Tipperary
Fire & Rescue Service

Framed Construction – Dwelling Fires

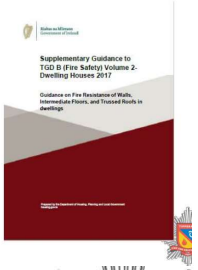
Assistant Chief Fire Officer – John Hoctor BE CEng MIEI

Agenda

- Dwelling fires - framed construction failures
- House stock - current & planned
- Construction Trends
- A fire engineering perspective
- Tipperary Fire & Rescue Service approach
- FF emergency response - suggestions to consider ?

Good News

- Significant decline in fire fatalities in Ireland over the last 20 years
- Irish Fire fatalities below 6 per million of population =in the league of countries that have minimised fire deaths 2021 US =13.0 deaths per million
- TGD B Vol2 FDAS = LD2 in all houses
- Supplementary Guidance to TGD B (Fire Safety)
- Comprehensive Community Fire Safety Programme
- NSAI - IS440 for timber frame construction
- NSAI - Agrement certs for other framed construction



Busy NDFEM environment

Minister O'Brien thanked the outgoing Board and welcomed the incomi
Board.

Minister O'Brien noted the following priorities for 2024/25:

- Retained Review and implementing the WRC agreement;
- National Mobilising & Communications Programme;
- Capital Programme;
- Equality, Inclusion and Diversity in the Fire Service;
- External Validation process for all Fire Services;
- Stardust Inquest, anticipating findings and recommendations;
- Urban Search & Rescue capacity;

Construction Sector

159,300 construction sector employees

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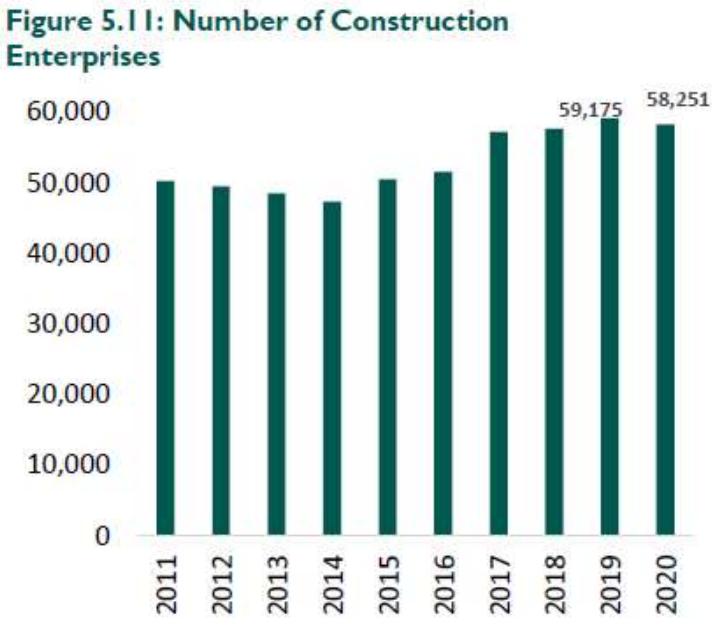


2023 NFPA Report Firefighters Fatalities in the US

- 2023 = 89 US firefighters 40 % of fireground fatalities at residential properties
- Number of injuries at structure fires due to roof or floor collapses = reminder that building fires are burning hotter and faster due to the proliferation of synthetic materials in indoor furnishings and engineered structural components.
- Firefighter consideration for the potential of a premature failure of structural components

Why is US data relevant ?

2011 review Fire in timber frame buildings - A review of fire statistics from the UK and the USA

Our best estimate of Lightweight Timber Frame dwellings is:

- 1.7% in England;
- 1.5% in Wales;
- 9.9% in Scotland; and
- **90% in the United States**

LTF building restriction	USA	UK
Unsprinklered height	40ft (typically three floors)	No restriction
Maximum area before significant structural firewall required	2000m^2	No restriction
Sprinklers mandated	All multiple occupancy dwellings	Not mandated

https://cfpa-e.eu/app/uploads/2022/06/Article-2-from-Jim-G.pdf

SAFETY & HEALTH

Lightweight Truss Systems: A Killer of Firefighters

Gary Morris reports that testing reveals the effects of fire on lightweight truss systems and pose early collapse potential.

- Phoenix Fire Department partnered with NIST to conduct live-fire testing on lightweight truss systems
- The Phoenix Fire Department review refers to the 17-minute and eight-minute collapse time factors as “dangerously and deceptively high.”

Fire Research Division Building and Fire Research Laboratory National Institute of Standards and Technology
https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=101408

OFFALY INDEPENDENT

Deirdre Verney

Fri 15 Oct 2021, 1:24 PM
Fri 15 Oct 2021, 2:43 PM

The scene of the house fire yesterday.

UPDATE: Local firefighter suffers extensive injuries following 'devastating' house fire

Edinburgh school wall collapse report highlights 'lack of scrutiny

The problems first became apparent when engineers examined the wall that collapsed at Oxgangs Primary during stormy weather

