Fire Resistance Rating Materials and Systems
Requirements based on the new Code of Practice for
Fire Safety in Buildings 2011

Speaker: Samson Ho (Chairman of HKFPA)
1. Changes of fire resistance rating applications in new Code of Practice

2. Changes in fire testing standard - from BS476 to BS EN

3. Examples of BS EN applications
## Changes of Fire Resistance Rating Applications

<table>
<thead>
<tr>
<th>Change in Compartment volume requirement</th>
<th>Such as not limited in residential, hotel (before was 28,000m³) other pls refer to the table C1</th>
<th>See table C1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure around or sealing system for services other than staircase /protected lobby</td>
<td>Requires integrity and insulation</td>
<td>See table C2</td>
</tr>
</tbody>
</table>
| Where flats or guestrooms are connected to a common corridor | 1. Door not less than the fire barrier  
2. Smoke seals for doors | See clause C 6.1 |
### Changes of Fire Resistance Rating Applications

<table>
<thead>
<tr>
<th>Common internal corridor serving room or flats with different occupancies</th>
<th>Fixed lights installed within the corridor should have the same FRR as wall</th>
<th>See clause C7.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exit route is dead end (Balcony approach)</td>
<td>1. Window FRR -/30/30 2. Door and fixed light same as fire barrier</td>
<td>See Clause C7.5</td>
</tr>
<tr>
<td>Opening in Fire compartment wall</td>
<td>1. Door, shutter must meet integrity and insulation if they are &gt; 25% of the length of the compartment wall</td>
<td>See Clause C.8.1</td>
</tr>
</tbody>
</table>
## Changes of Fire Resistance Rating Applications

<table>
<thead>
<tr>
<th>Doors in protected or exited corridor</th>
<th>In double door situation, FRR for occupied side is same as fire barrier as classified, then 2(^{nd}) door does not need FRR</th>
<th>See clause C9.3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>If both doors have the same FRR, then it can be half of the fire barrier</td>
<td>ditto</td>
</tr>
<tr>
<td>All element in the required staircase</td>
<td>Non-combustible (if using new standard of BS EN, it is classification A1)</td>
<td>See clause 9.4</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>See Clause</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Unprotected opening</td>
<td>Smoke barrier 450mm downstand FRR -/30/- Non-combustible</td>
<td>10.1</td>
</tr>
<tr>
<td>in floors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spandrel 900mm up</td>
<td>FRP not less than the intervening floor Does not apply to a sprinkler</td>
<td>C11.1</td>
</tr>
<tr>
<td>and downstand</td>
<td>protected building</td>
<td></td>
</tr>
<tr>
<td>Kitchen in restaurant</td>
<td>FRR for door -/60/60</td>
<td>C13.2</td>
</tr>
<tr>
<td>Protection of</td>
<td>1. All element of construction 240/240/240</td>
<td>C14.1</td>
</tr>
<tr>
<td>basement</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Fire barrier forming fire compartment wall 120/120</td>
<td>ditto</td>
</tr>
</tbody>
</table>
There are 2 principle groups of fire tests:

(a) Reaction to fire – the extent to which a product burns and contributes to the development of fire. Eg, non-combustibility.

(b) Resistance to fire – That is, Fire Resistance Rating (FRR)
Non-combustibility A1 & Limited Combustibility A2 (Clause E10.1 & E11.1)

- It is based on Classification standard of
  
  **EN 13501-1**

- Related test standards for this classification
  
  **BS EN ISO 1182 (non combustibility test)**
  **BS EN ISO 1716 (Calorific potential test)**
  **BS EN 13823 (Single burning item test)**
  **BS EN ISO 11925-2 (Ignitability test)**
1. **BS EN ISO 1182 (Non combustibility test)**
   - This test identifies product that will not, or not significantly, contribute to a fire.
   - The test is relevant for the classes A1, A2, A1f1 and A2f1.

