Structural Fire Design According to Eurocodes

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With

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2nd to 5th September 1666

Previous building regulations largely ignored. 1212 thatch banned in London (following a great fire).

New Regulations had means of enforcement by the employment of Surveyors (1667), required buildings to be built of brick or stone, no thatch roofs, roofs behind parapets (1709) and recessed wooden windows (1774)

CEN/TC250 Structural Eurocodes

Structural Eurocodes are a set of harmonised technical rules for the design of construction works (at room and at elevated temperatures)

The National Standards implementing Eurocodes may be followed by a National Annex

The National Annex may only contain information on those parameters which are left open in the Eurocode for national choice, known as Nationally Determined Parameters (NDPs)

Fire parts within :

EC 1 : ACTIONS on STRUCTURES

EC 2 : CONCRETE STRUCTURES
EC 3 : STEEL STRUCTURES
EC 4 : COMPOSITE STRUCTURES
EC 5 : TIMBER STRUCTURES
EC 6 : MASONRY
EC 9 : ALUMINIUM ALLOYS STRUCTURES

CONSTRUCTION PRODUCT DIRECTIVE (1988-12-21)

ESSENTIAL REQUIREMENTS :

- Mechanical resistance and stability
- Safety in case of fire
- Hygiene, health and environment
- Safety in use
- Protection against noise
- Energy, economy and heat retention

Adopted on 18 January 2011 with a view to the adoption of Regulation (EU) of the European Parliament and of the Council laying down harmonized conditions for the marketing of construction productand repealing Council Diretrive 89/106/EEC (CPD).

Essential Requirements

SAFETY in CASE of FIRE concerning the construction work :

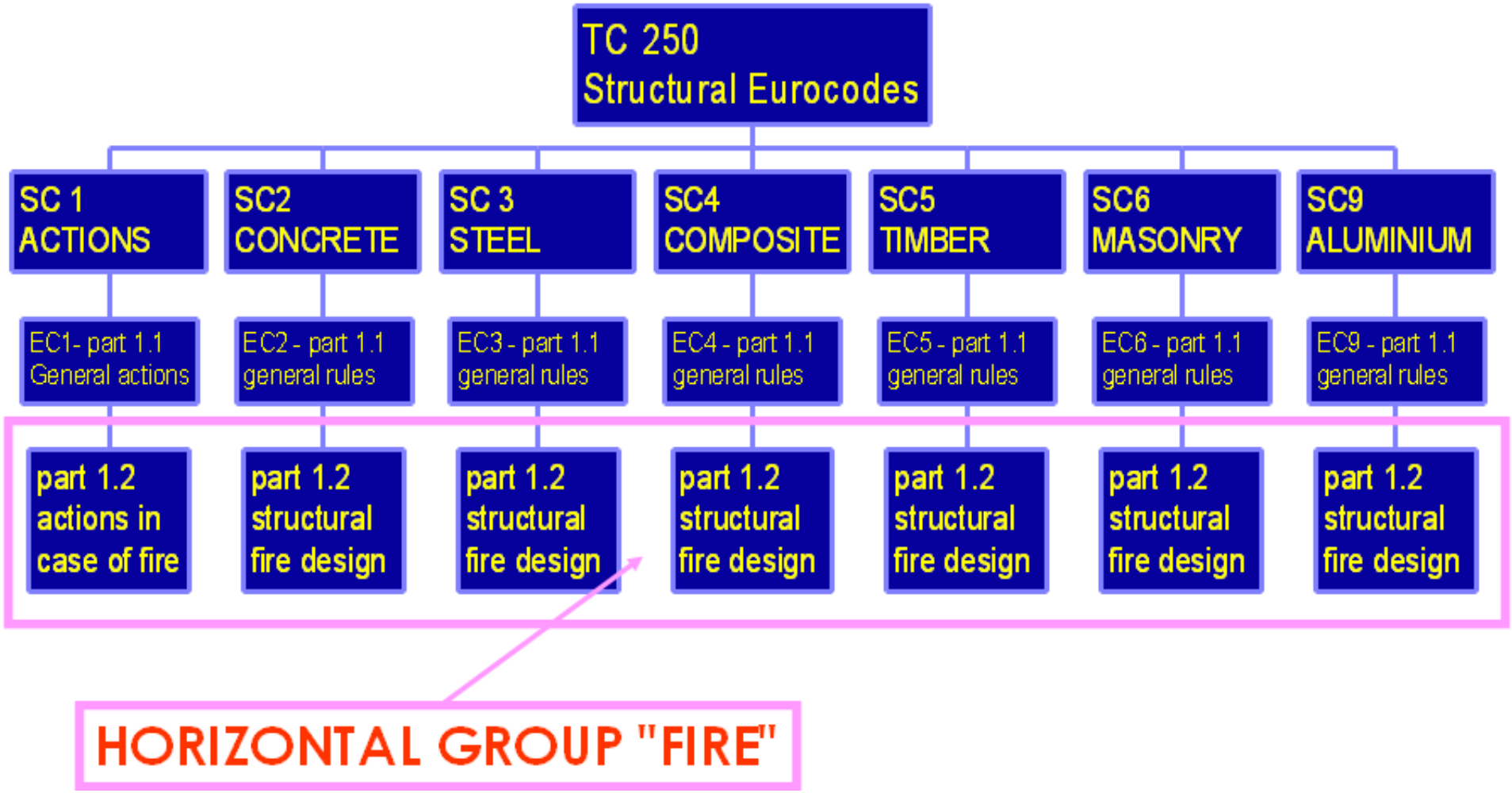
- Load bearing capacity of the construction can be assumed for a specific period of time
- The generation and spread of fire and smoke within the works are limited
- The spread of fire to neighbouring construction works is limited
- The occupants can leave the works or be rescued by other means
- The safety of rescue teams is taken into consideration

