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Curtain Wall Systems

A Primer

Committee on Curtain Wall Systems

EDITED BY
Ali M. Memari, Ph.D., P.E.

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Prepared by
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PREFACE

As the trend in building envelope system design moves toward significantly more transparent elements instead of opaque systems, the role of architectural glass is becoming more important than it once was in traditional window and curtain wall systems. Expectations of today's curtain walls that use architectural glass or other glazing products exceed the basic functions of providing natural lighting and protecting the interior from environmental effects such as wind and rain. Curtain wall systems are now expected to conserve energy, provide occupant comfort by controlling heat flow and solar radiation, and, in some cases, even convert solar energy to electricity. Last but not least, curtain wall systems are expected to perform acceptably when exposed to natural disasters such as hurricanes, earthquakes, and man-made hazards such as explosions and blasts. As these functions imply, depending on the application, proper design, fabrication, construction, and maintenance of advanced and efficient curtain wall systems demand involvement of professionals from several fields of engineering and building technology.

Design of building envelope systems in general and curtain wall systems in particular is not part of the curricula in architecture, architectural engineering, and civil engineering programs. The professionals whose work involves design, fabrication, and construction of such systems likely receive their training on the job and learn the fundamentals and design principles through experience of working on various projects. Few books and guidelines specifically address most major aspects of interest in glass curtain wall systems. The main goal of this book is to provide one such reference for beginners with no prior knowledge of curtain wall systems. The book is considered a primer because it does not treat the various subjects discussed at great depth. This book's chapters provide an introduction to several topics related to curtain wall and glazing systems, including material properties; manufacture, fabrication, and construction methods; various loading types and testing methods; design

methodologies with respect to wind, seismic, and blast; building physics with respect to waterproofing and energy efficiency; and some technological innovations and new developments in glazing systems and design, and construction of complex forms.

This book can help design professionals to better understand not only many aspects of curtain wall systems but also how such systems may affect other building systems they work with. The book can also help with more efficient design of building structural and envelope systems. The book is deemed appropriate as a textbook for students in civil and architectural engineering and architecture programs and also as a reference for building owners, architects, engineers, fabricators, contractors, and building code officials.

CHAPTER 1
INTRODUCTION

Faron A. Morris

The architectural appeal of glass comes from its most obvious properties—light reflectance and transmittance. In daylight, glass reflects its surroundings. On a high-rise tower blue sky is seen reflected on a clear sunny day, clouds on an overcast day, and lit offices at night. Glass gets your attention. The dynamic, always-changing appearance of a glass-clad tower is not possible with any other building material. Light transmission allows natural indoor lighting and a view from inside the building, providing a closer connection to the natural outdoor environment. Reflectance and transmittance—properties unique to glass—have increased its popularity and use in multistory construction.

The wall of glass seen in high-rise construction is a sophisticated manufactured product called curtain wall. Separating and moderating the interior building environment is its primary function. As an environmental separator it must keep out air and water; reduce heat loss in cold weather and reduce solar heat gain in warm weather; safely support wind loads, which become significant on high-rise buildings; accommodate thermal movement due to temperature fluctuations throughout the day and changing seasons; and accommodate building interstory movements caused by wind, live, and seismic loads. In certain geographical locations, extreme events require special design consideration for impact forces from flying debris in hurricane winds or large interstory movements caused by seismic events. Other special design considerations include reducing fire spread from floor to floor or across a floor at the structural slab edge and preventing injury to occupants from a blast event.

This primer will highlight the materials used in the manufacture of curtain wall in high-rise construction and discuss specialized aspects of curtain wall design and analysis for extreme events such as earthquakes

and bomb blasts. This information is not readily available because the curtain wall industry is relatively young compared with other well standardized construction industries such as structural steel, timber, and concrete. Material-specific information is spread across the glazing, sealant, plastic, and aluminum extrusion industries and is not generally taught in college or university courses, though in recent years architectural engineering programs are focusing more on building science and cladding. This primer compiles a basic review of the many aspects of curtain wall and current topics that affect the design and performance of curtain wall all in one document.

This primer's focus is on factory-assembled (unitized) and site-assembled (stick system or stick built) curtain wall in which transparent glazing is the predominant infill. Types of cladding not addressed in this primer include punched windows, strip windows, skylights, structural glass, and point-supported glass façades.

This primer is written for the individual outside the curtain wall manufacturing and consulting industry who possesses little to modest prior knowledge and wants to learn more about this specialized field. The target audience for this primer comprises architects, structural engineers, HVAC engineers, general contractors, building owners, and building operators.