Milford Manor Estate
Newbridge fire March 2015

Dwellings – age profile to 2012

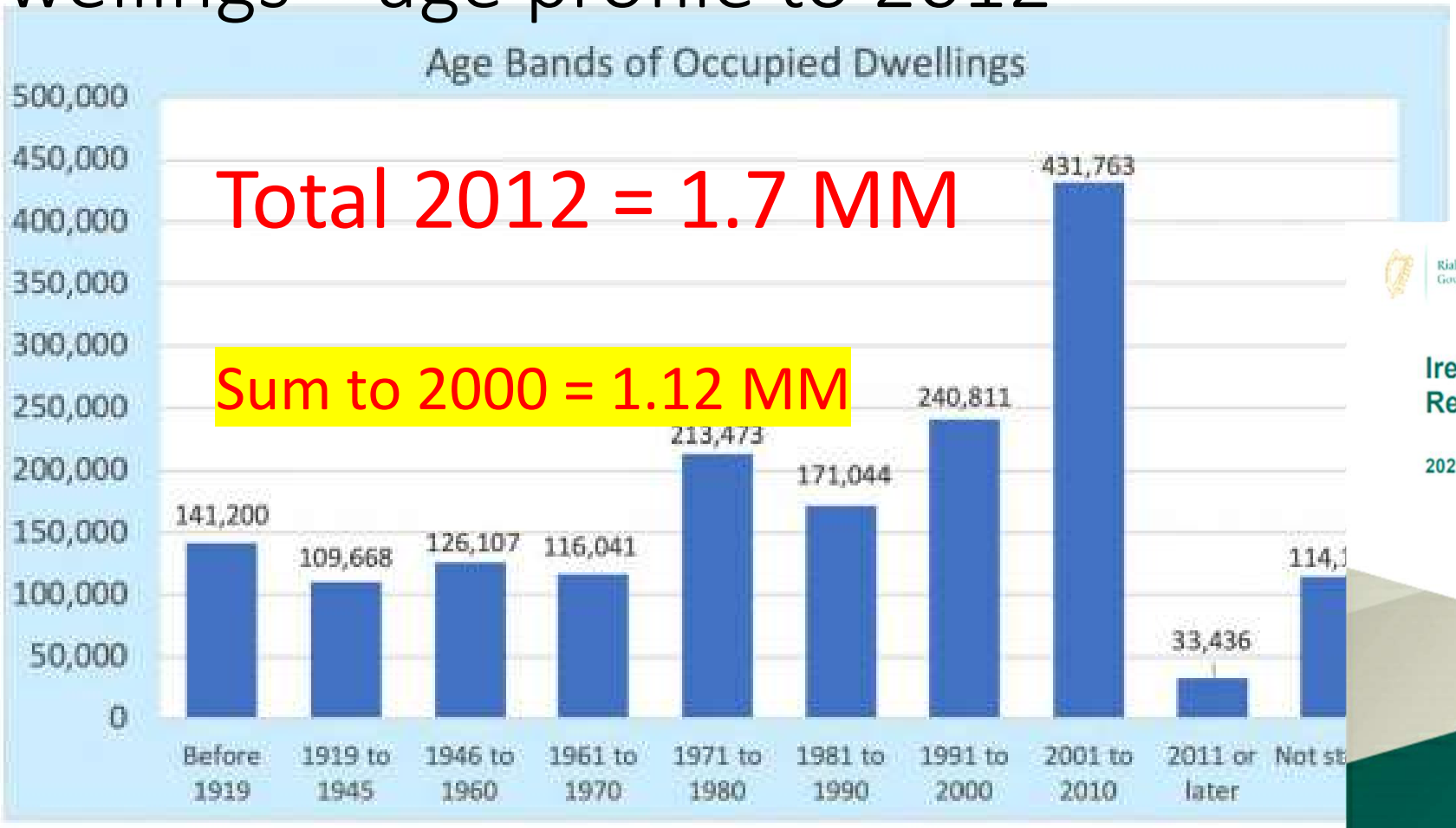


Figure 2: Age Bands of Occupied Dwellings

Rialtas na hÉireann
Government of Ireland

Ireland's Long-Term Renovation Strategy

2020

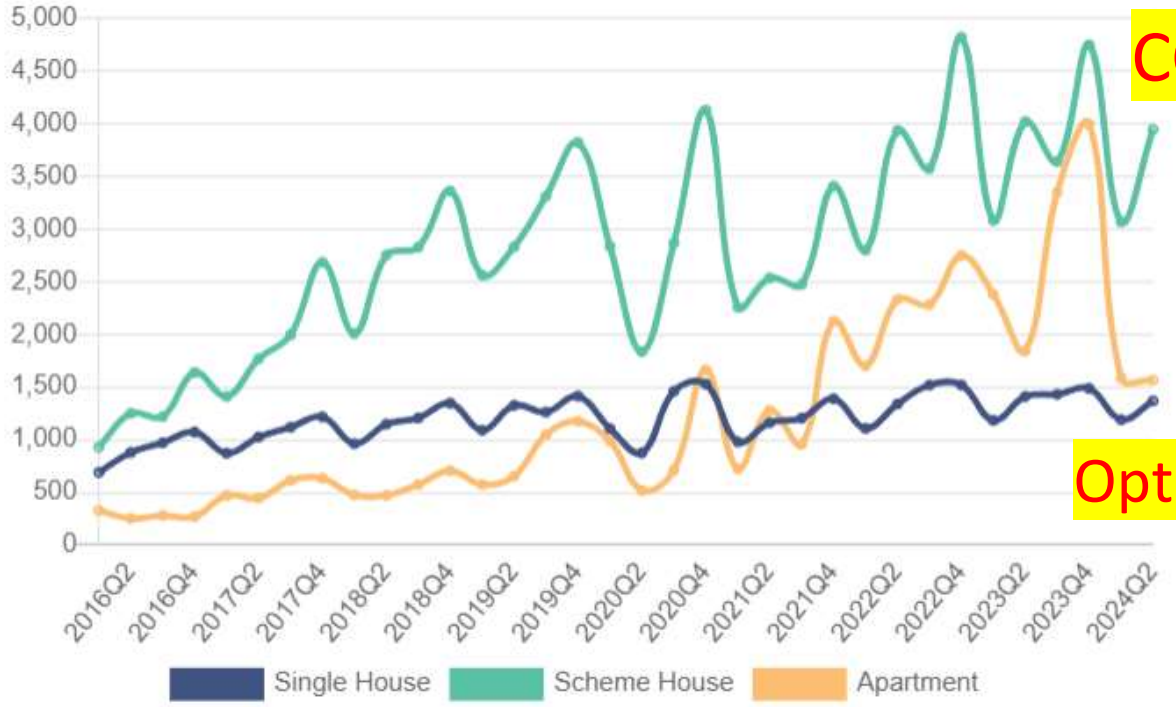
As required by Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency

Dwellings to 2000 = 1.12MM

Dwellings to 2000 = 1.12MM

Total dwelling to 2012 = 1.7 MM

Figure 1: Number of new dwelling completions by type of dwelling Q1 2016 - Q2 2024



© Central Statistics Office, Ireland

CCC's

Opt Outs

	2016 to 2024
Apartment	**35,940**
Scheme	**96,386**
Single house	**40,857**
	173,183

The 2022 Census permanent habitable housing units at 1,881,732

Total Dwellings projection to 2040

Dwellings to 2024 1.88 MM (dwellings to 2000 = 1.2MM)

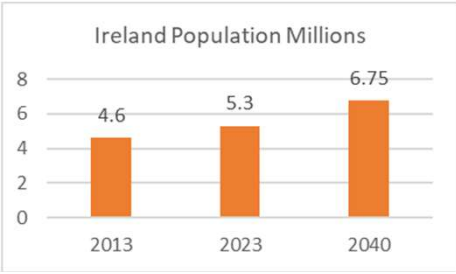
Housing Commission Report

- if you want to plan for a population increase of, say, 6.75 million,

with an average household size of 2.1 and an obsolescence rate of 0.5%, = a mid-range calculation, then the average annual output of new homes required is 57,600.

