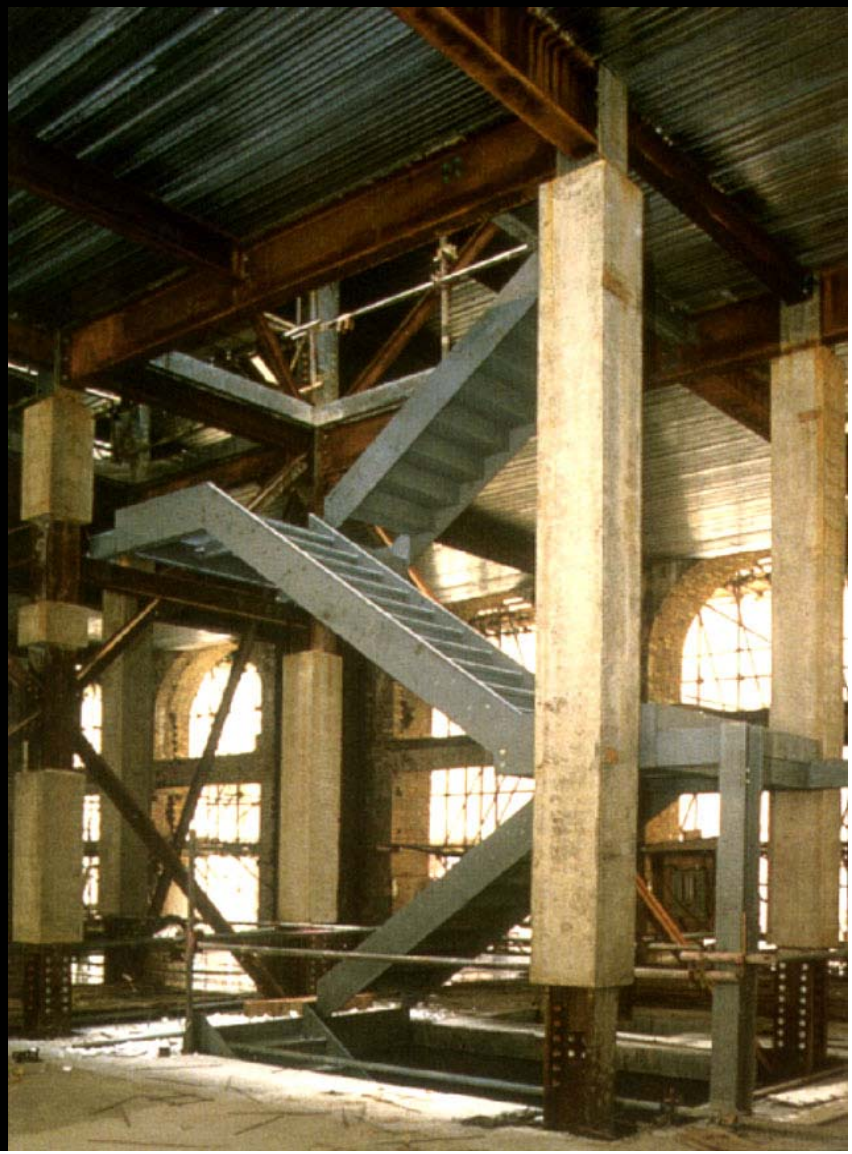


LTA LAU HENG HUI
FSSD

Scope

- Introduction
  - Element of Structure
  - Fire resistance rating
- Fire protection to steel structure
  - Intumescent paint
  - Fire rated board
  - Vermiculite spray
- Conclusion

