

Fire Officer Perspective: A Light Gauge Steel Case Study



John Cummins, SEFPO
Cork City Fire & Building Control Dept

14 March 2024



Introduction

- Modern methods of construction (MMCs) add a layer of complexity to fire safety design (and construction)
- MMCs present novel fire risks – compliance with TGD B does not indicate *prima facie* evidence of compliance with Part B of Building Regs
- Probably additional risks associated with MMC are not mitigated against in TGD B



Introduction (Contd.)

- NSAI Agrément certs go some of the way but:
 - Test certs have limitations
 - New systems will have new risk that emerge (just like old systems)
 - These new risks in new systems might be significant
- Do new combinations have significant new risks?
 - ICF/ timber frame junctions
 - ICF/ masonry junctions
- What are the fire implications and where does Building Control fit into our picture?
 - Does the detail make sense to BC
 - Is there something missing or does it contradict another TGD

Introduction (Contd.)

- Judgement calls:
 - How far do we chase ‘novel risks’?
 - How do we establish if a new risk is really significant?
 - What can we reasonably be expected to foresee?



Light Gauge Steel (contd.)



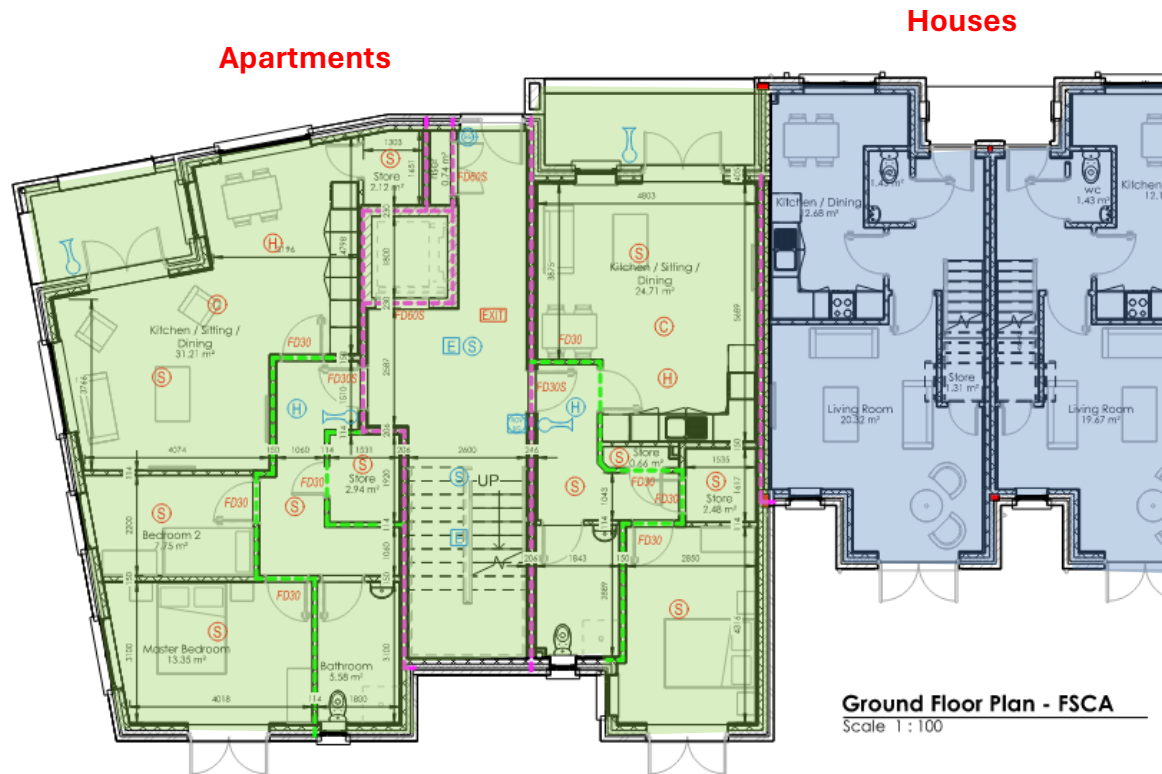
Source: Remagin



Source: Remagin

