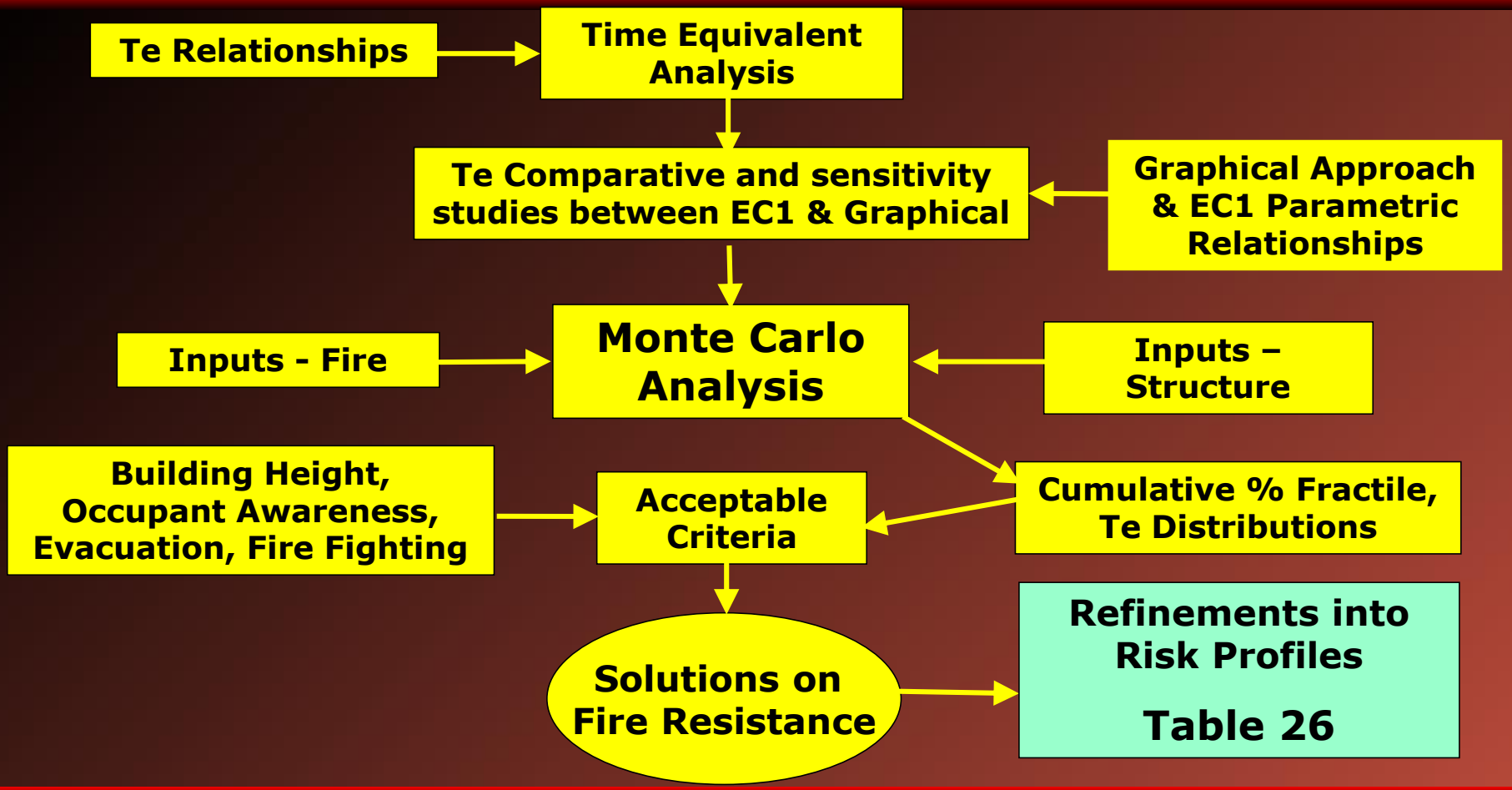
BS 9999

'Code of Practice for fire safety in the design, management and use of buildings'

Replaces BS5588 series (except Part 1)

Summary of the Analytical Process

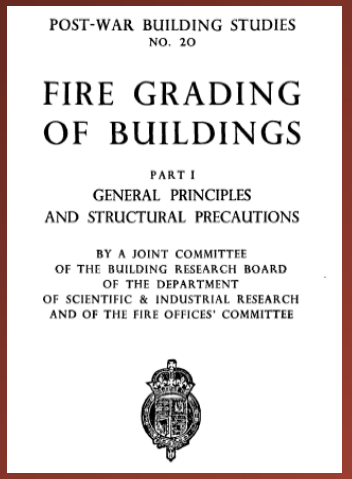


Time Equivalent Analytical Methods

- Law
- Harmathy
- Pettersson
- DIN 18230
- CIB W14
- **Eurocode 1**
- **Graphical**