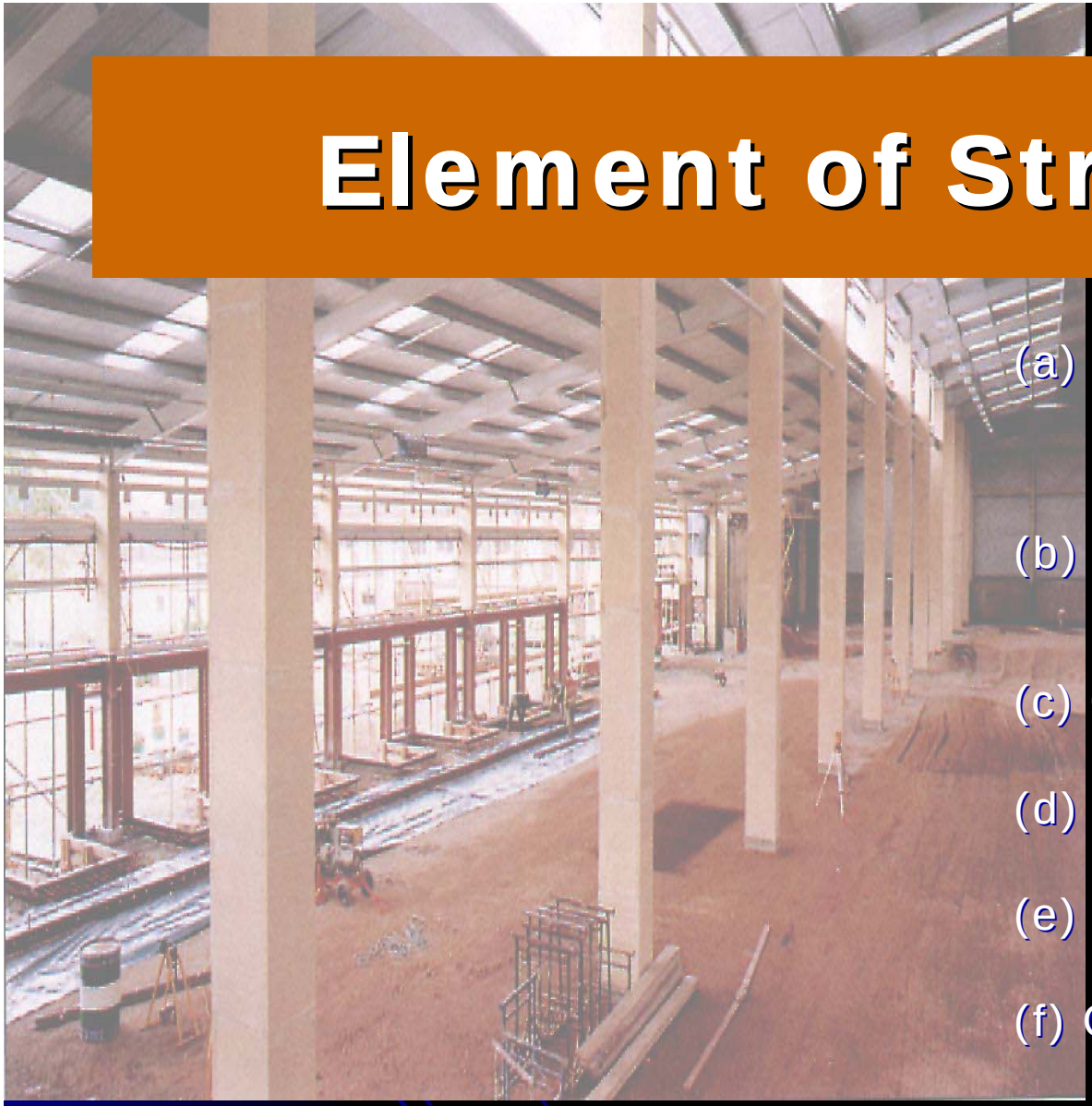


Introduction

Element of Structure



Element of Structure



(a) A member forming part of the structural frame of a building

(b) A loadbearing wall or loadbearing part of a wall

(c) Compartment floor

(d) External wall

(e) Separating wall

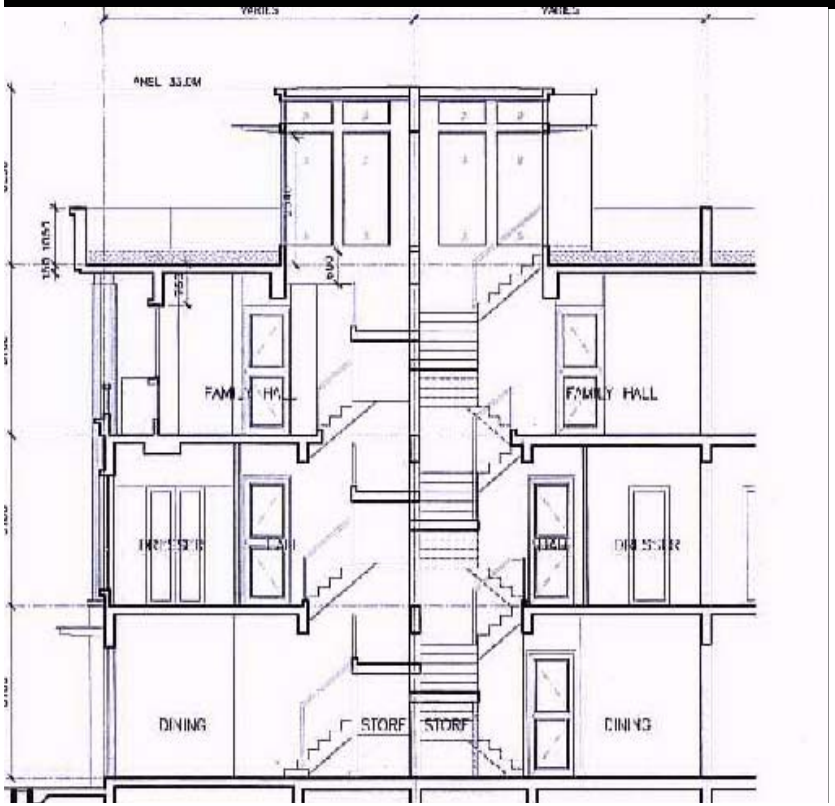