AND
Non-combustibility (Class A1 in BS EN 13501-1)

BS EN ISO 1716 (Calorific potential test)

- This test determines the potential maximum total heat release of a product when completely burning.
- The test is relevant for the classes A1, A2, A1_{fl} and A2_{fl}.
Classification for Reaction of fire (BS EN 13501-1)

- The standards involved for the classification for reaction of fire is as follows:

<table>
<thead>
<tr>
<th>Test Standard</th>
<th>Class</th>
<th>A1</th>
<th>A2</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN ISO 1182</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN ISO 1716</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN 13823</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>EN ISO 11925-2</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

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## Classification for Reaction of Fire

**(BS EN 13501-1)**

Requirement on building material to satisfy Class A1 in BS EN 13501-1

<table>
<thead>
<tr>
<th>Class</th>
<th>Test method(s)</th>
<th>Classification criteria</th>
<th>Additional classification</th>
</tr>
</thead>
</table>
| A1    | EN ISO 1182 a  | $\Delta T \leq 30 \, ^\circ C$; and  
        and  
        EN ISO 1716 | $\Delta m \leq 50 \%$; and  
        $t_i = 0$ (i.e. no sustained flaming)  
        $PCS \leq 2.0 \, MJ/kg$ b  
        $PCS \leq 2.0 \, MJ/kg$ c  
        $PCS \leq 1.4 \, MJ/m^2$ d  
        $PCS \leq 2.0 \, MJ/kg$ a | - |

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**a** For homogeneous products and substantial components of non-homogeneous products.
**b** For any external non-substantial component of non-homogeneous products.
**c** Alternatively, any external non-substantial component having a $PCS \leq 2.0 \, MJ/m^2$, provided that the product satisfies the following criteria of EN 13823: $F\Gamma GRA \leq 20 \, W/m^2$, and $LFS < $ edge of specimen, and $THR_{600}$ ≤ 4.0 MJ, and $s1$, and $d0$.
**d** For any internal non-substantial component of non-homogeneous products.
**e** For the product as a whole.
**f** In the last phase of the development of the test procedure, modifications of the smoke measurement system have been introduced, the effect of which needs further investigation. This may result in a modification of the limit values and/or parameters for the evaluation of the smoke production.

$s1 = SMOGRA \leq 30m^2/s^2$ and $TSP_{600} \leq 50m^3$;  
$s2 = SMOGRA \leq 180m^2/s^2$ and $TSP_{600} \leq 200m^3$;  
$s3 = not s1 or s2$  

$d0 = No$ flaming droplets/ particles in EN 13823 within 600 s;  
$d1 = no$ flaming droplets/ particles persisting longer than 10 s in EN 13823 within 600 s;  
$d2 = not d0 or d1$.  

Ignition of the paper in EN ISO 11925-2 results in a $d2$ classification.

**h** Pass = no ignition of the paper (no classification);  
**Fail = ignition of the paper (d2 classification).**

**i** Under conditions of surface flame attack and, if appropriate to the end-use application of the product, edge flame attack.
Classification standard (now clarifying with BD, most likely not required):

**BS EN 13501 – 2**
All assemblies, excluding ducts, dampers and roofs
Fire Test standards to test the FRR

General requirement:

**BS EN 1363 – 1**

Non load bearing elements (partition, ceiling, etc):

**BS EN 1364 – 1, 2, 3 and 4**

Load bearing elements (wall, floor, beam, column, etc):

**BS EN 1365 – 1, 2, 3, 4, 5 and 6**

Service installations (smoke duct, smoke dampers, firestop, raised access & hollow core floor, etc):

**BS EN 1366 –1, 2, 3, 4, 8, 9**

Door, shutter and openable windows:

**BS EN 1634 – 1 ,2,3**
Be aware of the clause saying, for example:

Doors, windows, and fire shutters shall be tested in accordance with one of the following standards to demonstrate the FRR:

(a) BS EN 1634-1 (Fire resistance test)
(b) BS EN 1634-2 (Fire resistance characterisation test for elements of building hardware)
(c) BS EN 1634-3 (Smoke control test for door and shutter assemblies)
(d) BS EN 14600 (Requirements and classification)

Now clarifying with Buildings Department, it is likely to modify the wordings.
Loadbearing capacity, $R$

- Maximum deflection $L/20$
- Maximum deflection rate
Loadbearing capacity, R, is the ability of the element of construction to withstand fire exposure under specified mechanical actions, on one or more faces, for a period of time, without any loss of structural stability.

- The criteria of loadbearing element shall be either:
  - for flexural loaded elements, e.g. floors, roofs.
  - for axial loaded elements, e.g. columns, walls.
Integrity, E
Integrity, E, is the ability of the element of construction that has a separating function, to withstand fire exposure on one side only, without the transmission of fire to the unexposed side as a result of the passage of flames or hot gases.

Integrity failure may cause ignition either of the unexposed surface or of any material adjacent to that surface.

Integrity failure shall generally be made of the following 3 aspects:
- Cracks or openings in excess;
- Ignition of cotton pad;
- Sustained flaming on the unexposed side.
Insulation, I
Plate Thermocouple

- A plate thermometer with a large surface area exposed to the furnace, but insulated from the test specimen, gives a more representative measurement of heat received by the specimen, especially in the early stages of a test.