Ingberg – 1920's

$$Te = q \times c \times w$$


POST-WAR BUILDING STUDIES
NO. 20

FIRE GRADING
OF BUILDINGS

PART I
GENERAL PRINCIPLES
AND STRUCTURAL PRECAUTIONS

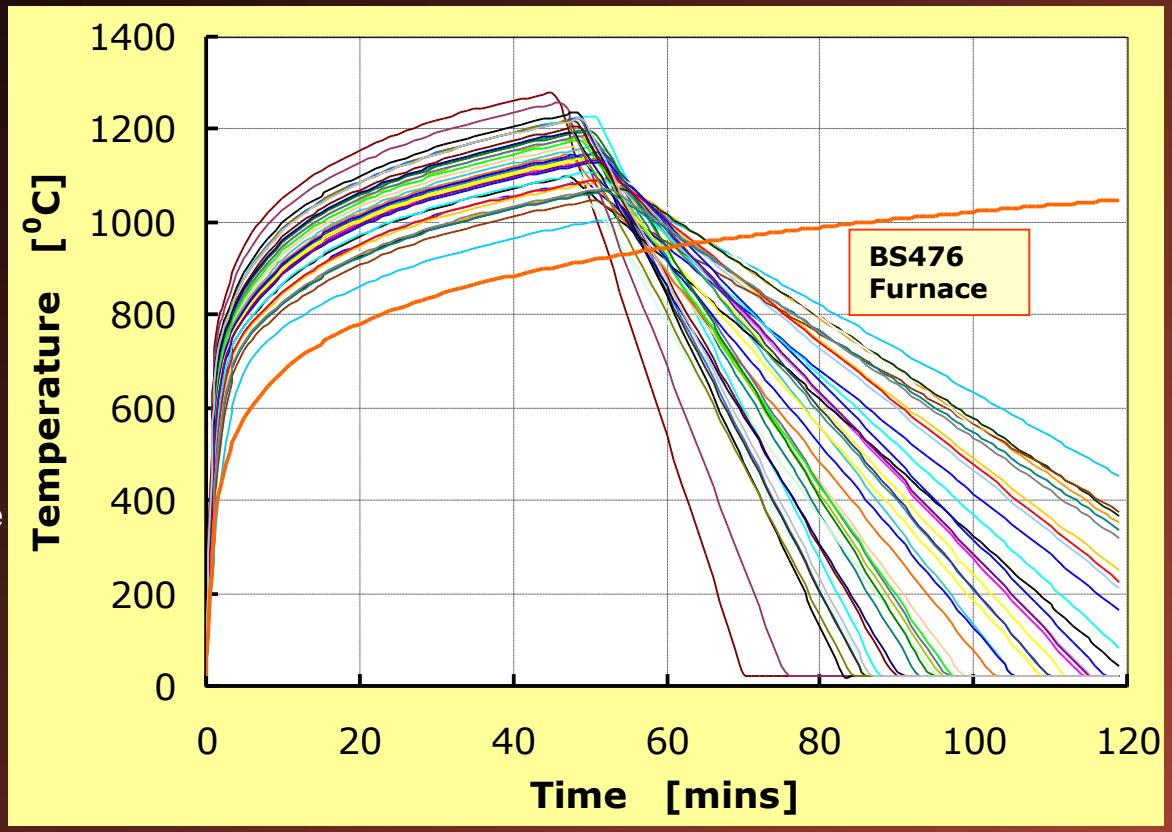
BY A JOINT COMMITTEE
OF THE BUILDING RESEARCH BOARD
OF THE DEPARTMENT
OF SCIENTIFIC & INDUSTRIAL RESEARCH
AND OF THE FIRE OFFICES' COMMITTEE

Major Full Scale Real Fire Tests

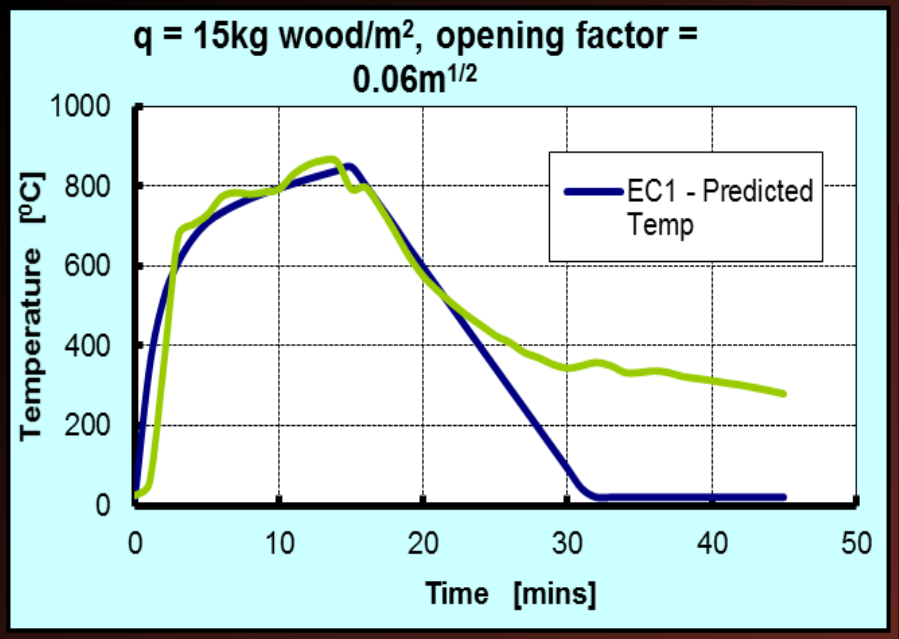
Comparment fire tests with floor areas up to effective 253m^2