(f) Compartment wall

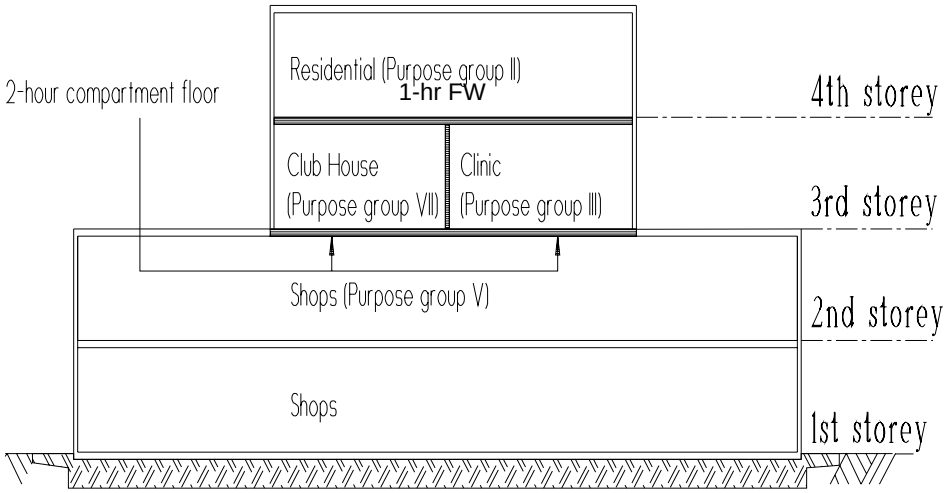
(g) Structure enclosing a protected shaft

CONSTRUCTION OF ELEMENTS OF STRUCTURE

Shall be constructed of non-combustible and have fire resistance rating for not less than the relevant period specified in

Table 3.3A (Fire Code)