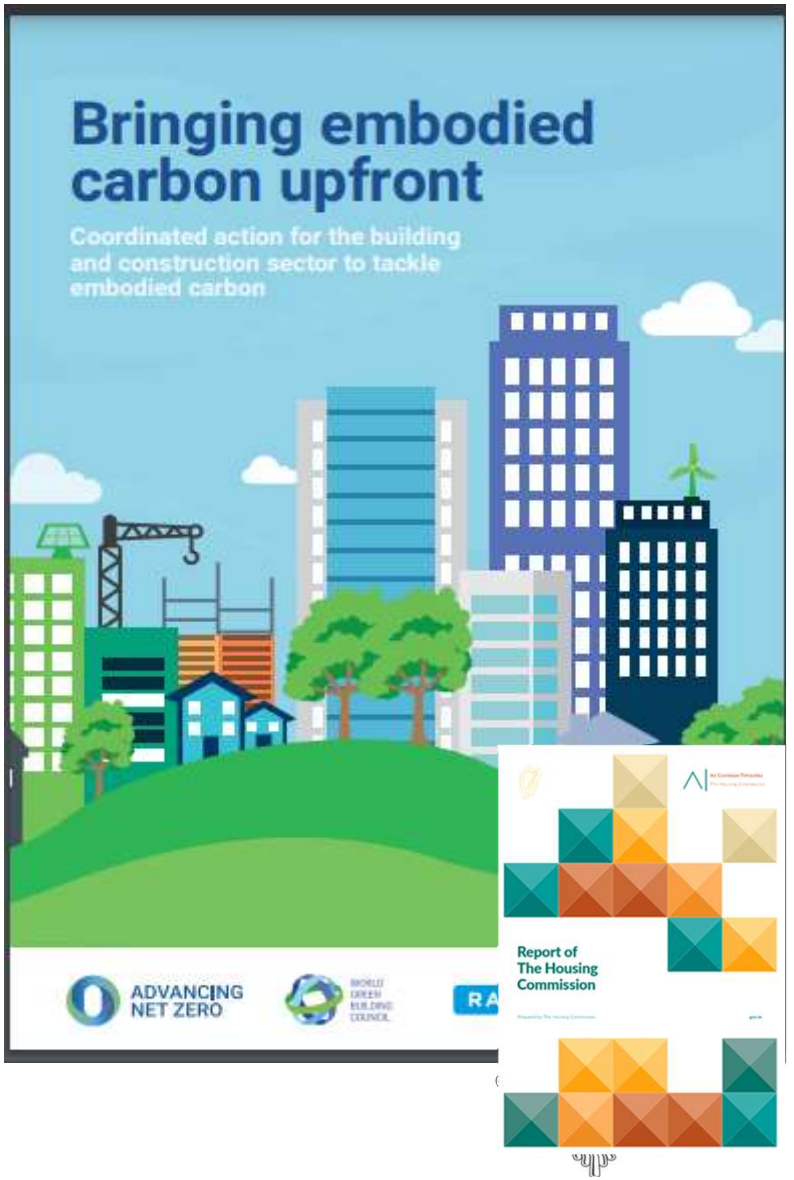
By 2040 could have approx. 2.65 MM dwellings units

of which approx 1.4 MM dwelling constructed since 2000 (> 52 % of 2040 housing stock)



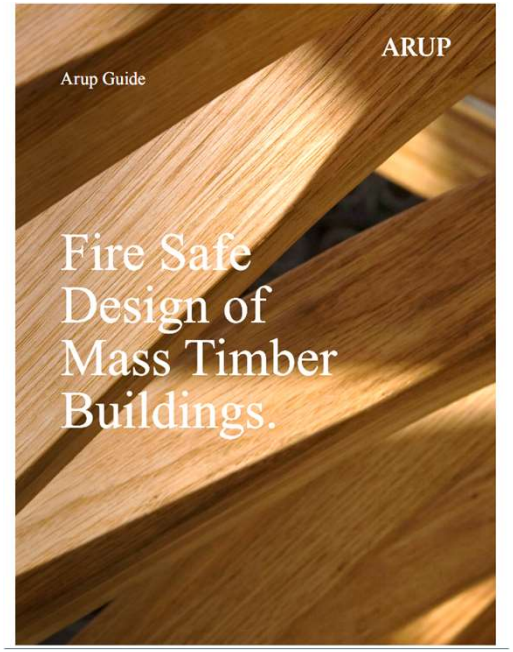
Trends

- 2050 world population -> 10 billion, the global building stock -> 2X
- By 2050, new buildings, infrastructure and renovations will have net zero embodied carbon, and all buildings, must be net zero operational carbon
- Report of the Housing Commission #81. Support and deploy more widespread use of timber in housing construction
- Scotland 95 % of new = build timber frame



Arup - Fire Safe Design of Mass Timber Buildings

- Whole Life Carbon Assessments aim that by 2030 all new and refurbished buildings must be Net Zero in operation and achieve a 40% reduction in embodied carbon
- To support the fire safe design of mass timber buildings, Arup has developed this Guide which proposes features to be incorporated into the design for residential, education and business occupancies (up to 50m tall for residential and business use and up to 25m tall for education use)
- The Guide is not applicable to lightweight timber frame construction



Arup - Fire Safe Design of Mass Timber Buildings

Table 7: Building height, evacuation expectations and firefighting tactics

Building Height	Evacuation Time	Firefighting and rescue tactics
Low-rise ≤ 12m	Evacuation times are short. There will be fewer people who require assistance to evacuate down stairs.	External firefighting effective and often preferred. Internal firefighting provisions may be limited to protected egress stairs.

