INTRODUCTION

Volume I — The Behavior of Glass and Other Materials Exposed to Fire

Knowledge of the behavior of materials which, exposed to elevated temperatures, direct the course and consequences of structural fires is critical to the design of fire safe structures. Understanding how materials behave as fuel sources, as structural load bearing elements and as partitions which can resist penetration by heat, flames, smoke, and toxic gases is fundamental in every application of fire science. In this collection, a number of issues which have been of wide interest in recent years are addressed. They include: the behavior of glass exposed to fire stresses, the role of wood char in combustion, and the somewhat unexpected behavior of high strength concrete at elevated temperatures.

The time and modes of glass failure affect fire ventilation which in turn often controls fire development and growth and the advent of flashover and back draft phenomena. Char oxidation in certain fire environments also plays an important part in the overall production of heat energy and smoke during fires which threaten life safety. The behavior of such common building construction materials as high strength reinforced concrete and polymeric insulation materials whose use is expanding significantly, demands continued research and dissemination of guidelines and standards for their use.

In this volume, chapters by Hassani, Shields, and Silcock review the current level of knowledge regarding prediction of when glazing may be expected to fail under fire conditions, and present data from half-scale room experiments directed to the study of thermal strains in glazing exposed to an enclosure fire. The authors discuss test methodology and draw conclusions with respect to glazing exposed to non-uniform thermal environments in both single and double pane window glazing systems.

Chapters by Belles discuss flammability behavior of foam plastic insulation in garage doors as determined by an updated, room/corner test. Smoke and heat release measurements are used to judge product acceptance. Belles also presents information on chemically treated loose-fill cellulosic insulation and its behavior over time. He discusses fire experience, model code requirements, tendencies

toward smoldering and flaming propagation, and experience with fire retardant treatments. To complement some of the work by Hassani, Shields, and Silcock, Belles presents a chapter on the history of wired glass in fire rated applications. Here the author discusses the use of twenty-minute glazing in one-hour corridor partitions and identifies some of the issues associated therewith.

In a chapter by Yuen, Lo, and Yeoh the authors discuss protection of compartment wall openings through use of a double shutter fire door system in place of lobby enclosures. The separation and emissivity of the shutters are the key factors considered in establishing the effectiveness of the system. A computational Fluid Dynamics technique is used to analyze the influences of the two parameters.

The spalling of high strength concrete at elevated temperatures as presented by Ali, Connolly, and Sullivan examines the factors which contribute to spalling at elevated temperatures and notes that explosive spalling is exacerbated as the strength of the concrete increases. The authors describe other factors that contribute to the tendency for the concrete to spall and review measures for the prevention of spalling as reported by others.

Moghtaderi, Novozhilov, Fletcher, and Kent present the results of their study of the role of char oxidation on the flaming combustion characteristics of wood-based materials using a cone calorimeter. The work was done in order to produce more realistic models of wood combustion for use in a Computational Fluid Dynamics Model of building fires. The authors found that char oxidation is relatively important in the case of vertical orientation of the fire site amounting to 10 percent of the heat release.

Zhang, Shields, Silcock, and Azhakesan present the results of their work on the behavior of plywood lining in full scale room tests. Observations included ignition behavior, surface flame spread, and charring of the lining. The authors report different effects in three distinctly different regions of the corner tests performed. They describe experimental conditions and discuss the contribution of plywood to enclosure fires.