Section

BUILDINGS OTHER THAN SINGLE STOREY BUILDINGS
Purpose Group VI and VIII

Purpose Group	Maximum dimensions			Maximum period of fire resistance (in hours) for elements of structure (*) forming part of:-	
	Height (in m)	Floor area (in m^2)	Cubical Extent (in m^3)	Ground storey or upper storey	Basement storey
(1)	(2)	(3)	(4)	(5)	(6)
VI (Factory)					
(Line 1)	7.5	250	NL	$^1/_2$	1(a)
(Line 2)	7.5	NL	1,700	$^1/_2$	1
(Line 3)	15	NL	4,250	1(b)	1
(Line 4)	28	NL	8,500	1	2
(Line 5)	28	NL	28,000	2	4
(Line 6)	**Over 28**	**2,000**	**5,500**	**2**	**4**
VIII (Storage & general)					
(Line 1)	7.5	150	NL	$^1/_2$	1(a)
(Line 2)	7.5	300	NL	$^1/_2$	1
(Line 3)	15	NL	1,700	1(b)	1
(Line 4)	15	NL	3,500	1	2
(Line 5)	28	NL	7,000	2	4
(Line 6)	28	NL	21,000	4(c)	4
(Line 7)	Over 28	1,000	NL	4(c)	4

FIRE RESISTANCE RATING



- Ability to resist spread of fire
  - Stability
  - Integrity
  - Insulation
- Fire resistance is expressed in terms of minimum period of time where element functions satisfactorily
- **BS 476 Part 20 to 23**



FIRE RESISTANCE MATERIAL

- Listed under the **PLS (Product Listing Scheme)**
  - Tüv Süd PSB Pte Ltd (formerly PSB corporation)

- Comply with requirements stated in Fire Code



Importance of protecting the element of structure

- Prevent premature collapse of building
- Evacuation of occupants
- Fire fighters to carry out fire fighting and rescue operations



Fire Protection of Steel Structure

- Traditional/Common form of fire protection
  - Concrete encasement

ADVANTAGES

- Durable and robust

DISADVANTAGES

- Building weight increases considerably due to thick encasement
- Time consuming at site to carry out encasement works
- Overall size can be quite large as compared to bare steel and other systems

Protection of Structural Steel with Intumescent Paint

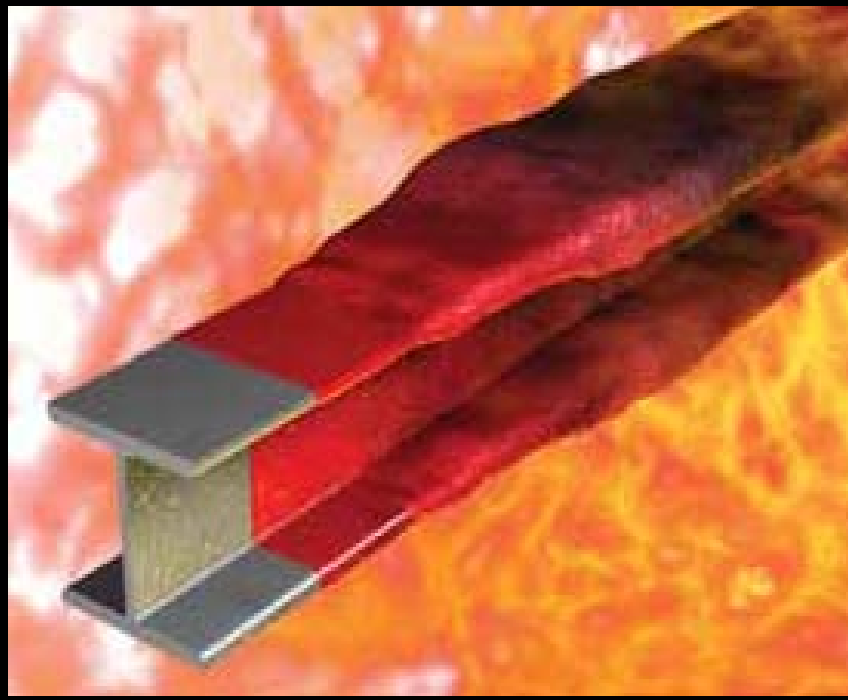




INTUMESCENT PAINT

-Intumescent coating to give fire protection to steel structure is permissible as long as it is :

- applied appropriately
- environment is non-detrimental to the fire protective properties of the coating
- only intumescent paint products listed in the PLS are acceptable to SCDF.

