FSC Report

ABP 308221-20

Appeal v Refusal or Appeal v Condition(s)	Appeal v Condition 4
Development Description	Erection of a storage unit and associated site works at Unit A02, Hub Logistics Park, Clonee, Co Meath
An Bord Pleanála appeal ref number:	ABP-308221-20
Building Control Authority Fire Safety Certificate application number:	FS/20008
Appellant & Agent:	Appellant : Hickwell Limited Agent : Michael Murphy Consulting Engineer
Building Control Authority:	Meath County Council
Date of Site Inspection	NA
Inspector/ Board Consultant:	Maurice Johnson
Appendices	NA

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2.0 Introduction

2.1 Subject Matter of Appeal

This report sets out my findings and recommendations on the appeal submitted by Michael Murphy Consulting Engineer [hereafter referenced as MMCE] on behalf of their Client, Hickwell Limited, against Condition No. 4 attached to the Fire Safety Certificate (Ref No. FS/20008) granted by Meath County Council [hereafter referenced as MCC] in respect of Erection of a storage unit and associated site works at Unit A02, Hub Logistics Park, Clonee, Co Meath

It is noted that the building is identified in the FSC Application Report submitted by MMCE as *"a storage warehouse consisting of high rack storage"* and is stated to have an intended use *"for the storage distribution of normal hazard materials. Stored in high racking storage"*.

The Fire Safety Certificate application was originally lodged by Staples Owley Ltd Fire Safety Engineering Consultants [SOL] in February 2020 as agents for Hickwell Limited and was subsequently taken over by MMCE circa June 2020. Furthermore, the initial submission by MMCE dated 06.06.2020, involved sub-division of the warehouse into three separate fire compartments to comply with travel distance limits in Technical Guidance Document B. This design strategy was subsequently altered in Additional Information submissions by MMCE dated 17.07.2020 and 11.08.2020. In these submissions the compartmentation was omitted in favour of a Deterministic fire engineering based design incorporating an automatic smoke and heat ventilation system in the roof with supporting analysis prepared by B-Fluid Ltd Buildings Fluid Dynamics Consultants [hereafter referred to as BFL].

The Fire Safety Certificate was granted on 27th August 2020 with 7 conditions attached.

Condition 4, which is the subject of the appeal, reads as follows:

Condition 4
The building or part thereof shall not be used to accommodate high-rack storage (i.e. storage greater than 4 metres in height), unless a suitable automatic sprinkler system is designed, installed and maintained in accordance with IS EN 12845:2015 (+AC:2016) (+A1:2019) including Annex F requirements

With the stated reason for the condition being*:*

Reason*: To ensure compliance with Part B1 and B3 of the Second Schedule to the Building Regulations, 1997-2017*

De novo consideration is not warranted and the Board can rely on the provisions of Article 40(2) of the Building Control Regulations and deal with the appeal on the basis of Condition 4 only. It is noted however that Condition 5 is a related Condition and thus is impacted by the consideration of Condition 4

2.2 Documents Reviewed

2.2.1 Fire Safety Certificate Application and Supporting Documentation submitted by MMCE and SOL on behalf of their Client

2.2.2 Further Information requests, decision and grant by MCC on 27.08.2020 with 7 conditions attached

2.2.3 Appeal submission to An Bord Pleanala by MMCE dated 15.09.2020 and 10.11.2020

2.2.4 Appeal submission to An Bord Pleanala by MCC dated 19.10.2020

3.0 Consideration of Arguments by Appellant and BCA

Condition 4

The building or part thereof shall not be used to accommodate high-rack storage (i.e. storage greater than 4 metres in height), unless a suitable automatic sprinkler system is designed, installed and maintained in accordance with IS EN 12845:2015 (+AC:2016) (+A1:2019) including Annex F requirements

With the stated reason for the condition being*:*

Reason*: To ensure compliance with Part B1 and B3 of the Second Schedule to the Building Regulations, 1997-2017*