- By using the plate thermometers, the initial temperature will be higher, thus affecting the insulation result at the end by approximately 10%.

- Therefore, this means that BS EN standard is more onerous than BS standard in measuring the insulation criterion.
Examples of BS EN systems
# Non-Loadbearing Partition

<table>
<thead>
<tr>
<th>Material</th>
<th>DURASTEEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Description</td>
<td>9.5mm thick DURASTEEL screw fixed to 125 x 50 x 2mm steel channels over 15mm thick board fillets with 2 layers of 60mm x 147 kg/m3 mineral wool infill</td>
</tr>
<tr>
<td>Test Standard</td>
<td>EN 1364-1 : 2000</td>
</tr>
<tr>
<td>FRR</td>
<td>EI 240</td>
</tr>
</tbody>
</table>
DURASTEEL non-load bearing partition

**Photograph nr. 5**
Detail of the specimen assembly

**Photograph nr. 6**
Detail of the specimen assembly

**Photograph nr. 7**
Aspect of the Unexposed side of the specimen 8403A before the test.

**Photograph nr. 8**
Aspect of the Exposed side of the specimen 8403A before the test.
## Partition

<table>
<thead>
<tr>
<th>Material</th>
<th>SUPALUX</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Description</td>
<td>2 layers of 12mm thick SUPALUX screw fixed to each side of 40 x 150 x 40 x 0.6mm steel channels with 3 layers of 50mm x 100 kg/m³ mineral wool infill</td>
</tr>
<tr>
<td>Test Standard</td>
<td>EN 1364-1 : 2000</td>
</tr>
<tr>
<td>FRR</td>
<td>EI 240</td>
</tr>
</tbody>
</table>
SUPALUX non-load bearing partition
# Ceiling (from below)

<table>
<thead>
<tr>
<th>Material</th>
<th>PROMATECT 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Description</td>
<td>2 layer of 25mm thick PROMATECT 100 screw fixed to 27 x 60 x27 x 0.6mm steel ceiling channels at 1200 x 600mm grid centers</td>
</tr>
</tbody>
</table>
| Test Standard          | EN 1364-2 : 1999-10  
                         | EN 1363-1 : 1999-10  |
| FRR                    | EI 120 ( b→a) in accordance with BS EN 13501 -2 : 2008                       |
Ceiling (from below)
Exposed side before test

Unexposed side before test

Ceiling (from below)
Ceiling (from below)

Unexposed side after test

Exposed side after test
## Smoke Extraction Duct

<table>
<thead>
<tr>
<th>Material</th>
<th>PROMATECT L500</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Description</strong></td>
<td>50 mm thick PROMATECT L500 screw fixed to 50 x 50 x 5mm L steel profile to form a 1,800 (w) x 900mm (h) rectangular duct of total length 7,600mm</td>
</tr>
</tbody>
</table>
| **Test Standard**         | EN 1366-8 : 2004  
EN 1363-1 : 1999-10                                                        |
| **FRR**                   | EI 120                                                                        |
Smoke Extraction Duct
Smoke Extraction Duct
Smoke Extraction Duct
Smoke Extraction Duct
# Structural Steel Protection

<table>
<thead>
<tr>
<th>Material</th>
<th>Promat Cafco SPRAYFILM WB3 intumescent coating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Description</strong></td>
<td>Various thickness of intumescent coating are applied to a series of structural steel beams and columns for testing</td>
</tr>
<tr>
<td><strong>Test Standard</strong></td>
<td>EN 13381-8 ; 2010 EN 1363-1 : 1999-10</td>
</tr>
<tr>
<td><strong>FRR</strong></td>
<td>Up to 120 minutes</td>
</tr>
</tbody>
</table>
longitudinal section showing the assembly
Structural Steel Protection

Beams and Column before test
# Fire Door

<table>
<thead>
<tr>
<th>Material</th>
<th>PROMATECT H</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Description</td>
<td>Timber door with 18mm Multiplex as core with 12 mm thick PROMATECT H clad on both faces finished by 4mm MDF boards. Glazing of size 1200 x 700mm made of AGC Pyrobelite is included in the specimen</td>
</tr>
</tbody>
</table>
| Test Standard     | EN 1634- 1 : 2008  
EN 1363- 1 : 1999-10                                                         |
| FRR               | E60                                                                      |
Fire Door
Fire Door
Thank You

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Or

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