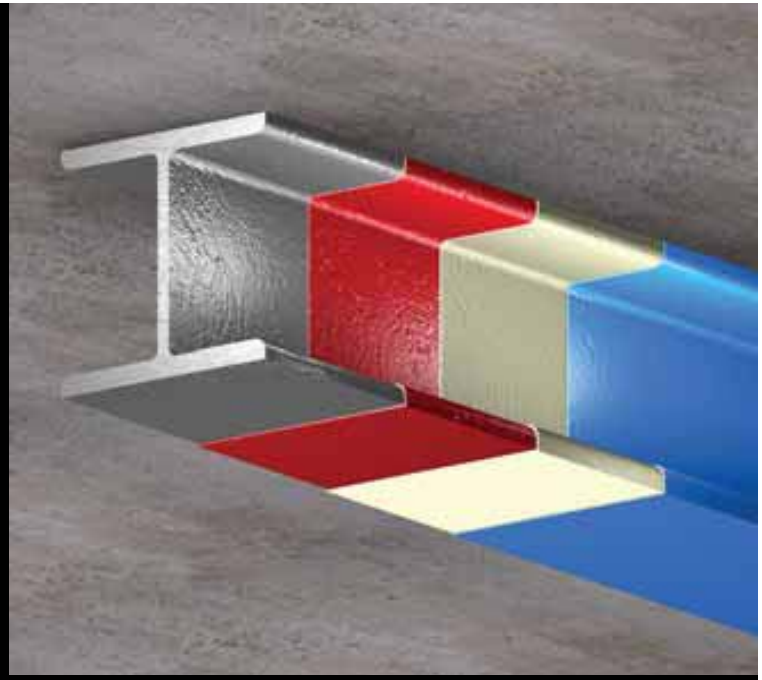


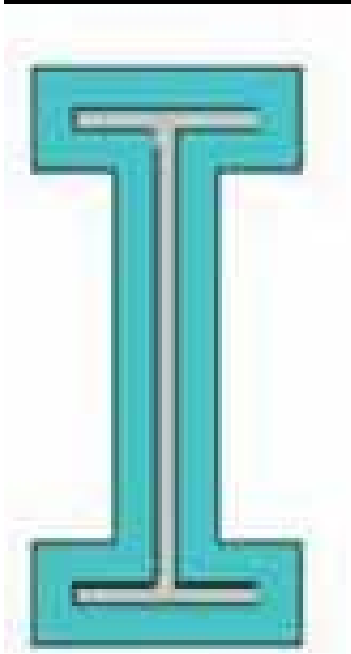
How does intumescent paint work?
Thin coating of intumescent expands up to 50 times to form a layer of insulating foam

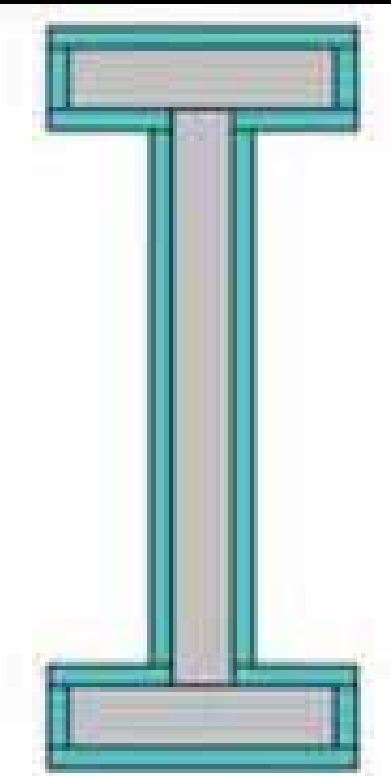
No restriction of height

INTUMESCENT PAINT

The thickness of the intumescent layers depends on:
(a) steel size
(b) steel type
(c) used as column or beam
(d) fire rating required







- Intumescent paint used at the site must be the SAME as the one used in the mock-up fire test.