Irish Dwellings = Lightweight Timber Frame

- ISS440 – Off site pre-fabricated timber frame structure
- Pre-fabricated roof trusses and floors - engineered product
- Roof trusses can use up to 40% less timber than a traditionally built roof

Irish Fire Regulatory Compliance requirements

- **B8 functional requirement** "A dwelling house shall be so designed and constructed that, in the event of fire, its stability will be maintained for a reasonable period."
- Achieved through effective sub-division using **fire resistant construction** AND through adequate **fire stopping** around opening or cavities.
- Standard fire tests of building elements / assemblies in furnaces gives fire resistance rating
- **R** resistance to collapse, i.e. the ability to maintain loadbearing capacity
- **E** resistance to fire penetration, i.e. an ability to maintain the integrity of the element
- **I** resistance to the transfer of excessive heat, i.e. an ability to provide insulation from high temperatures
- **Worldwide,** standard fire resistance test is the predominant means to characterize the response of structural elements in fires

BUT

In 1981, pioneering fire engineer Margaret Law (ARUPS) presented a paper

- the standard temperature-time curve is not representative of a real fire in a real building – indeed it is physically unrealistic and contradicts available knowledge of fire dynamics;
- the required duration of fire exposure in the standard test (or the time-equivalent exposure) is open to criticism on a number of grounds and should be revisited;
- the loading and end conditions in the standard test are not well defined – and clearly cannot represent the continuity, restraint, redistribution, and membrane actions in real buildings; and
- the structural properties of the test specimen at room temperature are not well defined.

A view point

- As a result, the Structural Fire Engineering community finds itself in a difficult situation;
- The standard fire has thus inadvertently become the performance objective, rather than a proper performance objective taking into account the range of fire risks and failure consequences for the specific building being designed

- the SFE community is only just beginning to truly wrestle with the true response of real structures in real fires….

https://www.researchgate.net/publication/261992399_Structural_Fire_Testing_-_Where_are_we_how_did_we_get_here_and_where_are_we_going

Collaborative Reporting for Safer Structures UK (CROSS-UK)

Fire protection light gauge steel frame-walls

- **Further justification for one-sided testing was provided on the basis that 'test houses' can only test walls from one side only. The reporter is of the mind that 'a constraint of testing is not a reasonable defence if the consequence is a significant overestimation of the performance of the structure in fire'**

- **For fire and rescue services:**
- Light gauge steel frame structures that do not have all-round fire-resisting protection may be vulnerable in a fire situation, potentially leading to the progressive collapse of the whole structure

- https://www.cross-safety.org/uk/safety-information/cross-safety-report/fire-protection-light-gauge-steel-frame-walls-1116

Tipperary Fire & Rescue Service

- Build Control Authority as well as Fire Authority
- Tipperary 2023 commencement notices
- 554 new buildings of which 465 were new domestic dwellings ? 50 % TFS/LGS
- 172 (of 178) building control inspections were enabled by 20 housing estates
- Move from masonry to framed construction

TGD B V2 Cavity Barriers FireStopping

- 3.6.2 Provision of Cavity Barriers Cavity barriers should be provided in accordance with the following: (a) At the top of an external cavity wall including any gable wall. (b) Vertically at the junction of separating wall and any such wall with an external cavity wall (c) Above the enclosures to a protected stairway (d) Around all openings (windows, doors, vents, service boxes etc.) in framed construction.
- 3.7 Protection of Openings and Fire Stopping. If an element that is intended to provide fire separation (i.e. it has requirements for fire resistance in terms of integrity and insulation) is to be effective, then every joint, or imperfection of fit, or opening to allow services to pass through the element, should be adequately protected by sealing or firestopping so that the fire resistance of the element is not impaired

Tipperary Fire & Rescue Service Approach

- Take credit for good work by NSAI with surveillance / recertification audits for IS440 (TFS) and Agrement certs (LGS/Other) = Design >Factory productions > Shipment to site
- Education/awareness
- Commencement Notices
- Inspections
- CCC's

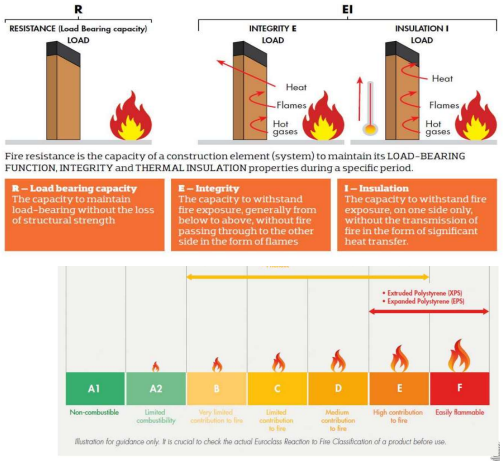
TFRS webinar Fire Resistance in Dwellings

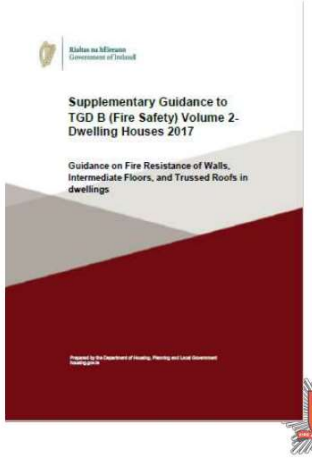
TFRS webinar link

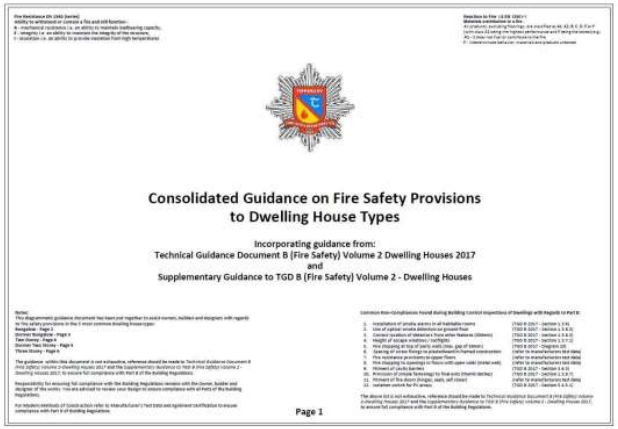
REI 60
(60 minutes fire resistance load bearing capacity, and integrity and insulation)

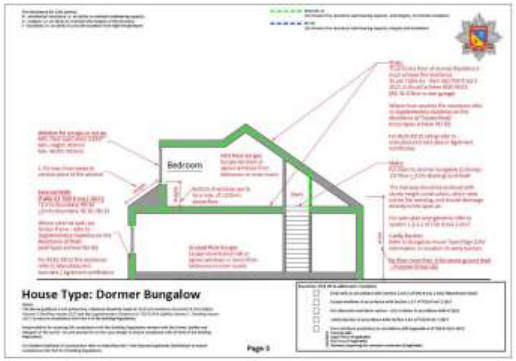
RE30 REI 15
(30 minutes fire resistance load bearing capacity and integrity, 15 minutes insulation)