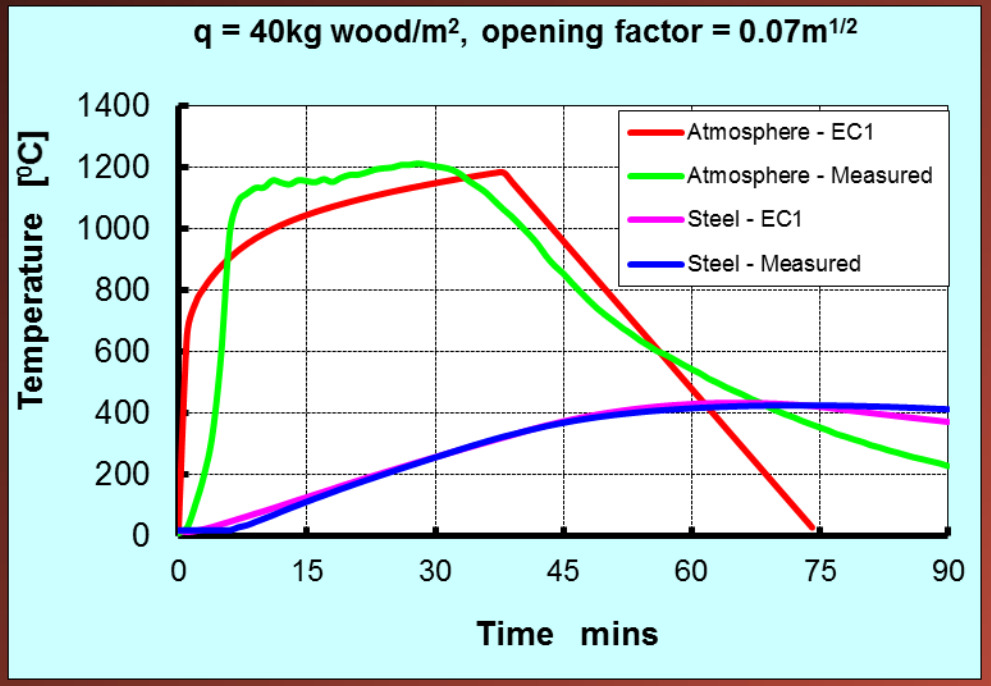
Set of Parametric Fire Curves (EC1-1-2)

