

## Justify Clause C4.4 Discussion Document

Clause C4.3 provides the performance criteria for fire safety of buildings to allow for safe evacuation. Clause C4.4 allows a dispensation in these criteria with the provision of sprinkler protection. Automatic fire sprinklers have a proven reliability for life safety whereby a reduced tenability criteria can be used. This dispensation only applies to occupancies of less than 1000 people as with large populations there is an increased risk of life and higher controls apply. The figure of 1000 people was also chosen to align with the Acceptable Solutions whereby additional fire safety systems were required for larger occupancies. New Zealand has not experienced a death in a sprinkler protected building which was not deliberate.

Visibility has traditionally been used as a tenability criteria however 'poor visibility' doesn't injure per se, but delays or prevents escape. Exposure to smoke and heat causes the actual injuries hence the use of FED of carbon monoxide and thermal effects in the Building Code.

Commentary to Building Code Clause 4.4 is as follows:

"C4.4 removes the performance criteria for *visibility* and *FED Thermal* when it is not possible to expose more than 1000 occupants in a sprinklered *firecell*. This is intended to promote the use of sprinklers in *buildings* and to provide closer alignment with the requirements of the Acceptable Solutions. However, it also recognises the current limitations in accurately modelling sprinkler performance in controlling the *fire* and reducing the threat to life safety."

The background on using FED greater than 0.3 in the Code can be found in BS 7974 and ISO 13571 as follows:

BS 7974-6

"Another simple approach is to provide tenability limits for different estimated exposure durations based upon the concentrations of carbon monoxide, carbon dioxide, oxygen and hydrogen cyanide in the fire effluent. Table G.2 shows some proposed limiting exposure times for asphyxiants based upon a 0.3 FED tenability limit for conditions considered typical for fires in buildings using the FED calculation equations from BS 7899-2."

ISO 13571

"Within the context of reasonable fire scenarios FED threshold of 0.3 can be used for most general occupancies in order to provide for escape by the more sensitive sub-populations. By whatever rationale FED or FEC threshold criteria chosen it is necessary to use a single value for both FED and FEC in a given calculation of the time available for escape."

The reasons for using toxicology dosage only with sprinkler protection is as follows:

- 1) Existing fire models are limited both by their capabilities and our understanding of extinguishment. Although there are a number of studies on extinguishment the problem is complicated by the stochastic factors such as what is the shape of the fuel, where was the fuel ignited, what is the fuel, is there any shielding, etc.

2) The sprinkler/layer interaction and how to incorporate this into the models. Although this a current research topic it is not ready for design.

3) How the sprinklers effect the smoke production and scrubbing soot out the smoke as well as the impact of the steam released in the process of extinguishment.

4) Statistics show that sprinklers are very effective with statistics from the US show their effectiveness is >90%. In New Zealand the numbers are even better because of the more stringent maintenance requirements and the fact that we monitor the valves.

In vulnerable populations are lower acceptance criteria may be applicable however in these type of buildings there is a known level of fire safety management. Occupants are not expected to self-evacuate and have assistance from trained staff to enable safe evacuation. The performance criteria in the code is suitable for all buildings as in vulnerable populations such as care homes and hospitals the intervention of trained staff to assist with evacuation removes need for lower fractional effective dose.

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