Insofar as the reason stated in the Grant of Fire Certificate for the imposition of Condition 4 is generic in nature it is considered appropriate to set out, in the first instance, the reasoning of MCC as outlined in more specific detail in their appeal submission to ABP dated 19th October 2020

Case made by MCC in respect of Condition 4

The MCC case for the imposition of Condition 4 is set out in the submission to ABP dated 19th October 2020 and the key points are summarised as follows:

I. MCC contend that High-Rack storage – as proposed by MMCE in their FSC application report – constitutes a "High Risk" storage as defined in Appendix E of Technical Guidance Document B 2020. In this regard MCC note that Appendix E, in Section E2(a,) identifies the following factor as one which would lead to the assessment of premises as being of High Risk:

   (a) the presence of materials likely, when ignited, to cause the rapid spread of fire, smoke or fumes. The materials may be solid, liquid, or gaseous and as well as the normal forms may be present as dust, spray, mist or vapour;

   MCC contend that a High-Rack storage configuration has the potential to result in *"the rapid spread of fire, smoke or fumes"* and therefore constitutes a High Risk storage use in accordance with Appendix E.

   In further support of this contention MCC reference a number of documents as follows:

   - BS9999:2017 which in Table 3 identifies *"high racked storage"* to fall into Fire Growth Category 4 Ultra-fast. MCC go onto note that BS9999 2017 requires this category of building use (i.e. Fire Growth Category 4) to be fitted with sprinklers in order for the code to apply. It is noted however that the term *"high racked storage"* is not defined in BS9999.
   - PD7974-1 2003 Section 8.3.3 and Table A.4 Stored Commodities: Specifically MCC reference an Ultra-Fast Growth rate (i.e. Ultra-fast = Growth time to 1MW

of 75 secs) as applying to various stacked commodities with stack heights of 4.3 to 4.9m It is noted that Table A.4 Stacked Commodities is no longer included in the current version of PD7974-1 2019 and has been replaced with Table A.3 Fire Growth rates for some discrete fuel assemblies as reproduced below. It is noted that "*cardboard and plastic boxes in vertical storage arrangement*" is identified as having an Ultra-fast Growth profile – however no information is given on the required height of the vertical storage arrangement to achieve this growth rate.

Table A.3 — *Fire growth rates for some discrete fuel assemblies*

Growth rate	α (kW/s^n)	n (-)	References
Cars – engine bay fire	0.01 to 0.06	2	[17]
Office reception workstation	0.003		
Wood frame chairs	0.008 to 0.017		
Stacked pallets	0.01		
Double bed	0.08		
Racked goods	0.0448 (per tier)	3	[40]
Upholstered furniture and stacked furniture near combustible linings	0.188	2	BS ISO/TR 13387-2
Office furniture — horizontally distributed	0.012		
Floor coverings	0.003		
Cardboard or plastic boxes in vertical storage arrangement	0.188		
Bedding	0.047		

- NFPA 204 Table 8.3.3(a) - which MCC contend also advises an Ultra-Fast Fire Growth Rate for goods stored between 4 and 5 m in height. It is noted that there is no Table A.8.3.3 in the current NFPA204 2018 and therefore it is assumed that MCC are referencing a superseded version of the code.

- UK Department for Communities and Local Government Publication Fire Risk Assessment Factories and Warehouse which identifies that fire spread can be rapid in stacked goods and notes experimental studies which indicate that fires in a 10m high racking system can spread to the full height of the rack in 2 minutes.

- Sprinkler codes BS5306 Part 2 1990 and IS EN 12845 – in both cases MCC note that for sprinkler classification purposes storage is identified as falling into the High Hazard Storage class [HSS] at storage heights which vary with the type of commodity and configuration of storage but note that the maximum height at which storage is not considered to fall into HSS is 4m. This subsequently appears to form the basis for MCC concluding that storage of more than 4m in height constitutes "High Risk" in accordance with Appendix E of TGDB and formed part of the basis for MCCs imposition of Condition 4.