"the

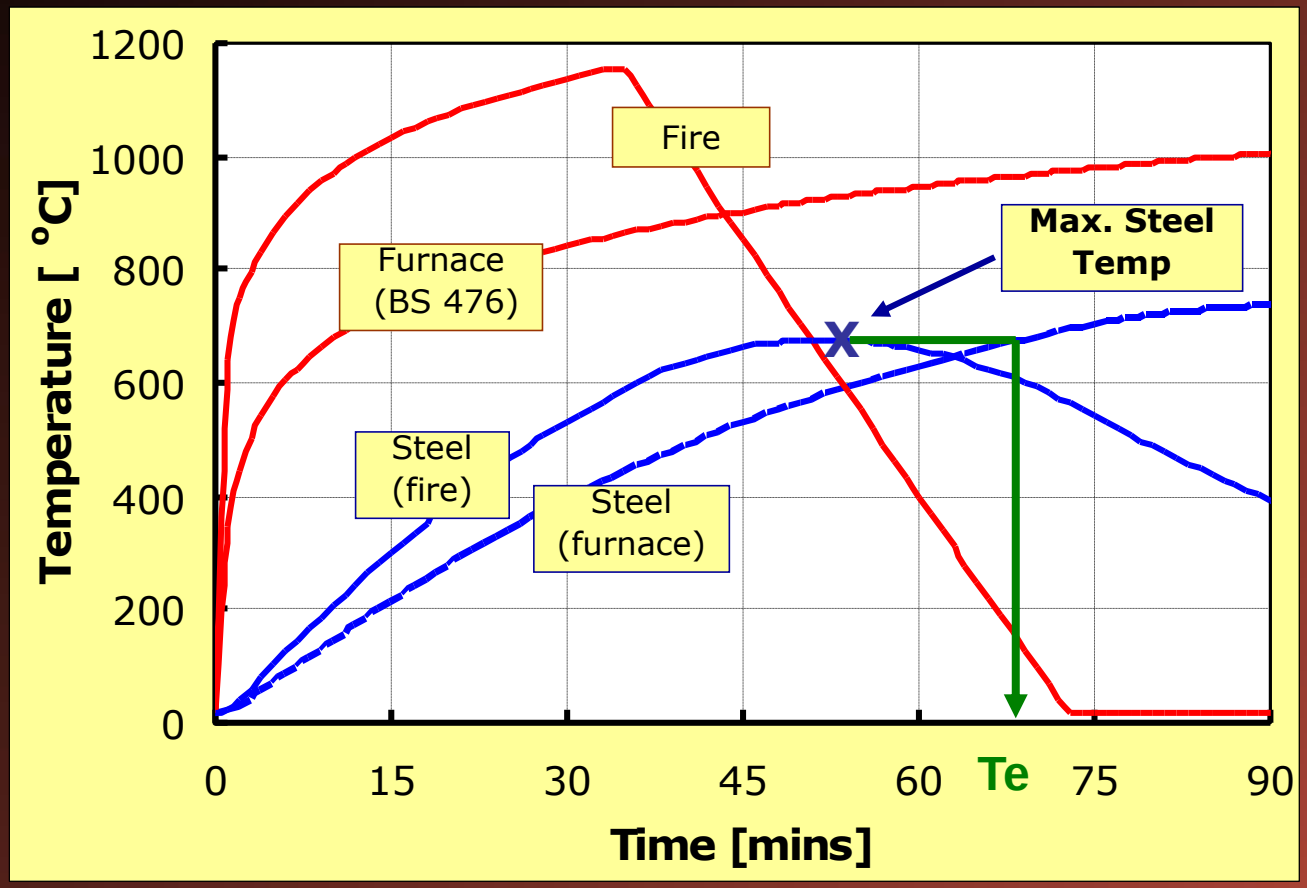


Calibration of Parametric Equations

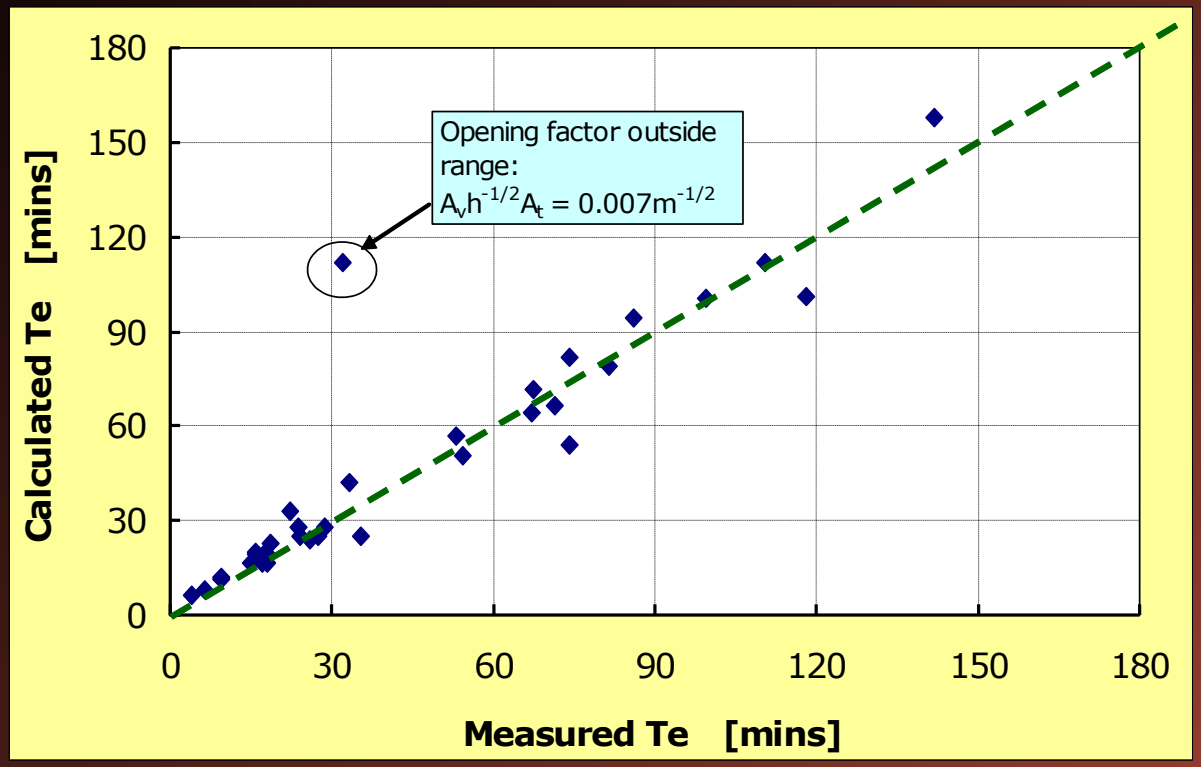