REI 30
(30 minutes fire resistance load bearing capacity, integrity and insulation)

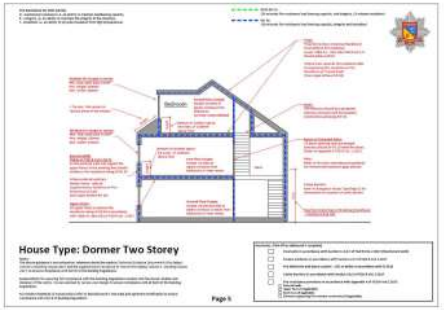








Dormer Bungalow



Dormer Two Storey

TFRS Inspection Notification

Common Non compliances identified during Building Control Inspections of Dwellings

Please Note

This is not an exhaustive list and it does not cover all potential non-compliances.

Responsibility for ensuring full compliance with the Building Regulations remains with the Owner, builder and designer of the works.

You are strongly advised to review your design to ensure that it is in full compliance with all Parts of the Building Regulations.

Part A – Structure

A	Number of wall ties per m^2 in cavities >100mm	(TGD A 2012 - Paragraph 1.1.3.27 & SR 325)
A	Spacing wall ties around opes	(TGD A 2012 - Diagram 9 & SR 325)
A	Notches and holes in timber joists	(TGD A 2012 - Paragraph 1.1.2.5)
A	Strapping of walls and floors.	(TGD A 2012 - Paragraph 1.1.3.24)
A	Strapping of walls and roofs.	(TGD A 2012 - Paragraph 1.1.3.25)

Part B – Fire Safety

B	Installation of smoke alarms in all habitable rooms	(TGD B 2017 - Paragraph 1.3.6)
B	Use of optical smoke detectors on ground floor	(TGD B 2017 - Paragraph 1.3.6.3)
B	Correct location of fire alarms (min 300mm from other features)	(TGD B 2017 - Paragraph 1.3.6.3)
B	Height of escape windows	(TGD B 2017 - Paragraph 1.3.7.1)
B	Fire stopping at the top of party walls	(TGD B 2017 - Diagram 10)
B	Spacing of screw fixing in timber frame party walls	(See manufacturer's instructions)
B	Fire Resistance of floors (testing to EN standards)	(See manufacturers updated instructions)

Comhairle Contae Thiobraid Árann
Tipperary County Council

Our Ref: CN/2024/0230
Document ID: 44928-38709

20 June 2

MARTIN MURPHY
MURPHY MASTON O SULLIVAN CONSULTING ENGINEERS
THE CHAPEL, BLACKROCK HOUSE BLACKROAD ROAD
CORK

PHASE 2 ROSEFIELD, TIPPERARY TOWN - CONSTRUCTION OF 30 NO. DELLINGS, NO'S 31-60 AND ALL ANCILLARY SITE WORKS, SUBMISSION NUMBER 83/0780 AT PHASE 2 SAINT MICHAEL'S AVENUE TIPPERARY TOWN FOR PRAMUKH GOGNEENI MAJESTIC PROPERTY DEVELOPERS LTD

Dear Sir/Madam,

Further to your submission of a Commencement Notice for the above development, I write to inform you that this project has been selected for inspection by Building Control Officers of this Department.

You should expect that a number of site inspections will be carried out and that requests for clarifying details and further information may be made.

You should ensure that procedures are in place to promptly and adequately address any issues which are raised, so as to ensure tha when the Certificate of Compliance on Completion is submitted there are no outstanding issues to be resolved which may delay validation and subsequent placing on the Register.

Where written requests for information are made, our letters will be addressed to both the current building owner and builder as nominated in the Commencement Notice. In accordance with item 3 of the Notice of Assignment, copies will also be forwarded to th Assigned Certifier.

In order to facilitate our inspections of the works and in order to perform a more detailed analysis of the development, we request tl following information under Section 11(2) of the Building Control Act 1990 & 2007.

The requested information should be forwarded to this Department by email to firepf@tipperarycoco.ie within 14 days from the date of this letter quoting reference CN/2024/0230.

1. Contact details for the site engineer or other onsite technical representative, who will be available to assist us during an inspection of the site.
2. Proposed Ventilation strategy for the dwellings and a Part F Ventilation Compliance Document *(for an airtightness value of les than 3m³/h.m², mechanical ventilation should be utilised to ensure adequate ventilation rates)*
3. Results of all Airtightness tests, including failures *(as they become available)*
4. Results of all Sound tests, including failures *(as they become available)*

Where a Compliance on Completion Certificate is submitted for the above development to this Building Control Authority, please ensure the following supporting documents are uploaded:

- IS 3218 Annex K Certificate of Commissioning for the fire detection and alarm system for each dwelling.
- BER Certificate for each dwelling.
- Airtightness Test Report for each dwelling.
- Sound Testing Reports in accordance with the testing arrangements outlined in Technical Guidance Document E 2014 for semi detached / terraced dwellings and apartments.
- RECI / Safe Electric Completion Certificate for the electric system of each dwelling.
- NSAI Ventilation Validation Certificate (where mechanical) or confirmation natural ventilation calculations are in accordance w Technical Guidance Document F 2019 for each dwelling.

for each dwelling CCC to submit

1. IS 3218 Smoke Alarm Annex K Certificate
2. NSAI Ventilation Validation Certificate
3. RECI / Safe Electric Completion Certificate
4. Sound Testing
5. Airtightness Test Report,
6. BER Certificate,