- MCC also reference various smoke ventilation design guides in support of their assertion that High Rack storage constitutes High Risk as set out in Appendix E of TGDB

In summary MCC conclude that High Rack storage constitutes "High Hazard/Risk" as set out in Appendix E of TGDB.

MCC acknowledge however that there is no specific international definition of High Rack storage (i.e. defining the height at which this term applies) but based on the requirements of the aforementioned sprinkler codes MCC conclude that 4m is an appropriate height to regard racked storage as constituting a High Risk in TGDB Appendix E terms

II. On the basis of their conclusion that *"High-rack"* storage exceeding 4m constitutes *"High Hazard/Risk"* in accordance with Appendix E of TGDB, MCC contend that the appropriate compartment size limit for this type of use is 1000m^2 per Table 3.1 of TGDB and not 14,000m^2 as is being asserted by the Applicant. They note that the proposed floor area, at 9870 m^2, is considerably in excess of the TGDB limit for High Hazard storage and cannot in their view be adequately offset by the provision of smoke venting.

III. MCC also take issue with various aspects of the smoke ventilation modelling which was submitted by MMCE and make reference to various smoke ventilation design standards/guides which caution that smoke venting has limited value in controlling fire growth in high rack warehousing and therefore is of limited benefit in assisting fire-fighting operations which they consider to be an essential component in offsetting the excess in compartment size. In MCC's view smoke venting does not adequately offset the deviations from TGDB which they say arise as a consequence of the use of High-rack storage which they define as being more than 4m. Consequently MCC contend that these deviations can only be offset by the provision of sprinkler protection.

Case made by MMCE in respect of Condition 4

For their part, MMCE make the following arguments:

I. They contend that the use being proposed does not constitute *"High Hazard/Risk"* per Appendix E of TGDB on the basis that the commodities which will be stored do not fall within the scope of the materials defined to be *"Hazardous Materials"* in Appendix E3 of TGDB. They further correctly note that TGDB Appendix E2 does not reference or define High Rack storage of normal combustibles as falling within the definition of Hazardous Materials and in consequence MMCE conclude that it was not the intent that High Rack storage be regarded as High Risk. There is clearly merit in this argument insofar as it would have been easy for the authors of TGDB to have included *High-rack* storage in the scope of *Hazardous Materials* in Appendix E3 and to have included a specific definition for *"High-rack"* had that been the intent.

II. MMCE acknowledge that travel distances exceed limits in TGDB for Normal Hazard storage but argue that the CFD analysis undertaken by B- Fluid adequately demonstrates that the excess in travel distance is offset by the proposal to provide natural smoke and heat venting.

III. MMCE accept that fires can spread rapidly in High Rack storage but argue that from a fire-fighting perspective this is not an issue as fire-fighting will be undertaken on a Defensive basis in the event of a warehouse fire i.e. MMCE contend that the fire brigade will attack the fire from the exterior rather than deploying BA teams to undertake interior fire-fighting operations.

IV. MMCE also contend that MCC are "cherrypicking" codes in referring to BS9999 when the design was undertaken to TGDB with supported fire engineering smoke venting proposals to justify the excess in travel distance.

4.0 Assessment

Having reviewed the arguments advanced by MMCE and MCC there are 2 key issues to be considered in this appeal:

i. Does "High-rack" storage in itself constitute High Hazard/Risk storage in terms of the application of TGDB 2020 including in particular the application of Table 3.1 vis compartmentation and Table 1.2 vis travel distance. It is noted that the compartment size limit is 1,000m^2 for High Hazard/Risk and 14,000m^2 for Normal Hazard and the corresponding travel distance limits are 32m for High hazard/Risk and 45m for Normal Hazard/Risk

ii. Is the smoke venting which is being proposed sufficient to offset the excess travel distance of 73.5m being proposed i.e. 130% in excess of the High Hazard limit and 62% in excess of the Normal Hazard limit.

Risk Classification

In relation to the Risk Classification it is evident that Appendix E is somewhat open to interpretation on this issue.