Harmonization of assessment methods

To prove compliance with Essential Requirements :

- Tests + extended applications of results
- Calculation and/or design methods
- Combination of tests and calculations

CEN TC 250 – Sub-Committees involved in Fire Safety



NDP for Structural Fire Design

Selection thermal actions

- nominal fires
- parametric fire (simple fire models)
- advanced fire models

Some coefficients for load combination

Default value for reduction factor for the design load level in fire situation

Use of advanced calculation models

Some material properties

Use of informative annexes on simple calculation methods

Design fire scenario

(1) To identify the accidental design situation, the relevant design fire scenarios and the associated design fires should be determined on the basis of a fire risk assessment.

(2) For structures where particular risks of Fire arise as a consequence of other accidental actions, this risk should be considered when determining the overall safety concept.

(3) Time- and load-dependent structural behaviour prior to the accidental situation needs not be considered, unless (2) applies.

EUROCODES 2 to 6 and 9
parts 1. 2

Parts on structural fire design

The parts dealing with structural fire resistance in EC2 to EC6 & EC9 have the following layout:

- General (scope, definitions, symbols and units)
- Basic principles (performances requirements, design values of material properties and assessment methods)
- Material properties (strength and deformation and thermal properties)
- Assessment methods
- Constructional details (if any)
- Annexes (additional information)

Verification method – Basic Principle

Load-bearing function of a structure shall be assumed for the relevant duration of fire exposure *t* if :

$$E_{d,t,fi} \leq R_{d,t,fi}$$

where :

- $E_{d,t,fi}$: design effect of actions (Eurocode 1 part 1.2)
- $R_{d,t,fi}$: design resistance of the structure at time t