Example Issue – LGS Separating Wall

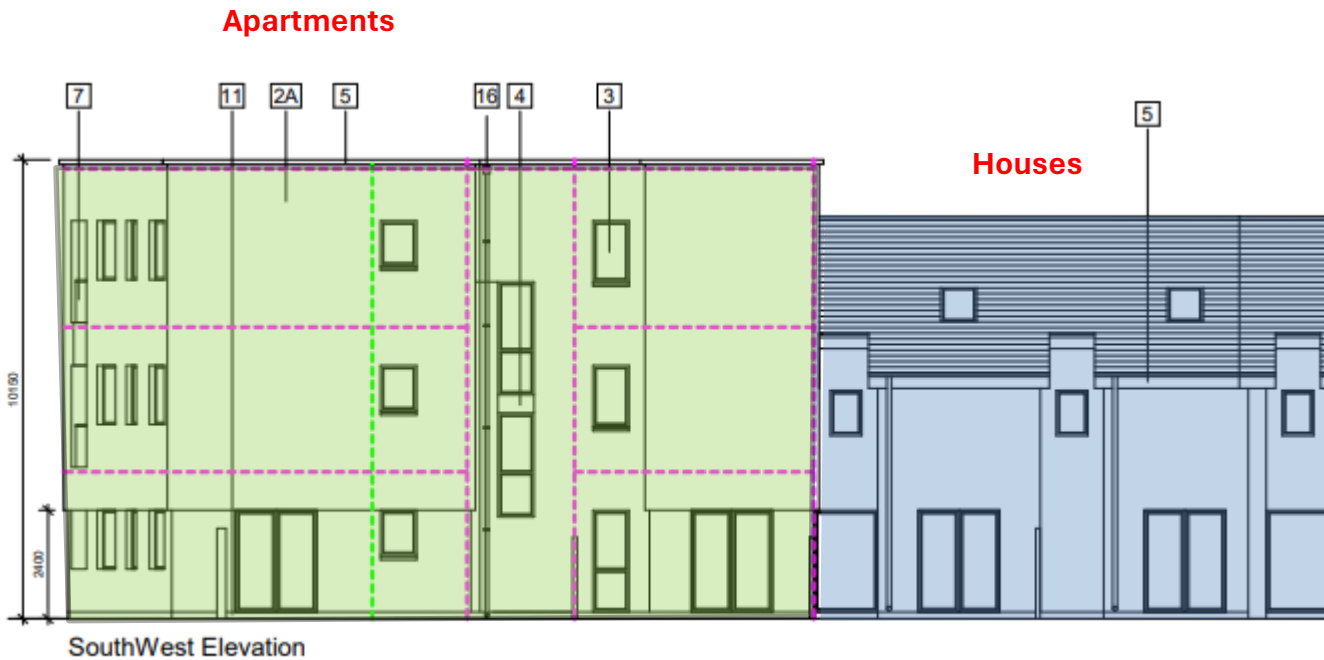
- FSC application for a three storey LGS apartment building attached to a terrace of LGS houses in Cork City



Source: DOSA Consulting Engineers

Example Issue – LGS Separating Wall (Contd.)

- Straightforward design
- LGS structural wall panels with composite steel/concrete floors



Source: DOSA Consulting Engineers

NSAI Agrément Cert

- System approved up to six storeys
- Panels tested in accordance with IS EN 1365-1: Fire resistance tests for loadbearing elements – Walls
- Queries responded to by Evulusion Innovation structural consultants on behalf of LGS manufactures (Remagin, prev. Horizon Offsite), on behalf of fire consultant



CI/SIB | (47) Ln6

IRISH AGRÉMENT BOARD
CERTIFICATE NO. 18/0404

Horizon Offsite Ltd.,
Unit A Cahir Business Park,
Cahir, Co. Tipperary,
E21 TF89.
T: +353 (0)52 744 1424
W: www.horizonoffsite.ie

Horizon Offsite Steel Frame Building System

NSAI Agrément (Irish Agrément Board) is designated by Government to issue European Technical Approvals. NSAI Agrément Certificates establish proof that the certified products are 'proper materials' suitable for their intended use under Irish site conditions, and in accordance with the **Building Regulations 1997 to 2017**.



