Fire safety and digital technologies – now and next

Presented By:
Dr Susan Lamont

Abu Dhabi Conference – Dusit Thani– Dec 12th 2019

Course Description

The presentation will highlight the opportunities and potential benefits of digital transformation for fire safety in buildings

Presenter

Dr Susan Lamont

Director - Arup

Dr Susan Lamont has worked in the fire protection industry for 15+ years in the UK, US and Middle East. She is a chartered engineer and professional member of the Society of Fire Protection Engineers (SFPE). Her Doctorate research looked at the response of steel frame structures in real fires. Since joining Arup she has worked on a diverse range of projects from large assembly buildings, hospitals, schools, shopping malls and offices to masterplans and transport hubs. Her role on many projects is to guide the developer/owner through fire safety design, testing and commissioning to occupation and fire safety management of the completed building. She is currently the Global technical skills leader for the fire engineering team at Arup. She works closely with her clients and the local authorities to maintain a high level of fire safety in new and existing buildings. Susan is currently working on delivery of Abu Dhabi International Airport Midfield Terminal Building amongst other projects.

Learning Objectives

1. Raise awareness of the benefits of digital transformation for fire safety in design, construction and through the life of a project
2. Understand BIM and its potential to improve fire safety in buildings
3. Raise awareness of future opportunities for the application of digital technologies in fire safety

The purpose of this presentation is to convey technical knowledge to the conference participants.

The presentation also contains slides with text that summarises the content of the presentation and the main learning objectives.

These may be used to update CPD records for relevant organisations including the Chartered Institute of Building (CIOB).

Safety Design In Buildings - 12th Dec 2019

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Fire safety and digital technologies – now and next