Development Inspection Plan

Code of Practice

for

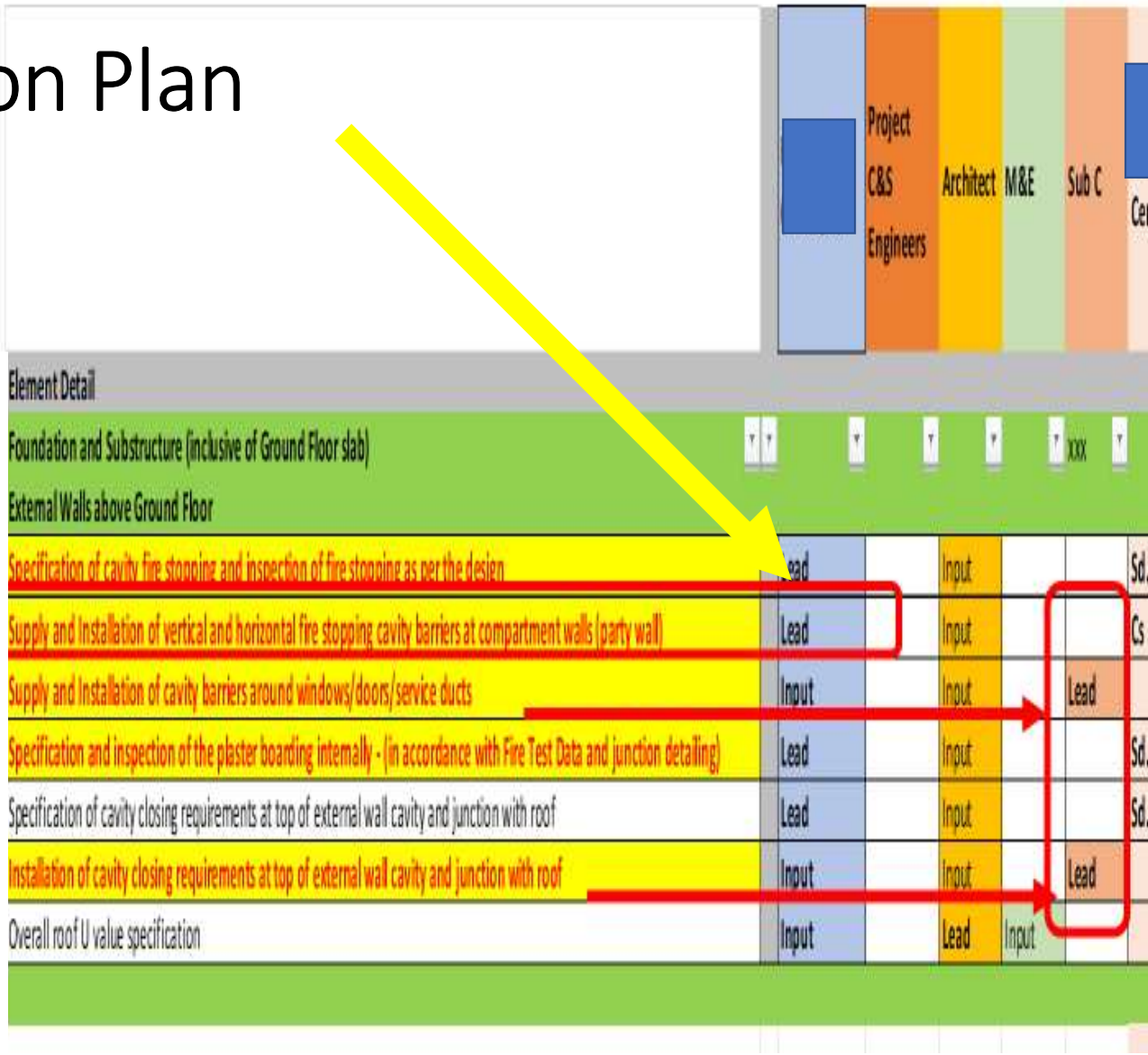
Inspecting and Certifying Buildings and Works

An Roinn Tithíochta, Pleanála, Pobail agus Rialtais Áitiúil
Department of Housing, Planning, Community and Local Government

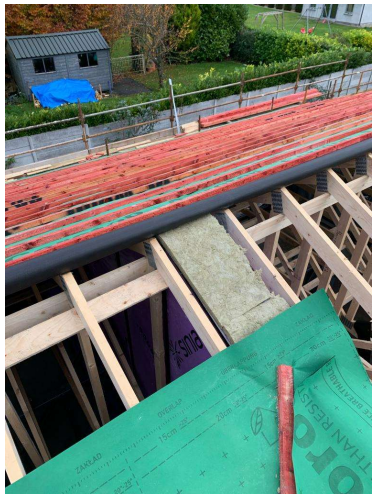
Building C… Regulati… 1997 to 2…

September,

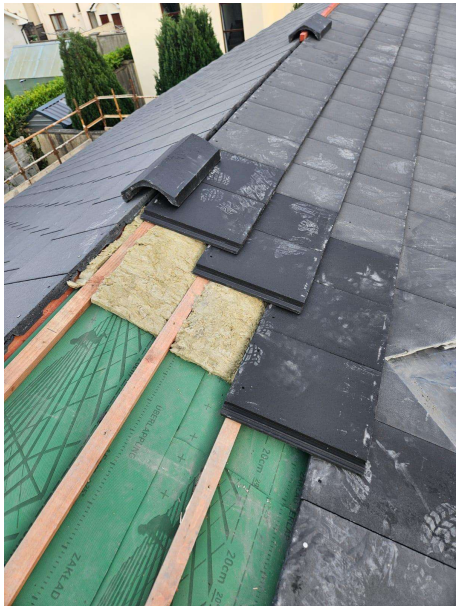
Table B.2 Inspection Plan			
Inspection Stages	**Priority elements to be inspected**	**Frequency of inspection required**	**Arrangements as implemented**
1. Excavation/ Formation	a) Ground bearing suitability	1 No.	**To be completed during course of works.** (These details will be lodged to accompany the Statutory Certificate of Compliance on Completion)
2. Foundations	a) General arrangement and reinforcement	1 No.	
3. Sub-structure works (including ground floor)	a) Radon membrane, sump/ venting pipe	1 No.	
4. Superstructure (prior to slabbing ceilings)	a) Timber floors b) Insulation c) Roof trusses, bracing, tie down etc.	1 No.	
5. Completion	a) Fire detection system b) Chimneys and flues c) Carbon monoxide detectors d) Ventilation e) Roof covering i.e. nailing/ flashing f) External render	1 No.	
Total No. of Inspections =		**5 No.**	