NSAI Agrément Cert (Contd.)

- What isn't covered in TGD B that needs to be to comply with Building Regs?
- Detailed *NSAI Agrément Cert* in place for LGS systems - very good coverage of fire safety - certifies compliance with Building Regs
- Certified in this case up to 6 storeys – significant building size



NSAI Agrément Cert (Contd.)

Table 4b: Fire Data for Separating Wall and Non-Load Bearing Wall Elements

Separating Walls*				
1	Twin Frame Wall <ul style="list-style-type: none"> Panel dimensions and test load per 2 Table 4a Two layers of 12.5mm Knauf Fire Panel (Type F plasterboard) fixed per 2 Table 4a LGS C-Studs (89x45x1.2mm) 100mm stone mineral wool insulation (22kg/m³ density) between the studs 50mm cavity LGS C-Studs (89x45x1.2mm) 100mm stone mineral wool insulation (22kg/m³ density) between the studs Two layers of 12.5mm Knauf Fire Panel (Type F plasterboard) fixed per 2 Table 4a 	IS EN 1365-1 ^[30]	60 mins from either side	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5

SUBMITTED ON: 10/12/2022

Table 4a: Fire Testing Conducted for Loadbearing Wall and Floor Elements

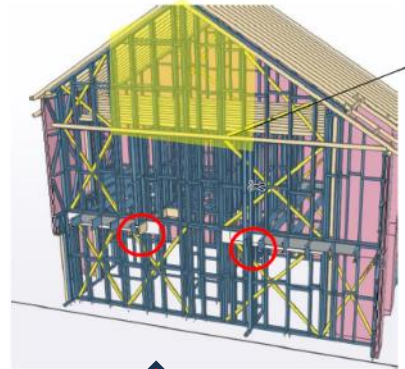
Type	Element	Test Standard	Results	Purpose Class
External Load Bearing Walls				
2	<ul style="list-style-type: none"> Test conducted on 3000mm high x 3000mm wide panel with uniformly distributed load of 60kN 6 No. LGS C-Studs (89x45x1.2mm) at 600mm centres and noggins at mid height First (inner) layer 12.5mm Gyproc Fireline (Type F plasterboard) fixed to the fire side face using Hilti AG Collated Steel Screws (S-DD01B 2007770) 3.5x35mm at max 300mm centres within the field of the boards and max 200mm centres along the board joints Second (outer) layer 12.5mm Gyproc Fireline (Type F plasterboard) fixed to the fire side face using Hilti AG Collated Steel Screws (S-DD01B 2007770) 3.5x55mm at max 300mm centres within the field of the boards and max 200mm centres along the board joints 75mm Kingspan Thermawall TW55 fixed to the non-fire side 100mm Rockwool RWA45 (45kg/m³ density) fitted between studs 2 No. Double Sockets were fitted on the fire side 	IS EN 1365-1 ^[30]	60 mins from exposed side	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5


NSAI Agrément Cert (Contd.)

- Which means:



This  is tested



This  is built onto a 3 storey LGS apartment building

1. So how are the separating wall panels connected together vertically?
2. Are they relying on floors with lower fire resistance to hold them up?
3. What happens if the floor falls away and exposes LGS panels?