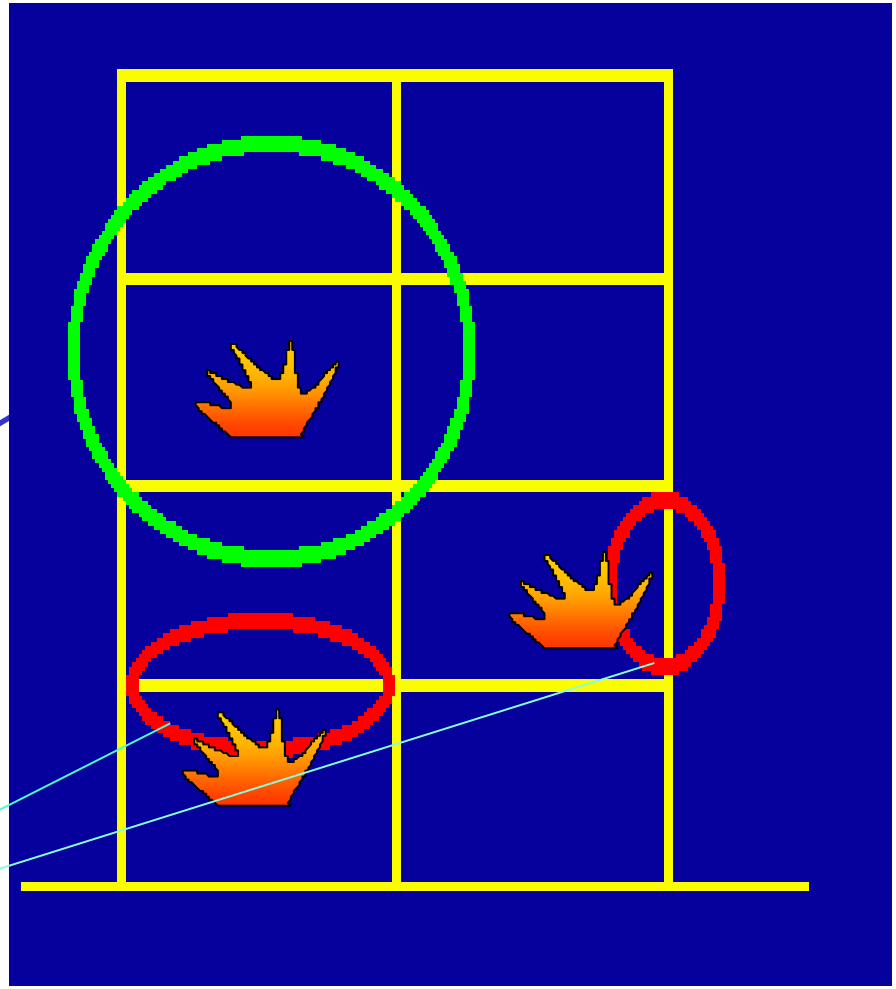
Schematisation of the structure

Various possibilities for analysis of a structure

global structural analysis

analysis of parts of the structure

member analysis (mainly when verifying standard fire resistance requirements)



(1) The effect of actions should be determined for time $t = 0$ using combination factors $\psi_{1,1}$ or $\psi_{1,2}$ according to EN 1991-1-2 Section 4.

(2) As a simplification to (1) the effects of actions may be obtained from a structural analysis for normal temperature design as:

$$E_{d,fi} = \eta_{fi} E_d$$

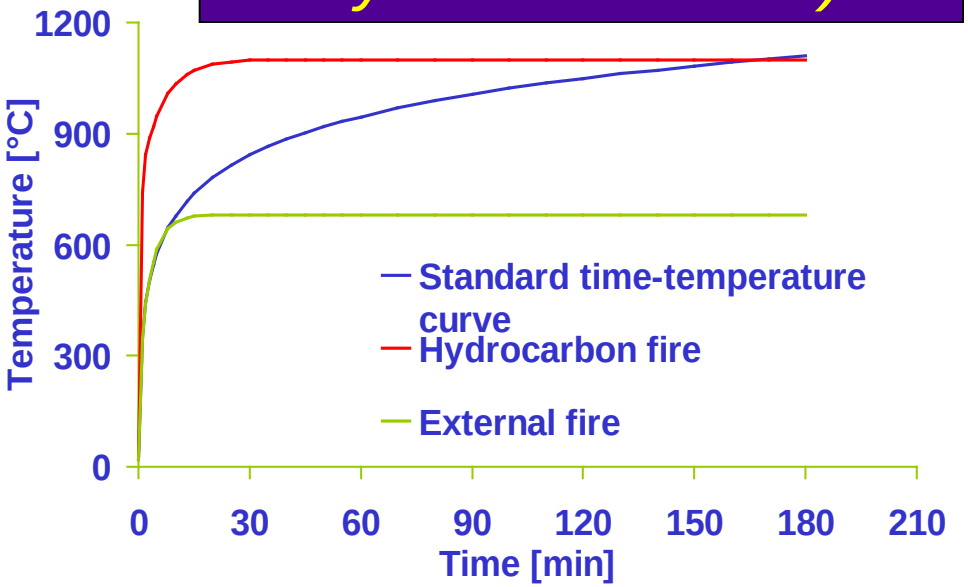
Where

E_d is the design value of the corresponding force or moment for normal temperature design, for a fundamental combination of actions (see EN 1990);
η_{fi} is the reduction factor for the design load level for the fire situation.

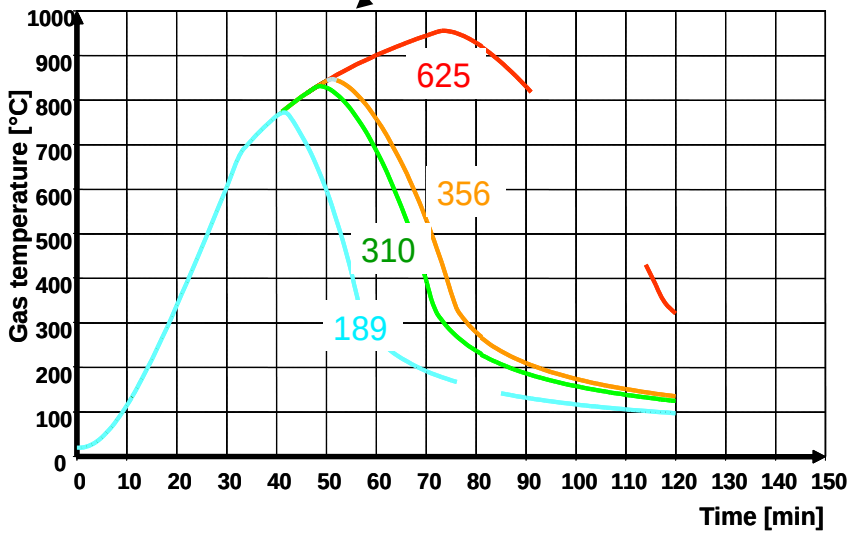
Possible Design Procedures

Project Design

Prescriptive Regulation *(Thermal Actions given by a Nominal Fire)*



Performance-Based Cod *(Physically Based Thermal Actions)*



Thank you for your attention