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Technics and Architecture

The Development of Materials and Systems for Building

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Introduction

The architecture of the Industrial Revolution, from the middle years of the eighteenth century to the last of the nineteenth, is best identified as Romantic. A variety of terms have been coined to mark subdivisions of this period's stylistic attitudes, using the term "Revival" in some cases and the prefix "Neo-" in others, but always adding the designation of a previous style of architecture. (Art Nouveau, at the very end of the nineteenth century, is perhaps the sole exception to this tendency.) From the start of the Renaissance to World War II, the dominant stylistic theme in architecture was a reliance on the past, the extent of historical accuracy varying according to the patronage, physical requirements, and architectural talent under which a project was executed. Until the middle of the eighteenth century, European designers, both Renaissance and Baroque, adapted ancient motifs with considerable freedom, and their styles themselves later became models for the eclecticism of the nineteenth century. Each of the Romantic movements—revisitations of the Greek, Roman, Romanesque, Gothic, and even more exotic styles—responded to current ideals. Newly established representative governments (for the Industrial Revolution was also a period of political revolution and theorizing) echoed the forms of Greece and Rome in their buildings; and religious groups, according to their outlooks, chose between the perceived rationality of classical styles and the emotionalism of Gothic.

The concurrence of the Industrial Revolution and Romanticism is understandable if one accepts the historical realities. The innovations of industrialization, so stunningly compressed and dramatized in history books, were slow to be accepted and operated throughout any industry or any coun-

try. During his lifetime the average citizen of the western world in the eighteenth and nineteenth centuries had contact with only a few significant technological advances, and these were accepted as merely sensible solutions to practical problems, not part of a juggernaut of industrial development. For instance in 1880, some four generations after the first steamboat, about three-quarters of the world's shipping capacity was still under sail. Many of the innovations that proved to be most influential were at first viewed as curious experiments, having questionable value under realistic conditions.

The reality of Romanticism is similar in that it was to some extent a part of the literature, painting, music, and architecture of all periods, and its dominance during much of the eighteenth and nineteenth centuries developed gradually in the company of considerable social and political change. While classicism had espoused the cause of simplicity and the evolution of acceptable forms of expression, Romanticism encouraged individualism, imagination, and emotion, accepting even fear and morbidity as beneficial experiences. Such preferences fostered an appreciation of variety and change, and the drama of invention was to the Romantic often more attractive than its results.

Our histories of architecture correctly stress the importance of milestone buildings that were far in advance of the normal course of design and construction; reading them, one might almost be persuaded that the innovations of Louis Sullivan or H. P. Berlage were quickly, enthusiastically, and widely accepted as models by the architectural profession and its clients. In truth, new ideas such as these prospered among narrow ranges of patronage and professional practice. The rate at which technolog-

ical advances were adopted was far more rapid for factories, office buildings, department stores, and other types of buildings that were blessedly free of professional or public preconceptions about architectural style than it was for the more traditional types of buildings. Later in the twentieth century the impetus toward nonhistorical designs and the incorporation of technological advances was severely limited by the twenty-year hiatus of the Great Depression, World War II, and the years of painful postwar recuperation.

It would be convenient, but only somewhat accurate, to attribute twentieth-century changes in architecture to the influence of technology as it was applied to buildings. Architecture is a complex art having many masters. A building is at the same time an object, an investment, and a cultural and personal expression of beliefs. Any change in the way buildings are built or the way they look must be tested against a variety of standards, their relative importance being somewhat different for every project. This truism explains why certain technological aspects of architecture have been readily adopted and others have been long delayed. For instance, elevators were a vital factor in the economic and social changes related to the great sweep of urbanization, and therefore elevator technology was immediately accepted and quickly developed. No similar urge spurred the development of a more rational system of plumbing and waste handling.

Often the mood of historicism was superficial. The choice of a Greek temple as model did not necessarily rule out grafting a dome or spire onto a design, and with up-to-date construction techniques Gothic naves often acquired proportions that bore limited relationship to those of the

buildings they emulated. New technologies intruded gently because historical accuracy and consistency, not prime criteria of Romanticism, were generally less valued than the evocation of appropriate sentiments.

Nearly all buildings are singular designs, though with pronounced similarities to other buildings of the same purpose, place, and period. The individuality of projects has effectively limited the extent to which industrialization has been applicable to architectural construction. In the early eighteenth century, the process of assembling a building might well begin on the site with preparation of the clay and kiln that would produce brick for the walls. Timbers for trusses would be cut, mortised, and drilled by the workmen who would set them in place. Today such elements of the construction will have been largely prepared before they are brought to the site for assembly into the final structure. Although craftsmen still work to fit and fasten in place the parts of a building, the nature of their work has gradually changed as industrialization and the concomitant standardization have increased the relative completeness of elements that are brought to the site of construction. At the same time, the Industrial Revolution and the revolution in transportation that accompanied it reduced the architectural significance of a region's own materials. Local differences in the prices of materials still exerted appreciable influence on selections, but their significance diminished as decades passed. Climatic differences have become less important, because equipment and materials have been developed to ameliorate the effect of external conditions on buildings' interiors, and cultural and economic exchanges between nations and places have acted to reduce the differences between build-

ings in different settings. Good or bad, office buildings throughout the world are much alike, government buildings have been similar since the Classical Re-revival at the start of this century, and even residences are moving toward greater similarity.

The modern movement in architecture, which blossomed in the 1920s and bore fruit after World War II, has been on the whole more eager to utilize new materials and incorporate new systems than were the Romantic historically based fashions that came before. In the chapters that follow, the reader will note that in the majority of cases the most advantageous improvements in the manufacture of materials and in the quality of systems for buildings were achieved in the last quarter of the nineteenth century and the first decade of the twentieth century. Since that time the acceptance and application of those advances have increased, and in many cases the need for further fundamental development has become apparent. At present, architects work with a relatively stable palette of technological development, seeking viable responses to social and economic functions and awaiting a revival of inventive enthusiasm that may improve the art's technological capabilities.

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