Check with Building Control!
Does all this make sense to them

Separating Walls

1. *How are the separating wall panels connected together vertically?*

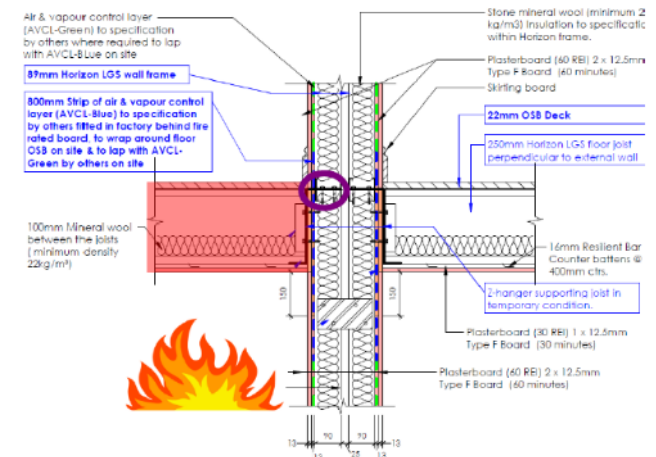
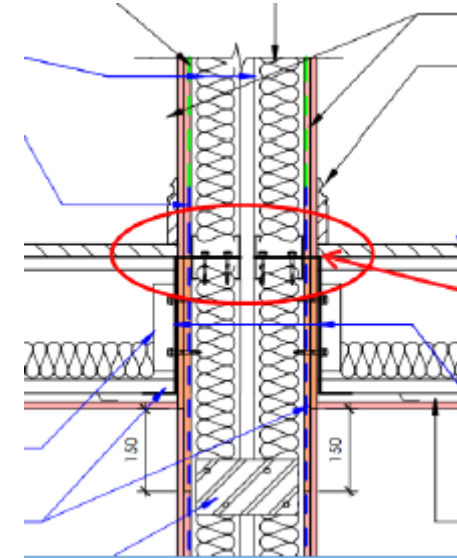
Screwed together at or around floor level

2. *Are they relying on floors with lower fire resistance to hold them up?*

Yes, laterally supported by floors

So do the floors have a lower level of fire resistance (elements of structure supporting?)

Yes, but they would be supported by a floor on the other side of the wall in the event of a fire



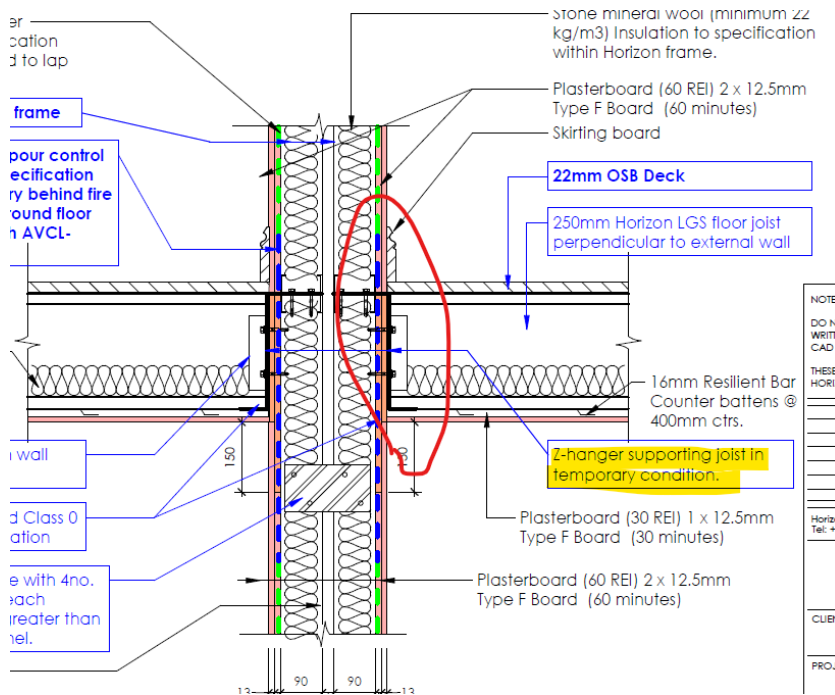
SD-057a - Joists to Party Wall

SCALE 1:10

Separating Walls (Contd.)

3. What happens if the floor falls away and exposes LGS panels to a fire?

A steel 'Z hanger' will stay in place and protect the steel



Not sure about this... need more reassurance!

The Issue

- CCFB provided with:
 - Explanation of separating wall buildup
 - Test report of single separating wall panel
- Fairly high temperatures on inside face of panel (360°C after 30 mins)
- What does that mean? Anything?