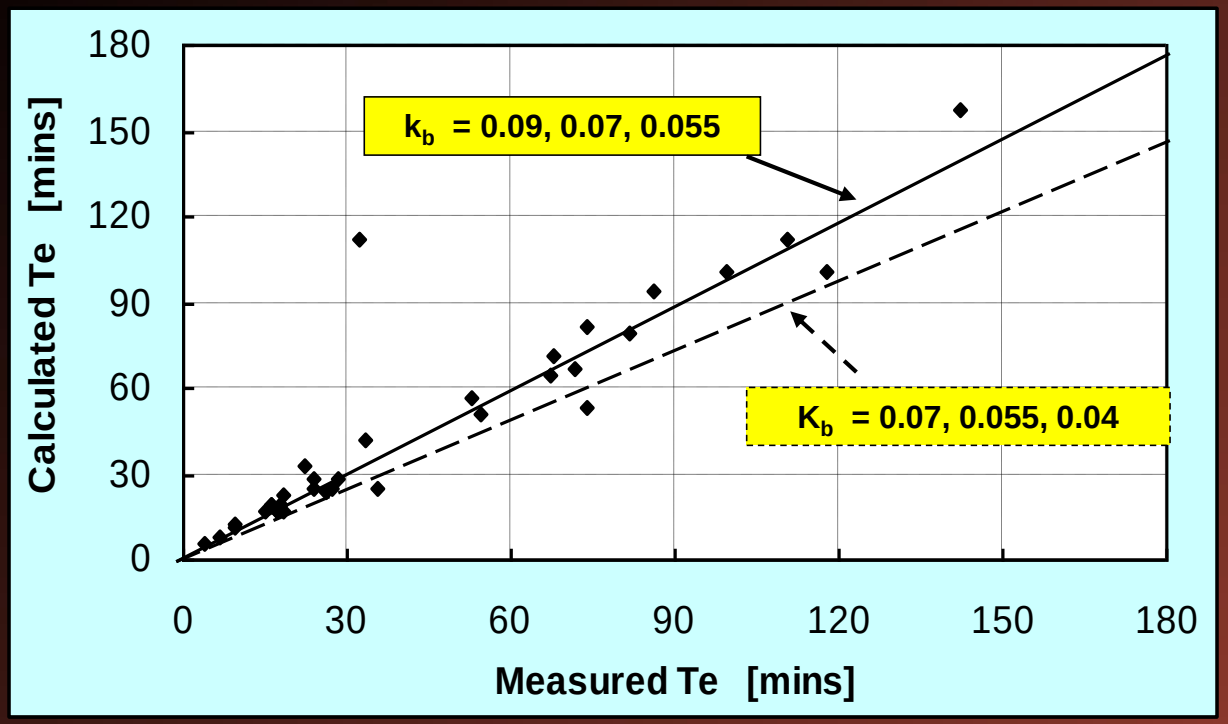
Time Equivalent – Graphical Analysis



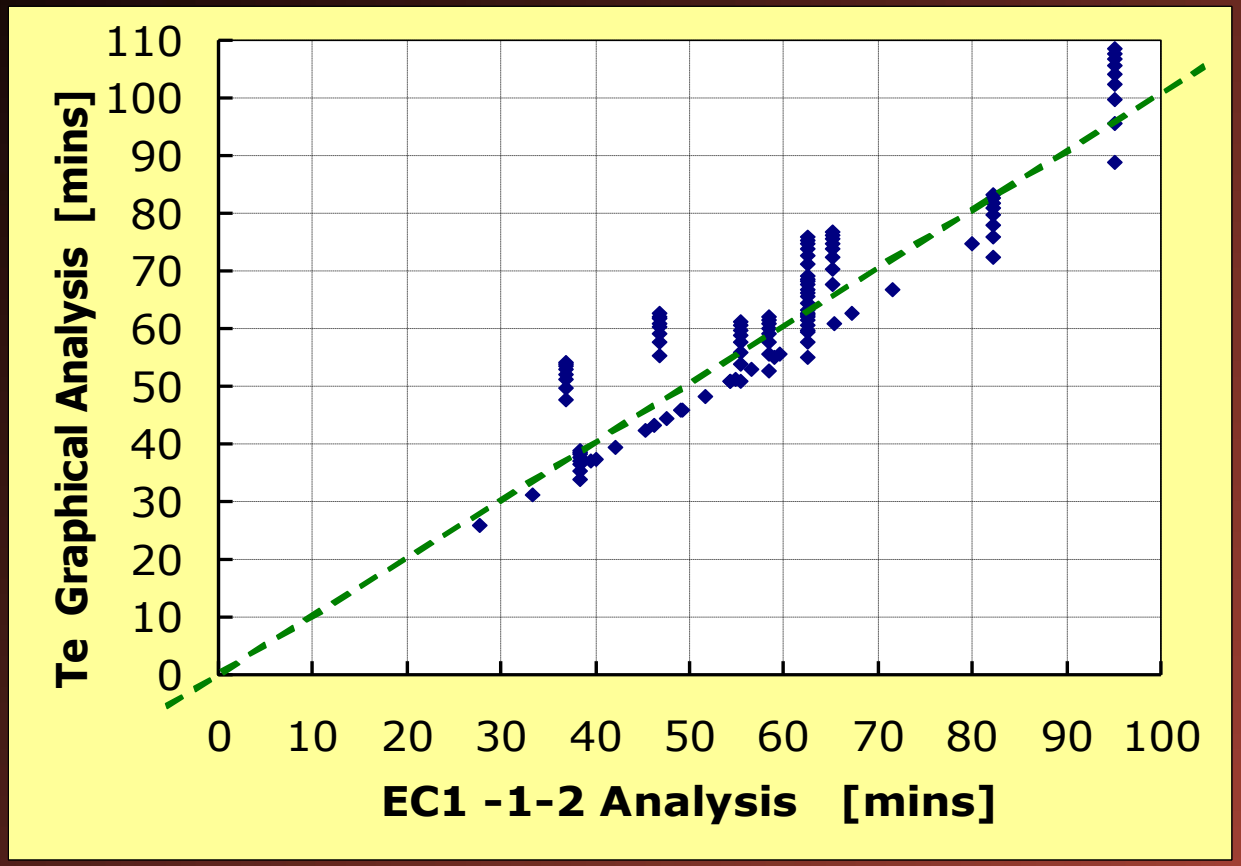