MMC correctly point out that Appendix E2(a) states that the presence *of "materials likely when ignited to cause the rapid spread of fire, smoke or fumes"* may be considered High Hazard. MCC interpret this as implying that High-rack storage constitutes High Hazard because normal combustibles configured in a High-rack configuration can result in rapid fire spread.

MMCE on the other hand argue that the materials themselves are not Hazardous as defined in Appendix E3 and therefore the appropriate classification is Normal Hazard.

Having considered both arguments I concur with the MMCE interpretation of Appendix E as paragraph E2(a) specifically references the *"presences of materials likely when ignited to cause the rapid spread of fire"* rather than the configuration in which those materials are stored. Accordingly I agree with the MMCE interpretation that it is the actual materials which define the risk rather than the storage configuration of the materials.

Furthermore, had the authors of TGDB intended that normal combustible materials stored above a certain height be regarded as High Hazard – as is the interpretation of MCC - the authors could easily have and ought to have introduced an explicit clause to that effect.

It is also informative to note that the current Scottish Technical Handbook contains identical compartment size and travel distance limits for warehouses to those in TGDB and defines warehouses as Class 1 (i.e. High Hazard) and Class 2 (Normal Hazard). It includes specific definitions in both cases and it is clear that in the case of the Class 1 High Hazard it is the nature of the goods stored and not the configuration of those commodities which determines the risk classification – refer copy extract below

> ***Storage building (Class 1)*** *is any storage building containing hazardous goods or materials, and any storage of vehicles containing hazardous goods or materials, including: any compressed, liquefied or dissolved gas, any substance which becomes dangerous by interaction with either air or water, any liquid substance with a flash point below 65º Celsius including whisky or other spirituous liquor, any corrosive substance, any substance capable of emitting poisonous fumes, any oxidising agent, any substance liable to spontaneous combustion, any substance that changes or decomposes readily giving out heat when doing so, any combustible solid substance with a flash point less than 120º Celsius, any substance likely to spread fire by flowing from one part of a building to another.*

Accordingly I concur with the MMCE interpretation that the appropriate classification is Normal Hazard/Risk based on the current provisions of TGDB.

Excess Travel Distance

As noted above the travel distance being proposed, as set out in the MMCE Fire safety Application Report is 73.5m. This distance exceeds the permitted travel distance in TGDB for Normal Hazard storage by 28.5m i.e. 63% excess

The Appellant argues that this excess in travel distance, which impacts both on the ability of occupants to escape and also impacts on the ability of the fire service to effect search and rescue should there be occupants trapped or injured in the building on fire service arrival, is adequately offset by the proposals to provide a natural smoke ventilation system.

The Appellant has submitted a report prepared by B-Fluid Building Fire Dynamics Consultants in support of this contention.

The B-Fluid report comprises:

- a smoke production and venting analysis using Computational Fluid Dynamics software [CFD] and

- a computer aided evacuation analysis (i.e. using Pathfinder software) based on an overall occupant level of 452 persons.

This analysis by B-Fluid is a Deterministic Analysis in which they conclude that evacuation will occur before the onset of untenable conditions.

It is noted that the use of fire engineering analysis to support deviations from the guidance in TGDB is acknowledged in paragraph 0.2.3 of TGDB as an Alternative Approach but cautions the following:

> In the case of a fundamental analysis and depending on the life risks involved, the uncertainties in the initial assumptions and the design procedures used, safety factors are required to ensure an adequate level of safety.

Paragraph 0.2.3 identifies 3 different potential approaches to a fire engineered design as follows:

- Determinstic approach, which establishes the worst credible fire scenarios to be considered in detail, with the addition of approriate safety factors
- a probabilistic or risk-based approach;
- a comparison of the performance of a proposed alternative solution with that achieved using the guidance in this Technical Guidance Document

In this instance MMCE and BFL have elected to adopt a Deterministic Approach.

It is noted that TGDB references, inter alia, the PD7974 *Application of fire safety engineering principles to the design of buildings* suite of codes as a relevant standard on which to base such an approach and indeed it is noted that B-Fluid reference PD7974 and the structural Eurocode IS EN 1991-1-2 *Eurocode 1: Actions On Structures - Part 1-2: General Actions - Actions On Structures Exposed To Fire* in their report.