Source: Evolusion Innovation

The Issue (contd.)

- Separating walls laterally supported by floors with lower (or no) fire resistance
- What happens if floor falls away early? Does it expose separating wall to collapse? Is this a 'fatal flaw'?
- Is heat transfer an issue?
- What are the consequences of having an untested, non independently verified arrangement?

Testing

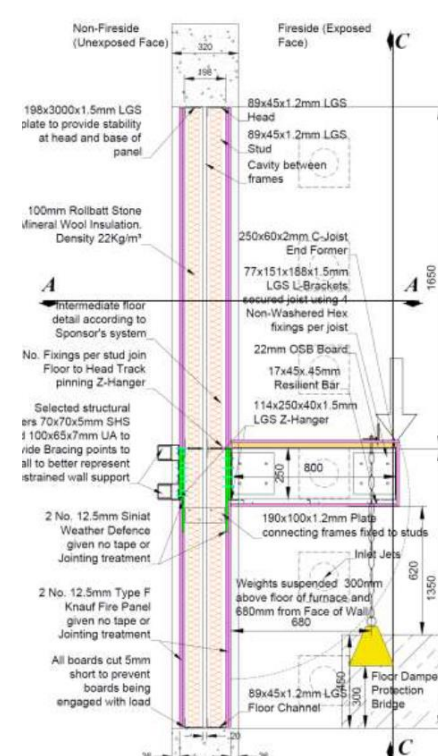
- Supplier decided to carry out indicative test to IS EN 1365-1 (Remagin then known as Horizon Offsite and Evolusion Innovation)
- CCFD granted FSC with floor upgrade condition
- Indicative (non-standard test) – *Efectis*, Jordanstown, NI
- Proposed set up with Cork City FD (testing is expensive and time consuming)

IS EN 1365-1 Test

- Loadbearing capacity performance criteria :
 - Deflection: <30mm in time period (30 mins)
 - Deflection rate: <9mm/min
- Integrity performance criteria:
 - No ignition of cotton pad within time period
 - No gap > 6mm wide and 150mm long
 - No gap > 25mm
 - No sustained flaming
- Insulation performance criteria:
 - 140°C average temperature increase on unexposed side
 - 180°C temperature increase on unexposed side

IS EN 1365-1 Test (contd.)

- The indicative bit of the test – ‘floor’ doesn’t cause mechanical damage to protective plasterboard exposing LGS steel frame to fire



Source: Evolution Innovation

Testing (Contd.)



Source: *Evolution Innovation*

Testing (Contd.)



Test Results



Efectis UK / Ireland Ltd
Shore road
Jordanstown
BT37 0QB County Antrim
Northern Ireland

TEST REPORT

FIRE TEST REPORT EUI-21-000633

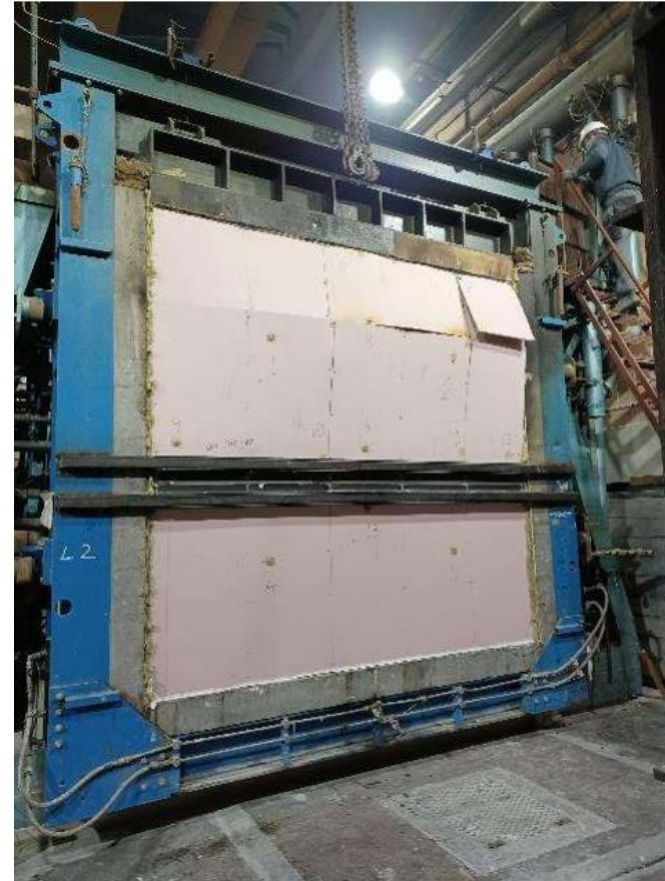
According to BS EN 1363-1:2020 and BS EN 1365-1:2012

