Envelopes: Structures at the boundary

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Summary

New technological boundaries have brought about a new envelope design paradigm. Modern digital tools and fabrication techniques are making possible more complex shapes and larger scales. In response, the structural engineering has to evolve into façade engineering, a new and distinct field.

Keywords: Geometry; Digital design; Large span structures; Geometrically complex, large scale envelopes; Façade engineering.

1. Introduction

The independence of the building envelope from the main structure brought about by the international movement promoted by Le Corbusier has been evolving along the 20th Century associated to a progressive increase of both geometrical complexity and scale. The building envelopes gradually changed from being part of the main load-resistant frame to non-load resistant infill elements first and then to self-supporting structures detached from the main frame and often with a non-negligible structural significance of its own. This process brought about a parallel evolution in the role of the engineer, from main responsible for the overall concept and design to a role subsidiary to that of the architect –who became often the almost only responsible for the envelope design as it often embody a significant proportion of the architectural expression of the building. The development of increasingly complex and structurally challenging envelopes, as mentioned above, is bringing again to the forefront the role of the engineer, now in its new incarnation as façade engineer.

Over the second half of the 20th Century, and especially during its last decades and the beginning of the current Century, the performance requirements imposed on the envelopes have grown increasingly demanding while at the same time the development of sophisticated digital tools has allowed the architects to take their geometrical definition beyond the boundaries of the conventional building typologies.

Traditional forms of vertical buildings are radically changing in the last decades. This is due to a renovated cultural context, new technological boundaries, innovative digital tools and industrial building components. Those factors give a new freedom to designer, who is spurred to experiment more complex shapes, using materials and construction systems according to completely unusual methods. Therefore contemporary architectural envelopes appear more complex not only in their morphology but also in their constructive configurations, raising new technological requirements.

In this context a new engineering discipline appeared –what has commonly been named “façade engineering”. The façade engineers are given the task of applying well established civil and building engineering concepts to complex systems of a smaller scale and a different nature of those for which the aforementioned concepts where created.

This document endeavours to shed light on the particular characteristics of what we will describe as a new integrated concept of building envelope design and the challenges it poses for the engineers

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