Key parameters assumed in the B-Fluid Deterministic Analysis are summarised as follows:

- the Design Fire is assumed to be a "Fast" growth rate fire (i.e. t-squared fire growing to 1MW in 150 seconds) peaking at 20.5MW at approximately 680 secs and remaining as a steady state fire thereafter for the duration of the model at 1200 secs. The fire area is stated to be 3.6m^2 x 10 pallets i.e. 36m^2.

- the evacuation analysis postulates a *"recognition plus response time"* of 120 secs. B Fluid identify this time period as sufficient to allow for both the detection of the fire by the fire alarm system and the subsequent pre-travel time by the occupants.

There are several aspects of this analysis which I consider do not conform with the guidance in the IS EN 1991-2 structural Eurocode and the PD7974 Part 6: *Human factors: Life safety strategies - Occupant evacuation, behaviour and condition (Sub-system 6*) as follows:

I. On page 32 of the B Fluid report they correctly note that the fire growth parameter 'α' for warehouses (i.e. storage uses) in IS EN 1991-1-2 is 0.188 which in turn corresponds to a fire growth rate classification of 'Ultra-fast' per table NA.4 of Irish National Application Document [NAD] for use of EN1991-1-2 in Ireland. – refer extract below. However B-Fluid then adopt a slower fire growth rate – i.e. a Fast Growth rate - in their CFD model. It is noted that the 20.5MW steady state fire which they assume in their model will occur in 330 secs with an Ultra-Fast growth rate compared to 680 secs in their model

Table NA.4 – Design fire growth rates

Building use	Fire growth rate
Picture gallery	Slow
Transport (public place)	Slow
Classroom (school)	Medium
Dwelling	Medium
Office	Medium
Hotel reception	Medium
Hotel bedroom	Medium
Hospital room	Medium
Library	Fast
Theatre (cinema)	Fast
Shop	Fast
Industrial storage or plant room	Ultra-fast

II. B Fluid assume that the fire will not grow beyond 20.5MW. This assumption is based on CFD modelling which they present on page 29/30 of their report. This modelling is in turn based on a stack of pallets 2.8m high in a room 4m high.

I do not consider that this model adequately caters for the fire growth conditions which may prevail in high rack storage for instance where the racking may extend to the order of 12-13m above the floor. It is noted that the height to eaves in the subject warehouse is 13.9m and thus racking of the order of 12-13 m in height could readily be achieved. In this type of configuration there is potential for rapid vertical fire spread resulting in flames impinging on the roof of the warehouse and then fanning out horizontally to cause further fire spread by downward radiation to adjacent stacks. This has not been modelled in the B-Fluid analysis and therefore their fire model does not in my opinion satisfy 0.2.3 of TGDB which requires the use of the *"worst credible fire scenarios to be considered"*.

It also appears that the B-Fluid model is based on a fire located at floor level whereas in a High Rack configuration the fire spread initially is primarily vertical which does not appear to be modelled by B Fluid.

B Fluid also make reference to the Smoke Ventilation Association *Guidance for the Design of Smoke Ventilation Systems for Single Storey Industrial Buildings, Including Those with Mezzanine Floors, And High Racked Storage Warehouses. Smoke Ventilation Technical Specification* in support of their use of a 36sqm design fire. However the SVA Guide offers no guidance for unsprinklered High Rack Storage warehouses and indeed opines that venting is of little value in controlling fire growth in this type of occupancy – refer extract below.

7.2.7 In unsprinklered warehouses, the current fire experience has been the total involvement, and subsequent loss, of the building. The speed of fire growth in all but the least combustible of materials (eg. steel) is such that venting is ineffective for practical considerations of stock protection and fire-fighting operations. See 9.2 below.