Test	REPORT EUI-21-000633
Performed on	28 th January 2022
Regarding	Interactive fire test comprised of full-scale loadbearing wall with cantilevered loaded floor attached to the exposed side
Sponsor	HORIZON OFF SITE LTD Unit A, Cahir Business Park Cahir, Co. Tipperary E21 TF89 IRELAND

Test Results (Contd.)



Post test exposed side wall panel (source: Evolusion Innovation)



Post test unexposed side wall panel (source: Evolusion Innovation)

Test Results (Contd.)

- Failure of '30 min' floor after 87 mins
- Passed load bearing capacity, integrity and insulation tests
- Protective longitudinal bracket connecting floor to wall stayed in place
- Plasterboard not mechanically damaged by floor falling away (59 mins)
- A pass?

11.1. FIRE INTEGRITY	
11.1.1. Cotton wool pad	
Duration:	EIGHTY-SEVEN MINUTES (87 min)
Cause of limitation:	Failure on load-bearing capacity.
11.1.2. Gap gauges	
Duration:	EIGHTY-SEVEN MINUTES (87 min)
Cause of limitation:	Failure on load-bearing capacity.
11.1.3. Sustained flaming	
Duration:	EIGHTY-SEVEN MINUTES (87 min)
Cause of limitation:	Failure on load-bearing capacity.
Thermal insulation	
11.1.4. Thermal insulation	
Duration:	EIGHTY-SEVEN MINUTES (87 min)
Cause of limitation:	Failure on load-bearing capacity.
11.1.5. Deflection	
Duration:	EIGHTY-SEVEN MINUTES (87 min)
Cause of limitation:	Maximal rate of deflection reached.
11.1.6. Rate of deflection	
Duration:	EIGHTY-SEVEN MINUTES (87 min)
Cause of limitation:	Maximal rate of deflection reached.

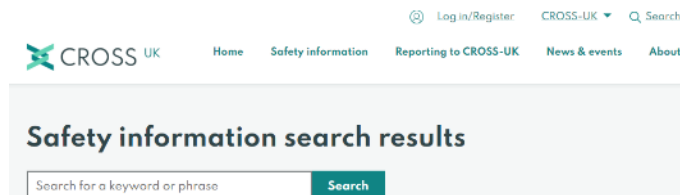
Learnings

Means of escape in case of fire.	B1	A building shall be so designed and constructed that there are adequate means of escape in case of fire from the building to a place of safety outside the building, capable of being safely and effectively used.
Internal fire spread (linings).	B2	For the purpose of inhibiting the spread of fire within a building, the internal linings - (a) shall have, either a rate of heat release or a rate of fire growth and a resistance to ignition which is reasonable in the circumstances (b) shall offer adequate resistance to the spread of flame over their surfaces
Internal fire spread (structure).	B3	(1) A building shall be so designed and constructed that, in the event of fire, its stability will be maintained for a reasonable period. (2) (a) A wall common to two or more buildings shall be so designed and constructed that it offers adequate resistance to the spread of fire between those buildings. (b) A building shall be sub-divided with fire resisting construction where this is necessary to inhibit the spread of fire within the building. (3) A building shall be so designed and constructed that the unseen spread of fire and smoke within concealed spaces in its structure or fabric is inhibited where necessary. (4) For the purposes of sub-paragraph 2(a), a house in a terrace and a semi-detached house are each to be treated as being a separate building.
External fire spread.	B4	The external walls and roof of a building shall be so designed and constructed that they afford adequate resistance to the spread of fire to and from neighbouring buildings.
Access and facilities for the fire service.	B5	A building shall be so designed and constructed that there is adequate provision for access for fire appliances and such other facilities as may be reasonably required to assist the fire service in the protection of life and property.