Calibration of Time Equivalent



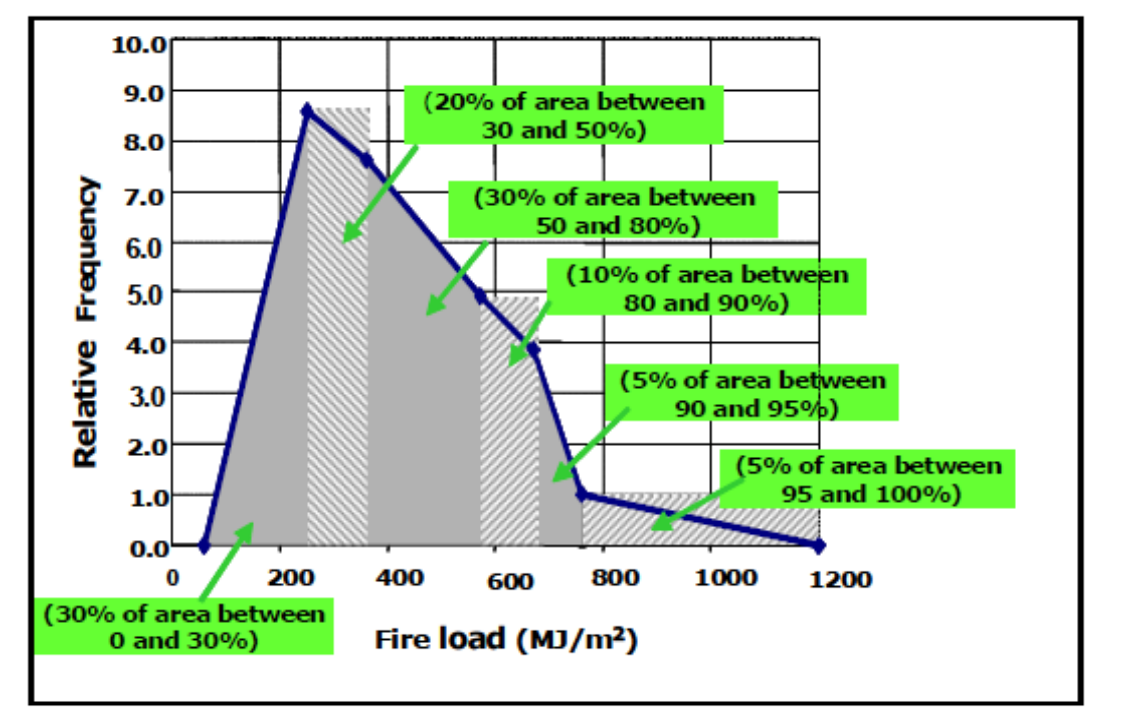
Calibration of Eurocode Time Equivalent Insulation Parameters