Intumescent Paints

- Weathering test **BS 8208: Part 2**
- Fire resistance test **BS 476: Part 20/21**
- Fire resistance rating of tested specimen **> 75%** of the original prototype.
- Finishing external coating in different colours acceptable





ADVANTAGES

- Allow building structure to be expressed architecturally
- Off site application possible

DISADVANTAGES

- Inspection and maintenance on a regular basis
- Up to 2 hours fire resistance

Intumescent Paint

- Industrial buildings and warehouses

  - Presence of **corrosive** atmosphere
    - QPs are to consult SCDF

- Highly **flammable/combustible** materials should not be stored within the vicinity of any structural steel members protected by intumescent paint.

- **Appendix F** of Fire Code



Procedures & Documents for Submission Annex F (Fire Code)

- **Plan Submission**
  - QP to submit a separate set of plans
    - locations of the structural steel members that are/will be coated with intumescent paint
- **Fire safety report**
  - If building exceed 1 storey
  - Useful reference



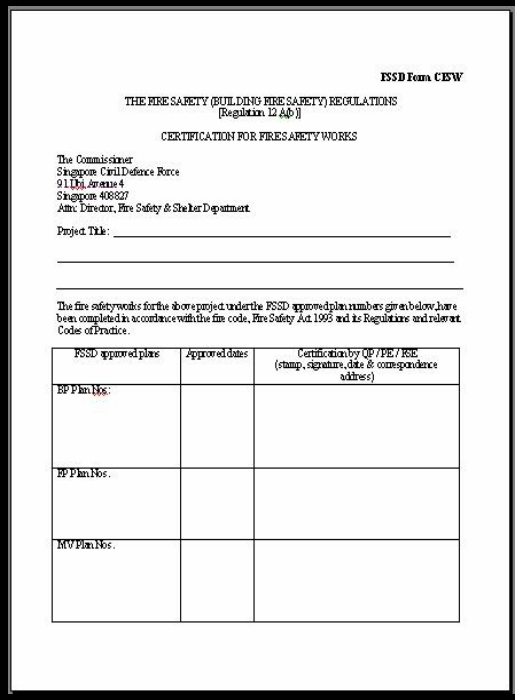
Procedures & documents for submission
Annex F (Fire Code)

SIGNAGE

- **A signage depicting the following minimum information shall be fixed at a conspicuous location:**

  (a) Name of supplier
  (b) Fire resistance rating of the intumescent paint
  (c) Date of painting
  (d) Expected date of re-painting
  (e) Caution note: *"Caution: No other paint/coating shall be applied to the surfaces of the structural steel members protected by the intumescent paint system"*

- **Fire Safety Manager**
  - Regular inspection
  - Records of inspection shall be properly kept
- Annual renewal of **Fire Certificate**
- **Addition/Alteration** in building
  - QP to submit plans to FSSD
  - Certification of registered inspector (RI) inspection
  - Fire safety report to be updated accordingly



FSSD Form CEW

THE FIRE SAFETY (BUILDING FIRE SAFETY) REGULATIONS
[Regulation 12 A(b)]

CERTIFICATION FOR FIRE SAFETY WORKS

The Commissioner
Singapore Civil Defence Force
91 Ubi Avenue 4
Singapore 408827
Attn: Director, Fire Safety & Shelter Department

Project Title: _____

_____

_____

The fire safety works for the above project under the FSSD approved plan numbers given below, have been completed in accordance with the fire code, Fire Safety Act 1993 and its Regulations and relevant Codes of Practice.