Finally, in modelling smoke production in a deterministic manner different heat release rates ought to be considered insofar as smoke conditions may be worse with lower heat release rates due to the lower buoyancy of the smoke. In this regard it is noted that heat release rates per metre height of storage may vary from as low as

30kW/m^2/m to as high as 2900kW/m^2/m (quoting from Table 2 of *Guidance for the Design of Smoke Ventilation Systems for Single Storey Industrial Buildings, Including Those with Mezzanine Floors, And High Racked Storage Warehouses. Smoke Ventilation Technical Specification)*

III. In their evacuation analysis B-Fluid have postulated a total time of 120 seconds (i.e. 2mins) to cater for *'detection'* + *'recognition and response time'* by the occupants. They calculate in their model the detection time to be circa 50 seconds and thus have allowed 70 seconds (i.e. 1.16mins) for recognition and response.
PD 7974 Part 6 on the other hand suggests a pre-travel time (i.e. which equates to a combination of the recognition and response times) for this category of use (i.e. Category A use, Level A1 alarm, Management Level M3 and Building Complexity B1-B2) of >15mins for the First Occupants and > 30mins for the 99th percentile occupant. i.e. substantially in excess of the 1.16 minutes assumed in the B-Fluid analysis.

Table E.2 — *Suggested pre-travel times for different design behavioural scenario categories (minutes)*

Scenario category and modifier	First occupants $\Delta t_{pre(1st\ percentile)}$ A)	Occupant distribution $\Delta t_{pre(99th\ percentile)}$ B)
A: awake and familiar		
M1 B1 – B2 A1 – A2	0.5	1.5
M2 B1 – B2 A1 – A2	1	3
M3 B1 – B2 A1 – A3	*>15*	*>30*
For B3, add 0.5 for wayfinding		
M1 would normally require voice alarm/PA if unfamiliar visitors likely to be present		

Furthermore in the B-Fluid evacuation analysis they do not appear to have allowed for the fire occurrence causing access to an exit to be blocked or impaired.

In summary I consider that the B-Fluid analysis falls far short of that which is required in a Deterministic Analysis to justify a 63% excess of the travel distance limits set out in TGDB.

5.0 Conclusion/Recommendation

In light of the foregoing and noting that there is no end user identified for the warehouse and therefore the application is catering for a full range of non-Hazardous Goods in various potential configurations - including High-rack storage - I recommend that the appeal be disallowed and that Condition 4 be upheld but modified as set out in 6.0 below.

Also Condition 5 should be modified to reflect the Revised Condition 4.

6.0 Reasons and Considerations

In relation to Condition 4, I conclude that the appeal be refused and that the Condition be modified to read as follows:

Condition 4

The building shall be fitted with a suitable automatic sprinkler system which is designed, installed and maintained in accordance with IS EN 12845:2015 (+A1:2019) including Annex F requirements

Reason: *To ensure compliance with Part B1 of the Second Schedule to the Building Regulations, 1997-2017*

Condition 5 should also be modified to read as follows, it being noted that the maximum compartment size permitted in Table 3.1 of TGDB for High Hazard Storage is 2000m^2.

Condition 5:

The products stored within the building or part thereof which are the subject of this application shall exclude high risk or hazardous materials as detailed in section E3 of Appendix E of Technical Guidance Document B

Reason: *To ensure compliance with Part B3 of the Second Schedule to the Building Regulations, 1997-2017*

7.0 Conditions

Modify Condition 4 and 5 to read as follows

Condition 4

The building shall be fitted with a suitable automatic sprinkler system which is designed, installed and maintained in accordance with IS EN 12845:2015 (+AC:2016) (+A1:2019) including Annex F requirements

Reason: *To ensure compliance with Part B1 of the Second Schedule to the Building Regulations, 1997-2017*

Condition 5:

The products stored within the building or part thereof which are the subject of this application shall exclude high risk or hazardous materials as detailed in section E3 of Appendix E of Technical Guidance Document B

Reason

Reason: *To ensure compliance with Part B3 of the Second Schedule to the Building Regulations, 1997-2017*

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MAURICE JOHNSON

Chartered Engineer I BE, CEng, FIEI, MIStructE, MSFPE

Consultant/Inspector

Date : _______________