COMPARING FULL-SCALE EXPERIMENTS WITH MODEL-SCALE EXPERIMENTS TO INCREASE FIREFIGHTER KNOWLEDGE OF FIRE DYNAMICS

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Purpose : Find simple, visually realistic models where theory can be explained and put in context to the fire service community. The project is using data from full-scale fire experiments in a single-family house as well as data from fire experiments in a 1:10 scale model of such a house.

Background: Training, as well as experimentation, using live fire can be time consuming as well as costly, especially large scale training facilities. In addition, repeatability is affected by the fact that training material is destroyed. Also, since large-scale training in most cases must be performed outside, weather conditions may affect the results significantly. At the same time, large-scale training opportunities are very much needed for several purposes:

- To demonstrate various fire phenomena, including material properties under fire conditions,
- Development and spread of fire or smoke in rooms as well as between rooms,
- Failure properties of building components under the influence of fire.

Outcome: This can, partly or fully, be satisfied by the use of scale models. Especially, when looking at problems facing the fire service, where all of problems listed above come together and where control of fire is a key component, we need to identify simple ways and simple correlation for how real world fire problems can be looked upon using scale-models. To put it simple, there is a great need to demonstrate fire phenomena for pedagogical purposes.

Examples of scaling laws

Heat release rate [kW]: $\dot{Q}_F = \dot{Q}_M \times \left(\frac{L_F}{L_M}\right)^{5/2}$

Velocity [m/s]: $u_F = u_M \times \left(\frac{L_F}{L_M}\right)^{1/2}$

Time [s]: $t_F = t_M \times \left(\frac{L_F}{L_M}\right)^{1/2}$

Energy [kJ]: $E_F = E_M \times \left(\frac{L_F}{L_M}\right)^{3} \times \frac{\Delta H_{c,M}}{\Delta H_{c,F}}$

Mass [kg]: $m_F = m_M \times \left(\frac{L_F}{L_M}\right)^{3}$

Temperature [K]: $T_F = T_M$

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