FSSD approved plans	Approved dates	Certification by QP / PE / RSE (stamp, signature, date & correspondence address)
BP Plan Nos.:		
EP Plan Nos.:		
MV Plan Nos.:		


Protection of Structural
Steel with
fire rated board

Fire Rated Boards

- Meet the required fire resistance

- Non-combustible calcium silicate / gypsum plaster boards

- Water absorption and bending strength performance
  - BS 1230 Pt 1 (Gypsum plaster board)
  - ISO 1896 (Calcium silicate / cement board)

-



Fire Rated Boards

- Impact & deflection performance
  - BS 5588 Pt 5 Appendix A
  - BS 5234 Pt 2

- Up to 2 hours fire resistance

- Proprietary board systems installed in accordance with manufacturer's specifications



Fire Rated Boards

- No restriction of fire rated board for any particular type of building

- Factories/Industrial buildings/warehouses

  - Presence of corrosive atmosphere that may affect the effectiveness of fire rated board
  - QP to consult SCDF



- Areas subject to explosion risks

- No height control in Fire Code 2007

- Fire safety report for buildings > single storey

ADVANTAGES

- Easy to install
- Easy to finish with decorative materials

DISADVANTAGES

- Holes cut into the board have to be filled with a comparable fire protection material
- Replacement is required after fire