Construction record - Cloud-based mobile solution #1



Fire stop roof cavity at party walls



Fire stop roof cavity at party walls

cavity insulation at party walls

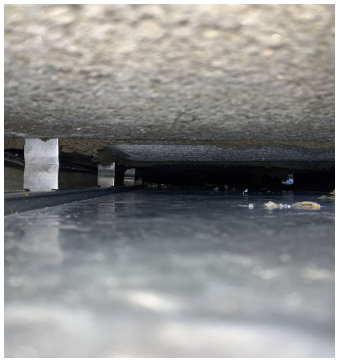
Cavity maintained at party walls

Construction record - Cloud-based mobile solution #2

Cavity barrier at window

Cavity barrier at eves

Cavity barrier at eves



Wall ties

CCC Documentation / Certification

for each dwelling CCC to submit

- IS 3218 Smoke Alarm Annex K Certificate
- NSAI Ventilation Validation Certificate
- RECI / Safe Electric Completion Certificate
- Sound Testing
- Airtightness Test Report,
- BER Certificate,

Schedule of BCaR Ancillary Certificates – KEY SUPPLIERS / CONTRACTORS SCOPE CONTACT CONTACT DETAILS CERT

1. aaaaa Design / Manufacture / Supply / Installation of Pre-Fabricated Components including Roof Trusses a Sd+Sc+Si+Cs Certs Received xx/xx/2024
2. bbbb Groundworks / Concrete / Radon Barrier / Fencing / Storm Water Soakaways - Labour & Plant Equipment Only (Materials Supplied by Main Contractor) Cs Cert Received xx/xx/2024
3. ccccc Labour Only Blockwork & Brickwork (Materials Supplied by Main Contractor) Cs Cert Received xx/xx/2024
4. dddd Supply / Installation of Plasterboard Ceilings & Partitions / Air-Tightness Measures / Insulation to Partitions Cs Cert Received xx/xx/2024
5. eeee Supply / Installation / Testing / Commissioning of Plumbing / Heating / DCV Ventilation Systems Cs Cert Received xx/xx/2024
6. ffffff Installation Only of Wall & Floor Tiles including Supply & Installation of Grout / Adhesives / Aluminium Trims / Tanking Kits / Ancillary Products / Etc Cs Cert Received xx/xx/2024
7. gggg Supply / Installation of Thermoplastic Road Markings to Specified External Areas Cs Cert Received xx/xx/2024
8. hhhh Supply / Installation of Rainwater Disposal Goods Cs Cert Received 08/02/2024 1 Submitted on 03-07-2024 Received xx/xx/2024
9. jjjjj Supply / Installation of 400mm Thick xxx Earthwool Loft Insulation to Attic Space including Insulating CWS Tanks.ie Cs Cert Received xx/xx/2024
10. kkkkkk Supply / Installation of External Windows & Doors to New Dwelling Houses Cs Cert Received xx/xx/2024
11. mmmm Supply / Installation / Testing / Commissioning of Electrical Installations Cs Cert Received xx/xx/2024
12. nnnn Supply / Installation of Tarmacadam to Specified External Areas including Associated Site Preparatory Works Cs Cert Received xx/xx/2024
13. ppppp Installation Only of Paving (Materials Supplied by Main Contractor) to External Areas including Associated Site Preparatory Works Cs Cert Received xx/xx/2024
14. qqqq Labour Only Plastering to Internal & External Areas (Materials Supplied by Main Contractor) Cs Cert Received xx/xx/2024
15. rrrrr W312 Labour Only Concrete / Formwork / Retaining Wall Works (Materials Supplied by Main Contractor) Cs Cert Received xx/xx/2024

Dwelling fires in years to 2040

- By 2040 ? 33 % probability that of dwelling fire incidents will be in framed construction- In US, FF concerns thermal image camera will not give warning of collapse
- **TGDBV2 0.1.1** The fire safety measures outlined intended for the protection of life from fire and **TGDBV2 Section 5** relates to measures intended to assist the fire services in the protection of life and property from fire
- Risk of early collapse of framed construction dwelling is reality

Should the Irish Fire Service do more in light of LTF collapse risk ?

FF Emergency Response - Suggestion 1

- To inform FF response to dwelling/other fires in framed construction, BA/CFBT refreshers / Hydra Incident Command courses to include risk of early collapse

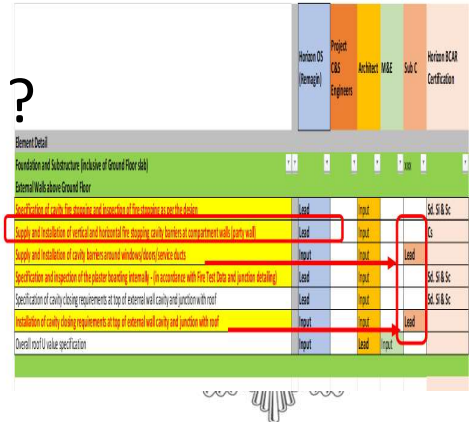
FF Emergency Response - Suggestion 2

- To inform FF response to dwelling/other fires in framed construction, develop EU project to use large test facilities to complete “real fire” testing of up three storey framed construction(Timber priority)
- 9 m tall testing furnace at the Centre Scientifique et Technique du Bâtiment (CSTB), Paris, France,
- National Fire Research Laboratory (NFRL) at NIST, USA. a unique ‘real fire’ testing facility - combines the capability to test large-scale multiple bay, multi-storey structures, subject to real fires with real fuel loads, while applying controlled loads both vertically and laterally and providing data on heat release rates and gas analysis

FF Emergency Response - Suggestion 3

Currently extensive guidance proforma certificate/statutory registers for RGI/FDAS/Ventilation Validation/RECI/Sound/Airtightness/BER –

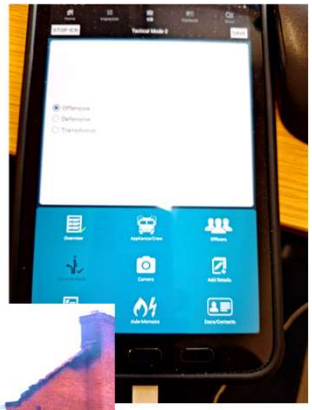
- Should be there be supplementary guidance on Cavity Barriers & Fire Stopping to outline approach to Specification / Procurement / Installation / Verification for listed Cavity Barriers / Fire Stopping within framed dwellings ?
- Submit Design Responsibility Matrix at CN stage as plan ?
- Submit Design Responsibility Matrix at CCC stage as record ?