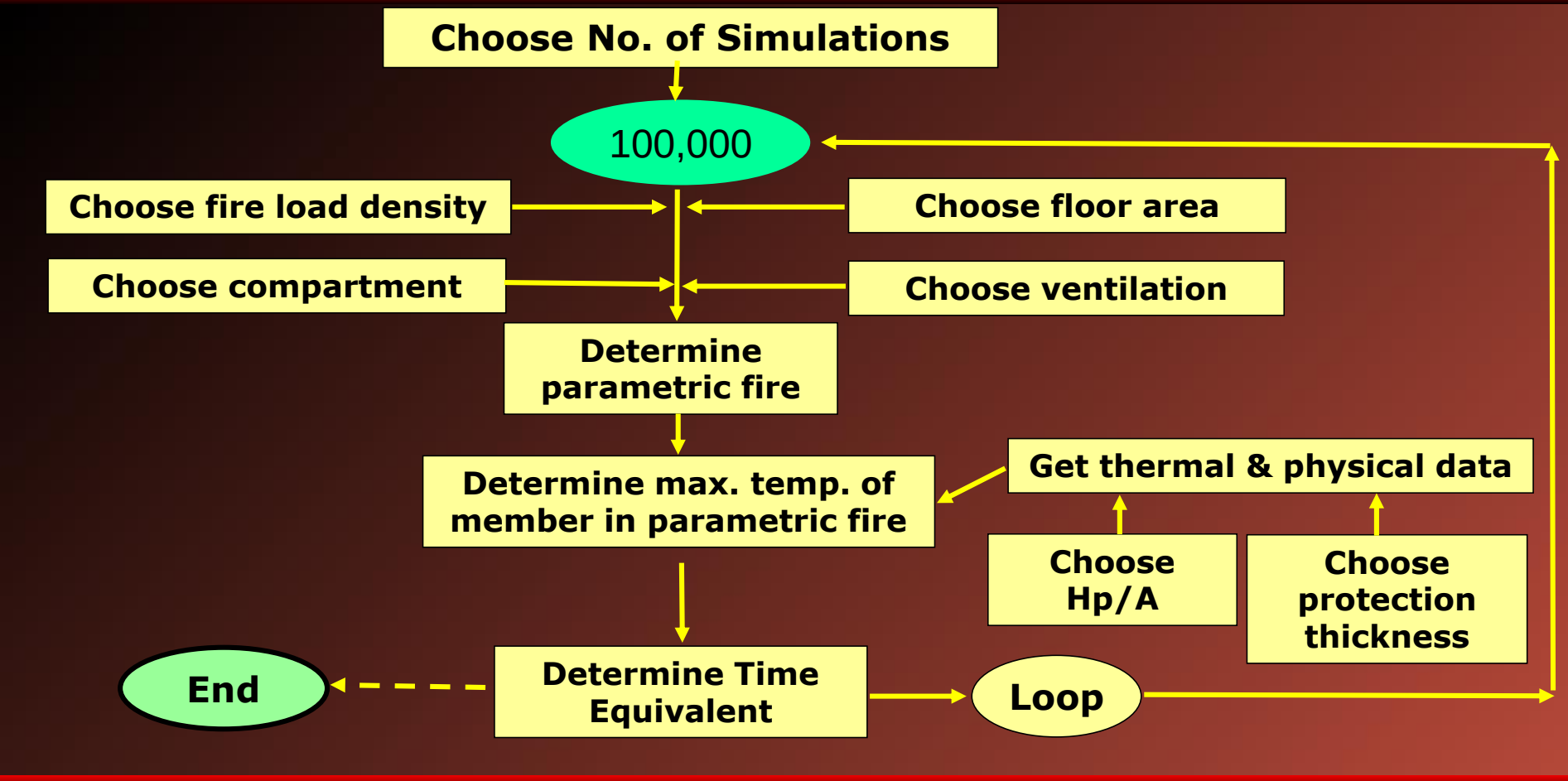
Calibration of Graphical Analysis with EC1-1-2



