diagnostic approaches: infrared thermography, drone-assisted visual inspection, and selective material sampling,

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and proposes a staged workflow linking anomaly detection with technical confirmation. Building on this base, the chapter evaluates targeted retrofit strategies, including sealant rehabilitation, partial cladding replacement, thermal upgrades, and localized structural repair. Climate-responsive application is also considered to distinguish priorities in humid and temperate contexts. The chapter argues that sustainable façade renewal should be evidence-based, proportional, and lifecycle-oriented, extending service life while reducing waste, disruption, and unnecessary replacement.

1. INTRODUCTION

1.1 Role of Façades in Building Performance

Façades do more than enclose buildings. In contemporary construction, they must respond simultaneously to environmental, structural, operational, and architectural demands. Attia et al. (2018) note that façade systems have evolved from simple outer skins into performance-oriented assemblies, while Xu et al. (2021) show that their effectiveness depends on the interaction of glazing, insulation, cladding, joints, supports, and drainage rather than on any single component.

From a building-performance perspective, façades influence heat transfer, air leakage, moisture control, daylight, acoustics, and solar modulation. These effects shape indoor comfort, energy use, and maintenance demand. Wang et al. (2018) show that façade design choices can materially influence operational energy performance, especially in buildings with glazed or shaded envelope systems. A façade is therefore both a barrier and a long-term performance asset.

Façades also serve a protective and structural role. They must resist wind pressure, accommodate movement, and maintain functional integrity under environmental stress. Oesterle et al. (2014) describe façade engineering as the integration of architectural intent, material behavior, structural response, and environmental performance. This perspective is important because façade failure rarely results from a single defect; more often, it reflects the interaction of detailing, exposure, construction quality, and maintenance history.

Because façades affect durability, lifecycle cost, and sustainability, they should not be treated as superficial architectural features. They require a long-term management perspective rather than a purely reactive one. This view also aligns with emerging lifecycle and service-oriented approaches to building-envelope management (Aguerre et al., 2022).

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