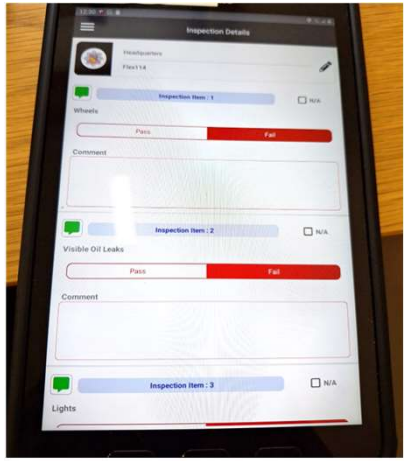


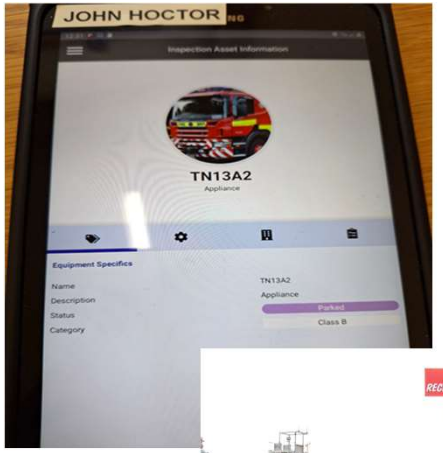
FF Emergency Response - Suggestion 4

Quality Systems

- Given Fire Service adoption of quality/ safety systems for BA/WaH/appliances/water rescue etc, should we ask for verification pictures of cavity barriers/ fire stopping before close up for each dwelling to be submitted with CCC?







FF Emergency Response - Suggestion 5

- Improve owner/ trade person awareness
- Should there be requirement to add QR code on each dwelling electrical panel improve owner/ trade person awareness?

QR code link to outline role of cavity barriers / fire stopping / gypsum boards to reduce risk of unintentional diminution of build integrity occurring due to dwelling improvement works/ alterations/ extensions

FF Emergency Response - Suggestion 6

The Functions of Regulation: Current Issues

Certificate in Enforcement for Public Bodies

Law Society of Ireland

5 April 2022

Ciaran Walker

Consultant, Eversheds Sutherland

Edinburgh school wall collapse report highlights 'lack of scrutiny'

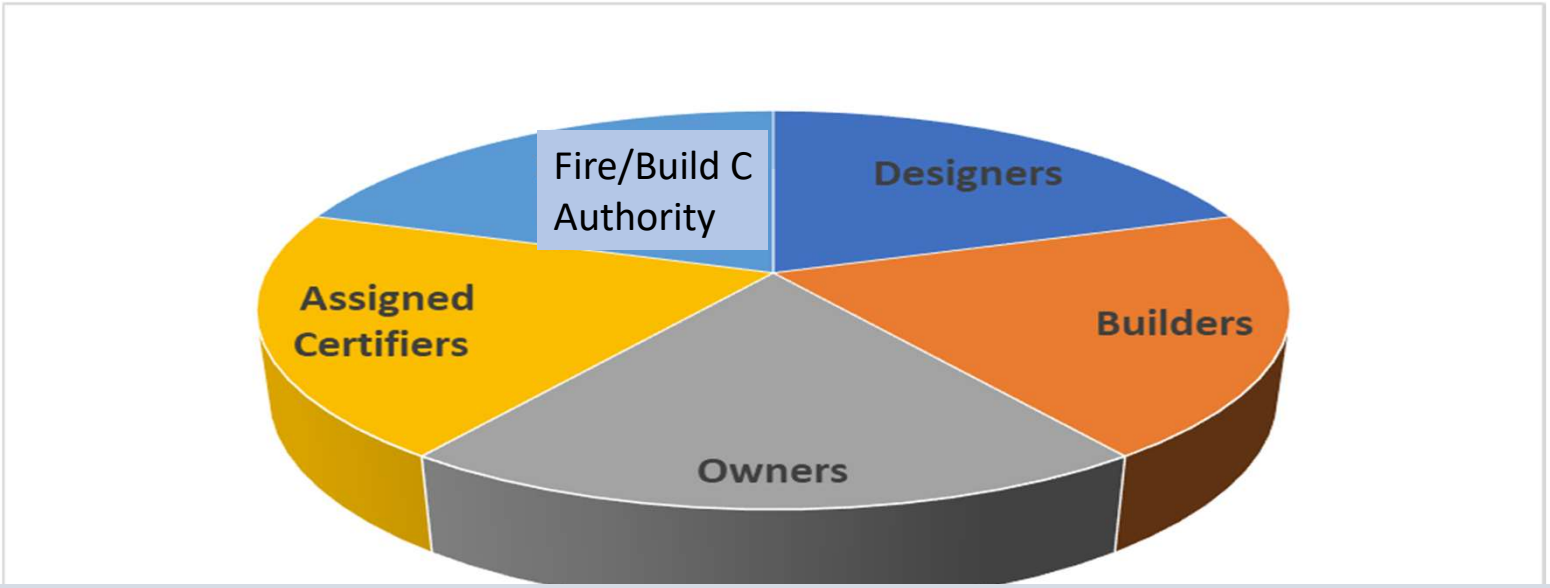
"The evidence that we have suggests that there are limitations on the extent to which greater compliance can be achieved by increasing fines and the probability of detection." (FCA)

FF Emergency Response - suggestion 6 Culture

Insights from behavioural economics: Changing the compliance choice architecture (UK Financial Conduct Authority)

Changes to choice architecture	Actions for firms	Actions for regulators	Drivers of poor behaviour this addresses
Changing perceptions of detection and punishment		Making punishments and detections salient and vivid; making regulatory communications of detections and punishments salient and vivid.	Salience and vividness bias; overconfidence.
De-biasing firms' decision making	Use of internal scrutiny and decision tools to minimise the impact of behavioural biases on their decision making.		Endowment effects, loss aversion, confirmation bias.
Enhancing the role of morality	Use reminders and moral codes to engage moral reasoning; increase the salience of the consequences of non-compliance.	Identify cases when the role of morality is reduced; improve regulation	Low salience of morals and distance from rule-breaking.
Improving culture	Enhance the role of morality in individual decision making; ensure staff have the right incentives; combat ideologies that drive non-	Enhance the role of morality in individual decision making; combat ideologies that drive non-compliance; publicise examples of good	Social and organisational drivers of poor behaviour

“Functional requirements provide for health, safety, welfare, and accessibility of people in and around sustainable buildings”



Ní Neart Go Cur Le Chéile

- **Questions**