Fire load:

An important factor in establishing the basis for the assessment of the fire risk pertaining to any building is the concept of 'fire load' which indicates the **quantity of heat liberated per unit area when a building and its contents are completely burnt.**

All occupancies/buildings, etc. can be graded according to their fire hazard and are to be provided for with suitable fire precautions on the basis of the fire load.

Hence, grading of buildings according to both fire load and fire resistance can be made.
The formula for calculating fire load is as stated.

$$\textbf{Fire load} = \frac{\textbf{(combustibles in kg) x calorific value in kcal/kg}}{\textbf{Floor area in square meters}}$$

The calculation of the fire load is the basis for the determining the classification of the occupancies for the fire grading of buildings.

Fire grading of the structures:

- ✓ Structural element of buildings are graded according to the the time factor which is nearly equal to but does not exceed the test period which the element fulfills its specified requirements.
- ✓ Accordingly, all structural elements have been graded under the following five categories depending upon their five resistance, viz.,

Grade 1…… 6 hours
Grade 2…… 4 hours
Grade 3…… 2 hours
Grade 4…… 1 hours
Grade 5…… 0.5 hours

Classification of Occupancies :

The fire offices committee (U.K.), in its report of fire grading of buildings in 1946, has recognized 3 main classes of occupancies on the basis of the fire load. This also conforms to the relevant I.S. specifications and may be stated as:

Occupancies of low fire load:
ordinary buildings for residential purposes, hotels, offices, schools, etc, or occupancies having a fire load not exceeding 2,75,000 kcal/sq.mtr of net floor area of any compartment, nor exceeding an average of550,000 kcal/sq.mtr on a limited isolated area. (for reference, the maximum for this type in F.P.S. system is 1,00,000 B.Th.U/sq.ft)

The fire resistance required by buildings of this category to withstand the complete burn-out of their contents without collapse is 1 hour as has been found after tests. Extensive investigations carried out in Switzerland and Germany have shown that the fire load in offices varies from 10 kg to 30 kg/sq.mtr wood equivalent to 43,356 to 130,068 kcal/sq.mtr where as this type of occupancy has an one hour rating with maximum fire loading upto 270,978 kcal/sq.mtr equivalent to 60 kg/sq.m.

Occupancies of moderate low fire load:
Retail shops, bazaars, stalls, factories, etc. hence the fire load exceeds, 2,75,000 kcal/sq.mtr, and is upto 550,000 kcal/sq.mtr.

This is equivalent to the fire load of 2,75,000 kcal/sq.mtr, not exceeding an average of 1,100,000 kcal/sq.mtr on limited isolated area as per relevant I.S. specifications. Occupancies of this type should have a fire resistance of two hours.

Occupancies of high low fire load:
Godowns, warehouses, etc. this category as per I.S. specifications exceeds the fire load by 550,000 kcal/sq.mtr, but does not exceed an average of 1,100,000 kcal/sq.mtr of floor area. A fire resistance of 4 hours for these types of occupancies is considered sufficient.

(for reference, the maximum for this type in F.P.S. system is 4,00,000 B.Th.U/sq.ft exceeding an average of 2,00,000 B.Th.U/sq.ft).

Example:

The manufacturing process industry uses the following material. Calculate the Fire load by using the following data:

Material	Quantity in kg.	Area in sq.mtr	Calorific value (kJ/kg)
Paper	1000	10	15600
Wood	20,000	20	17500
Coal	100,000	50	20000
Rubber	5000	25	40000
Paetroleum product	50,000	30	43000

Note: 1 calorie – 4.18 Joule

Fire load = (combustibles in kg) x calorific value in kcal/kg
Floor area in square meters

Fire load (paper) = $\frac{1000 \times 3732.05}{10}$ = 373205.74 kcal/sq.mt

Fire load (wood) = $\frac{20000 \times 4186.602}{20}$ = 418602 kcal/sq.mt

Fire load (coal) = $\frac{100{,}000 \times 4784.688}{50}$ = 9569377.99 kcal/sq.mt

Fire load (rubber) = $\frac{5000 \times 9569.37}{25}$ = 1913874 kcal/sq.mt

Fire load (Petroleum products) = $\frac{50{,}000 \times 10287.081}{30}$ = 17145135.57 kcal/sq.mt

Total fire load = 29420195.3 kcal/sq.mt

Result indicates that the occupancy has High fire load. So fire resistance should be of 4 hours.

Installation of fire extinguishers:

Example:

(1) Determine the number of fire extinguishers required to give adequate protection for a given property.

Risk: Light engineering workshop (Light hazard)
Area: 315m x 112 m. i.e. 35,280 sq. mtr.

Type of hazard:
Class 'A' fire due to normal combustibles.

As per IS 2190 this is Light Hazard so one 9 ltr water expelling extinguisher for every 600 sq.mtr of floor area should be installed. Extinguisher should be available within 25 mtr radius.

Here Total area is 35,280 sq.mt.

So no. of extinguisher = $\frac{35,280 \text{ sq.mt}}{600}$. = 58.8

so no. of extinguisher required is 59.

(2) Determine the number of fire extinguishers required to give adequate protection for a given property.

Risk: Petroleum processing units (High hazard)
Area: 300m x 150 m. i.e. 45000 sq. mtr.

Type of hazard:
Class ‘B’ fire due to petroleum products.

As per IS 2190 this is High Hazard so two 9 ltr foam chemical/mechanical type; or 5 kg capacity dry powder extinguisher for every 600 sq.mtr with minimum of four extinguisher per compartment shall be installed. Extinguisher should be available within 15 mtr radius.

Here Total area is 45000 sq.mt.

So no. of extinguisher = $\frac{45000 \text{ sq.mt}}{600}$. = 75

so no. of extinguisher required is 75.