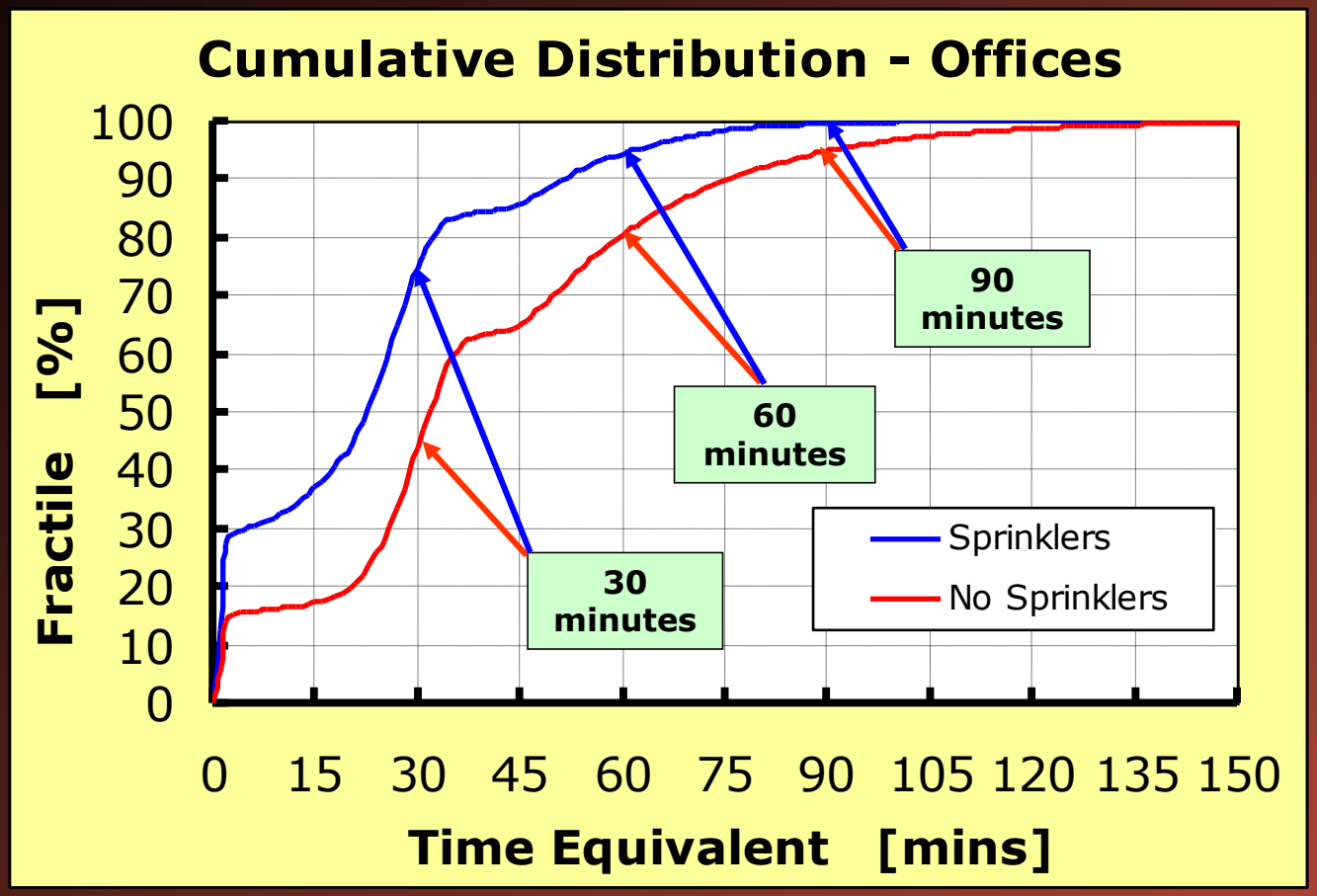
Fire Load Density Distribution



Monte Carlo Analysis



Monte Carlo Analysis – Typical Output



Risk Based Concept

Risk = frequency x probability x consequence

Frequency = number of fires in a given period - related to building height

Probability is related to the cumulative distribution curves

Probability = 1 – Fractile/100

Consequence = the damage due to fire if the Time Equivalent is exceeded - related to building height

Basis of Acceptable Criteria

Risk = frequency x probability x consequence

$$Risk \propto height \times (1 - fractile/100) \times height$$

$$Risk \propto (1 - fractile/100) \times h^2$$

$$Risk = (1 - 80/100) \times 18^2$$

$$Risk = 64.8$$

Building Height Categories

Current AD-B Height Categories

- Less than 5m
- Between 5m and 18m
- Between 18m and 30m
- Over 30m

New Height Criteria

- 11m
- 60m

Consequence Rating vs Building Height

Height m	Fractile %	Consequence Rating
0 –5	20.0	1
5 – 11	46.4	2
11 – 18	80.0	3
18 – 30	92.8	4
30 – 60	98.2	5
>60	99.6	6
*****	100.0	7

Adjustment to Risk

	A	B	C	D
Height to top floor m	**Awake and Familiar**	**Unfamiliar**	**Asleep**	**Restriction on means of escape (e.g. horizontal evacuation – medical care)**
0 - 5	0	0	+1	+2
5 - 11	0	0	+1	+2
11 - 18	0	0	+1	+2
18 - 30	0	0	+1	+2
30 - 60	0	0	+1	+2
>60	0	0	+1	+2

BS9999: Table 26

Risk profile	Minimum periods of fire resistance, in minutes					
	Height of top occupied storey above access level					
	Not more than 5 m	Not more than 11 m	Not more than 18 m	Not more than 30 m	Not more than 60 m (50m)	More than 60 m (50m)
A1 or A2 with sprinklers	15	30	30	60	75	90
A2 or A3 with sprinklers	30	30	60	90	120	150
A3 or A4 with sprinklers	60	60	90	120	300	300
A4	—	—	—	—	—	—
B1 or B2 with sprinklers	30	30	30	60	60	75
B2 or B3 with sprinklers	30	30	60	75	90	120
B3 or B4 with sprinklers	30	45	75	105	135	180
B4	—	—	—	—	—	—
Ci1 or Ci2 with sprinklers	45	60	75	75	90	105
Ci2 or Ci3 with sprinklers	60	90	105	120	—	—
(Cii1 or Ciii1), or (Cii2 or Ciii2 with sprinklers)	30	30	30	45	60	60
(Cii2 or Ciii2), or (Cii3 or Ciii3 with sprinklers)	30	45	60	75	90	105

Ventilation Parameter (Table 27)

Occupancy characteristic	Use	Ventilation parameter	
		Minimum potential area as percentage of floor area %	Height of opening B) as a percentage of the compartment height (i.e. from floor to ceiling) %
A	Office	5	30 to 90
A	Industrial	2.5	30 to 80
B	Shops and commercial	5	50 to 100
B	Assembly & Recreation	2.5	30 to 80
Ci	Individual residential	10	30 - 90
Cii and Ciii	Other residential	10	40 - 90

B) This is the weighted mean height (by ventilation area) of the potential openings. If a compartment has openings each with an area of *A*1, *A*2, *A*3,…*A*n and heights of *h*1, *h*2, *h*3,…*h*n, then the total area of the openings *A* = *A*1 + *A*2 + *A*3 +…*A*n, and the weighted mean height, *h*, is given by:

$$h = \frac{A_1 h_1 + A_2 h_2 + A_3 h_3 + ...A_n h_n}{A}$$

If *h* is the weighted mean height of all the openings and *H* is the height of the compartment then *h*/*H* should be between the values given in the end column.