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Combination of CFD and evacuation models for determination of FED and FEC levels

Previously developed methods to evaluate FED and FEC level via combination of CFD and evacuation simulation have been verified by new features of FDS6 and extended to fire cases involving common building materials. The FED levels calculated by the conversion factor based on carbon monoxide are compared with the direct calculation by way of mass fraction of carbon monoxide, hydrogen cyanide and carbon dioxide. FEC level is compared with FIC output of FDS6. Both values showed quite good agreement with each other when all the combustion products are exactly specified in the reaction formula. The difference between FDS5 and FDS6 is also investigated for the FED and FEC level of the cable fire case and the result shows approximately 10 percent difference on average, which may result from the new combustion model of FDS6, i.e. partially-stirred batch reactor model. As for fuel, a sofa and bookcases were selected to be representative common building items and assumed to be a mixture of different materials, composed of mainly polyurethane and wood respectively with small amounts of PVC. For each item, a single fuel formula and stoichiometry reaction were formulated and used for the FDS simulations. For all cases, FED and FEC levels remain below the tenability criteria. However, considering measurement uncertainties, sensitivity analysis reveals that the FIC level can exceed criteria in case of maximum HCl yield. Also when it comes to post-flashover condition, FED levels appear to be exponentially increasing far over the criteria due to the contribution of hydrogen cyanide. Lastly prediction of FED and FEC level for fires involving combination of both sofa and bookcase has been demonstrated.