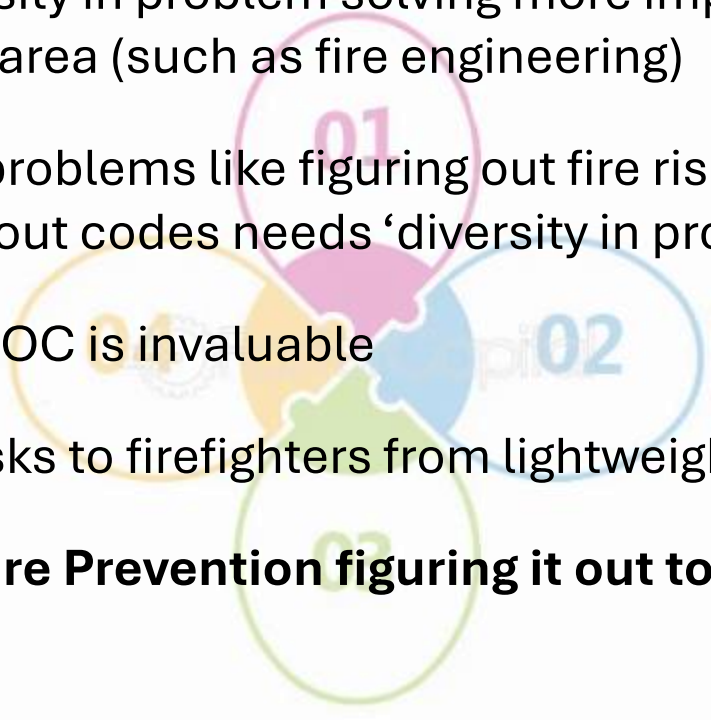
- Technical competence of MMC manufacturer important
- Proactive approach of manufacturer helps (in this case good engagement)
- Establishing what Part B noncompliant risks are (that aren't covered by TGD B) is key
- Figuring out if those risks are significant takes careful judgement

Learnings (Contd.)

- Analysis of fire issues in MMC is not easy – especially figuring out what’s a significant risk and what's not:
 - In an individual building
 - Across all buildings in the local authority area (statistical risk)
- Need to form an understanding on how the structure will react in fire (and afterwards)
- Testing is probably not usually the answer – slow and probably better organised nationally
- Independent resources like CROSS UK are invaluable



The BIG Learning

- Research says diversity in problem solving more important than expertise in a single area (such as fire engineering)
 - Relatively complex problems like figuring out fire risks in MMC building design without codes needs ‘diversity in problem solving’
 - Having a technical POC is invaluable
 - Concerned about risks to firefighters from lightweight construction
 - **Building Control/ Fire Prevention figuring it out together is probably key**
- 

The BIG Learning (contd.)

- A lot of MMC system fire issues seem to ‘detail’ related, such as:
 - Firestopping in volumetric modular
 - Onsite assembly of LGS
 - Junctions between different MMC systems/ MMC and conventional construction (e.g. ICF/ timber frame)
- Buildability logic is more important for Fire Prevention Officers
- Building Control Officers have the competence to advise on credibility
- Have to consider of manufacturers technical input also

Final Thoughts

- Design issues and construction issues – which is bigger in MMC?
- During construction inspections essential
- MMC building defects issues



'Paragon' 17 storey volumetric modular building – evacuated



Amsterdam apartment volumetric modular building – demolished post fire



Shetland SIPS modular hotel fire

QUESTIONS?



John Cummins

086 1027814

john_cummins@corkcity.ie