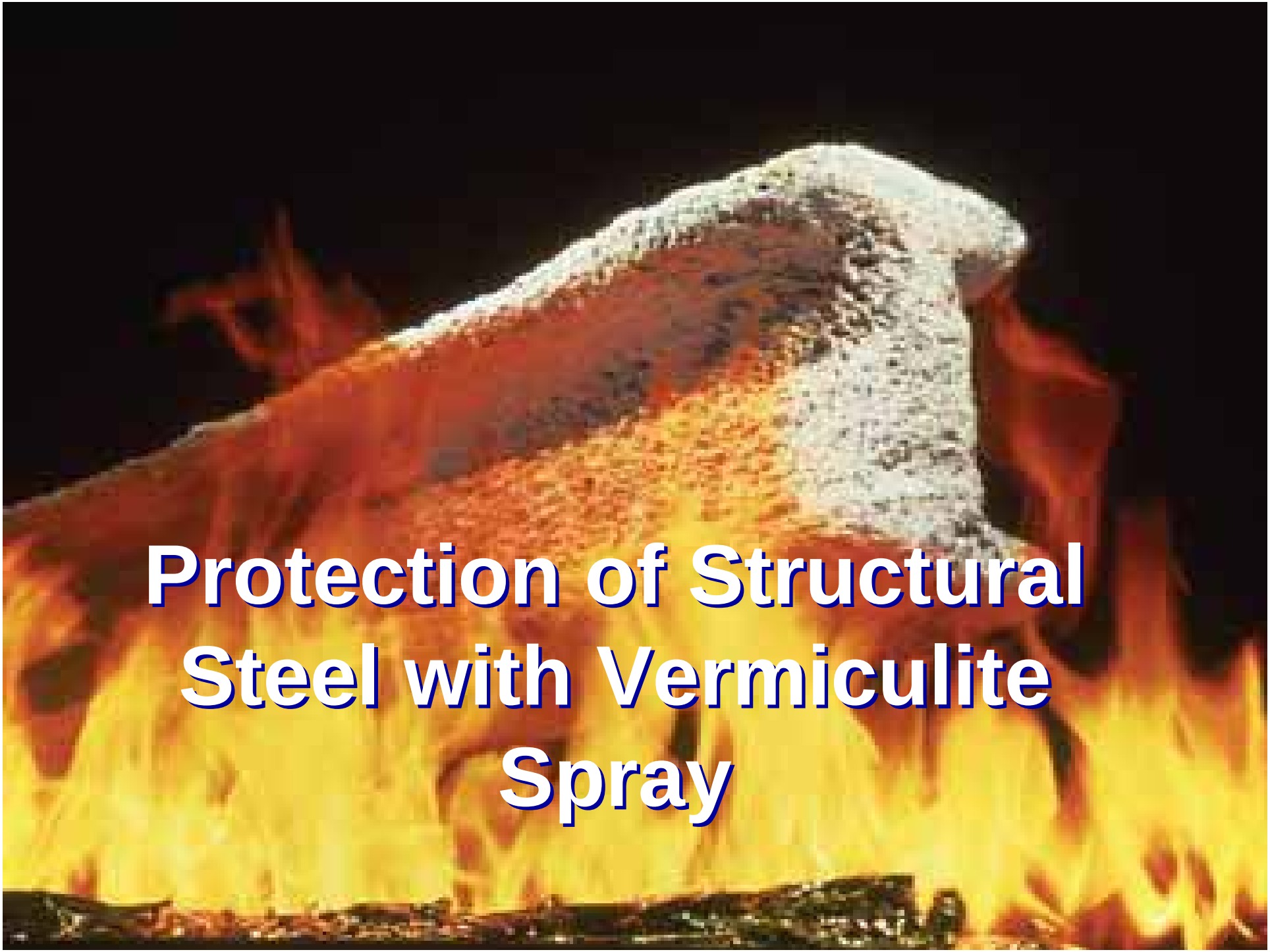
Fire Rated Boards

- Fire rated boards need not be constructed to be in full contact with steel element

- Gap to be filled with non-combustible material

- to provide support to the boards




Protection of Structural Steel with Vermiculite Spray

Vermiculite Spray

- Cementitious spray fire proofing material
  - -Aggregrates/fibres
  - -Gypsum/Portland cement
  - -Binders

- Products available in the market
  - -Fast-setting characteristic
  - -Higher field application efficiency

- Fire tests for spray material
  - -Required thickness
  - -Environmental conditions



Vermiculite Spray

- Can be used on structural steel columns, beams, joists, trusses, floor and roof decking

- For application at columns, the spray-on material will be more susceptible to damage during construction, fitting out or maintenance





ADVANTAGES

- Lower cost compared with other passive fire protection system
- Easy to apply
- Quicker in application through spraying

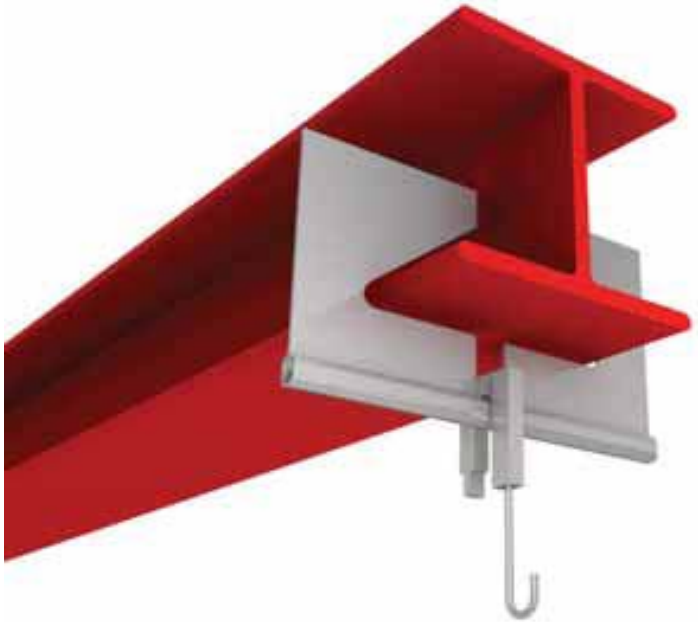
DISADVANTAGES

- Application method is wet, and can be messy when the building is in use
- Compared to architectural finishes, the resulting textured surface finish is not as aesthetically pleasing
- Spray-on material needs to be protected from damage during construction, fitting-out or renovations
- Not suitable for off-site application due to the risk of damaging the protection during transportation and erection

NOTE:

1. **Installation of services such as ducts, piping, equipment etc shall be done after fire proofing is completed**

2. **Installation such as clips, hangers, etc shall be done before application of vermiculite spray**





CONCLUSION

- Steel structure complies with Fire Safety requirements
- Maintenance by building owner


THANK YOU