Application of Structural Fire Engineering to the Steelwork Design of Cannon Place, London

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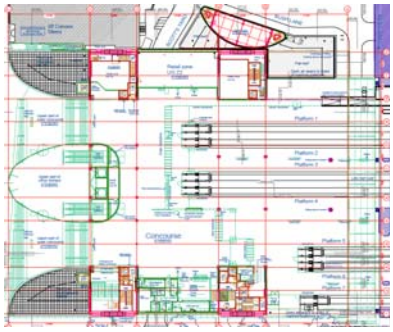
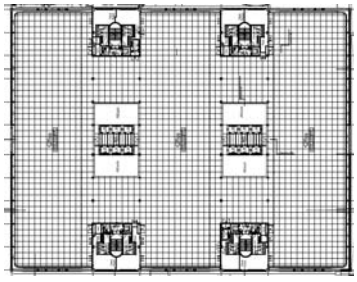


Overview

According to Approved Document B, the building needs sprinkler protection and 120min fire resistance to elements of structure.

However ADB is not statutory requirements and it recognises alternative 'fire-engineered' approaches.

Building Regulations in Britain are performance based and B3 states that "The building shall be designed and constructed so that, in the event of fire, its stability will be maintained for a reasonable period".

The intention of this structural fire engineering analyses is to demonstrate that, in the event of a foreseeable fire, the building will suffer no structural collapse throughout the entire duration of the fire.

Analysis Methods

The intention is to carry out an analysis of the 'reasonable worst case' fire in each individual area to determine its impact on the structure.

a) Analyse the potential fires in each area of the building that are to be reviewed;

b) From a), determine the temperature and duration of flames that may impact on any structure in the vicinity;

c) Analyse the impact of the flames on the structure (i.e. the temperature that the steel may be heated to);

d) Determine whether the maximum steel temperatures would lead to structural failure, and if so, what level of fire protection would be required when tested to BS 476.

Internal Structure

Two methods were used to calculate the equivalent time of fire exposure: a) Direct Method (using Equation 31 from PD 7974-3); b) Graphical Method (using in-house program).

A number of different fire scenarios were considered.

Fire Scenarios

	Scenario	Direct Method	Graphical Method
1	Whole floor plate, level 2, BASE	52 mins	54 mins
2	One tenancy, level 2, BASE	51 mins	49 mins
3	1/3 of a tenancy, level 2, BASE	51 mins	47 mins
4	Office floor plate, level 2, BASE	51 mins	36 mins
5	Whole floor plate, level 2, 75% glazing failure	63 mins	67 mins
6	One tenancy, level 2, 75% glazing failure	54 mins	57 mins
7	1/3 of a tenancy, level 2, 75% glazing failure	53 mins	55 mins
8	Office floor plate, level 2, 75% glazing failure	51 mins	36 mins
9	Whole floor plate, level 2, Eurocode 1 fire load 80%	46 mins	49 mins
10	One tenancy, level 2, Eurocode 1 fire load 80%	46 mins	38 mins
11	1/3 of a tenancy, level 2, Eurocode 1 fire load 80%	46 mins	37 mins
12	Office floor plate, level 2, Eurocode 1 fire load 80%	46 mins	35 mins
13	Whole floor plate, level 2, Reduced lining factor	52 mins	54 mins
14	One tenancy, level 2, Reduced lining factor	51 mins	49 mins
15	1/3 of a tenancy, level 2, Reduced lining factor	51 mins	47 mins
16	Office floor plate, level 2, Reduced lining factor	51 mins	37 mins
17	Foggo tenancy, Level 2, BASE	51 mins	49 mins
18	Foggo tenancy, Level 2, 75% glazing failure	54 mins	57 mins
19	Foggo tenancy, Level 2, Eurocode 1 fire load 80%	46 mins	38 mins
20	Foggo tenancy, Level 2, Reduced lining factor	51 mins	49 mins
21	1/3 of tenancy, Lev 2, Centre, BASE	67 mins	71 mins
22	1/3 of tenancy, Lev 2, Centre, 75% glazing failure	86 mins	88 mins
23	1/3 of tenancy, Lev 2, Centre, Eurocode 1	60 mins	65 mins
24	1/3 of tenancy, Lev 2, Centre, Reduced lining fact	67 mins	71 mins

External Structure

This structure would be outside the fire compartment itself and so would only be affected by any flames and radiation that project out of the windows. The severity of this would normally be significantly lower than for the internal structure. The scenario that produces the highest flame temperature was used to analyze the effect on the external members.

Results

Structural Elements	Fire protection required when tested to BS 476
Deck structure and structure below deck level	120 minutes
Structure that only supports the roof	Not required
Main internal structure above deck level	90 minutes
Every other secondary beam	Not required
External Macalloy Bars	Not required
X Frame – 500x500x50 fabricated box section	Not required
X Frame – 400x400x16 SHS	41 minutes
X Frame Joints – 100mm plate	Not required
X Frame Compression bars – 711x40 CHS	45 minutes
X Frame Compression bars – 752x35.5 CHS	43 minutes
X Frame Tension bars – 550x300 solid bar	Not required
External Perimeter Bars – 500x200x16 RHS	45 minutes
External Elements – 457 CHS with thickness varying between 8mm to 25mm	42 minutes