Susan Lamont
Director - Fire Engineering

Agenda

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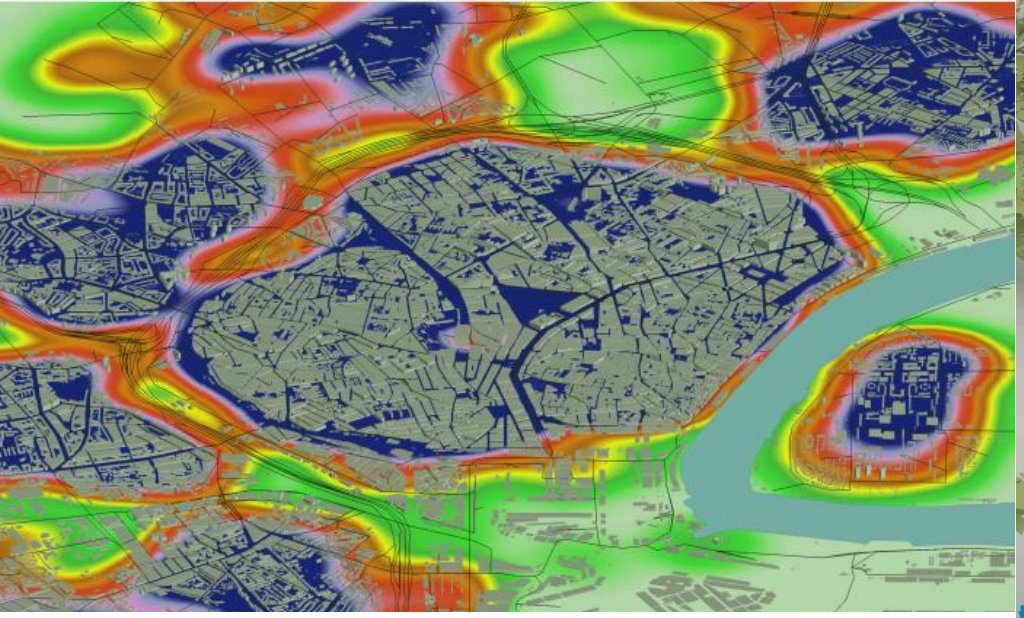
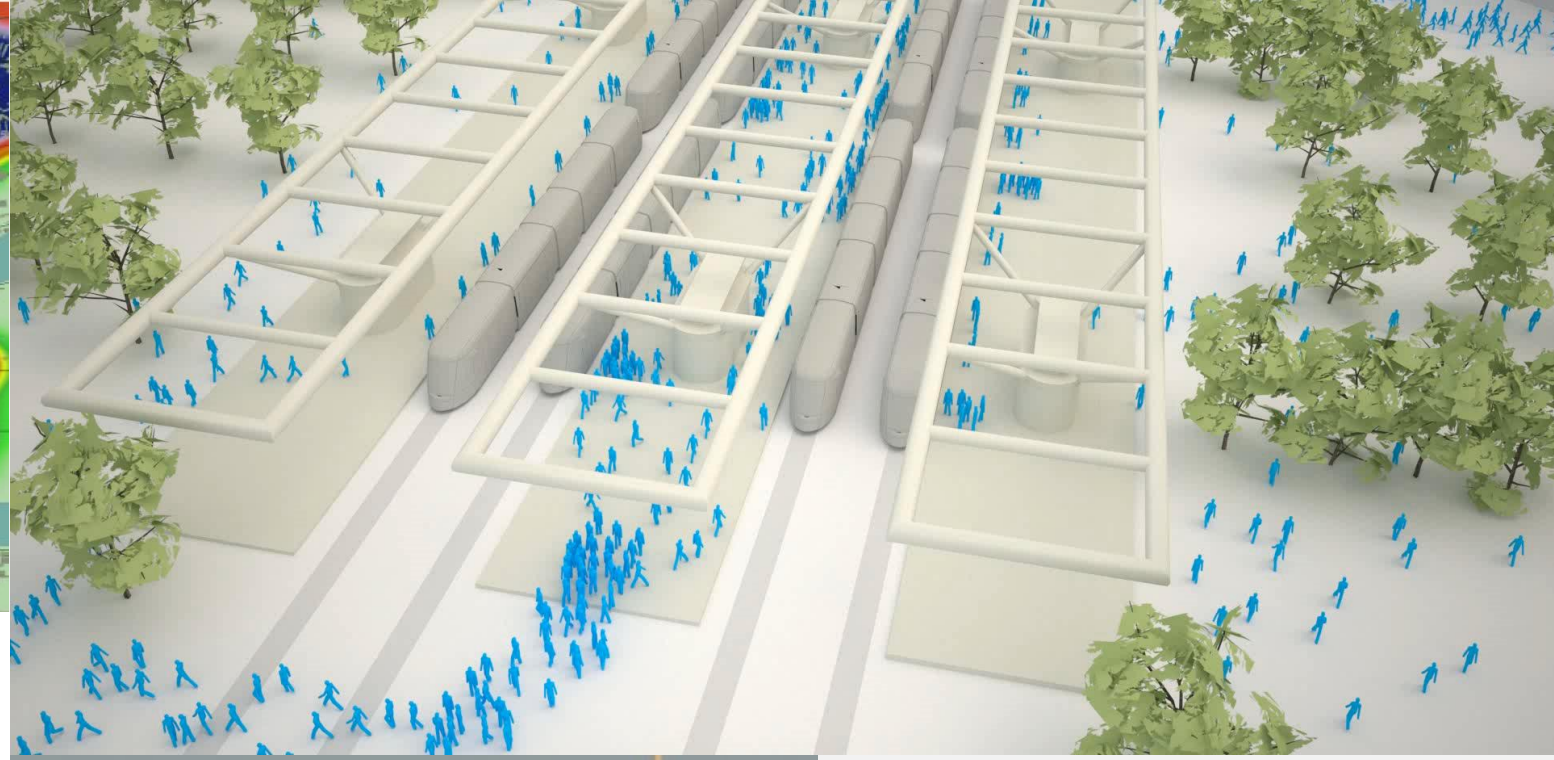
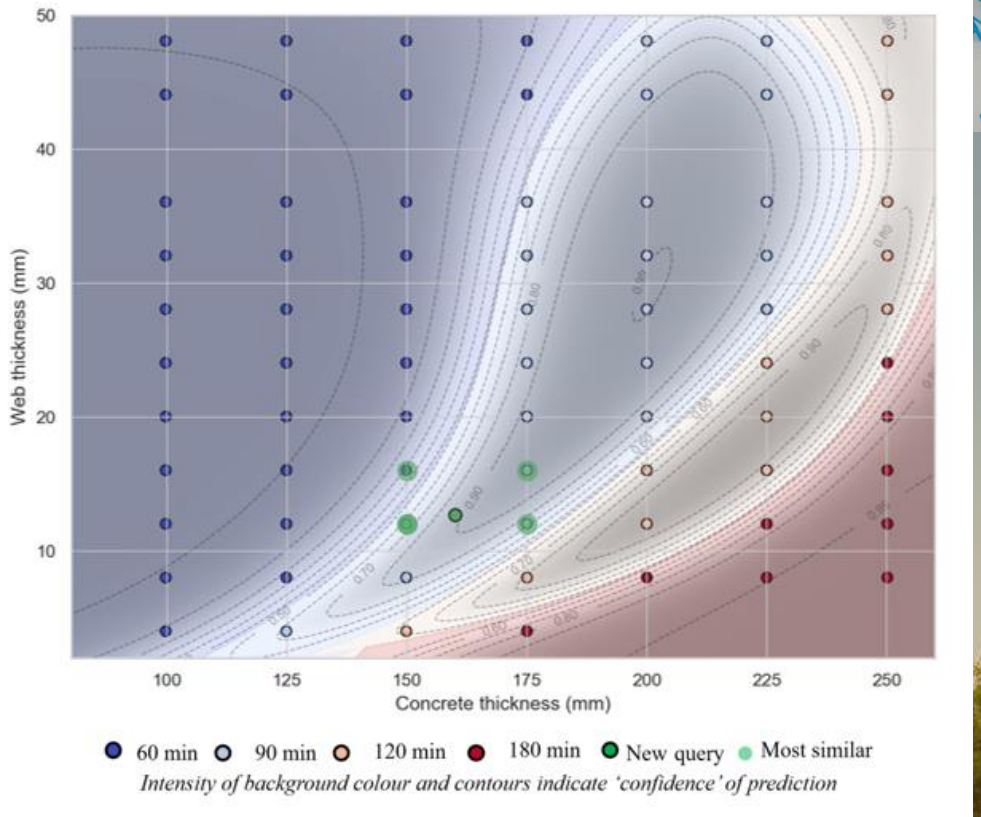
Digital transformation

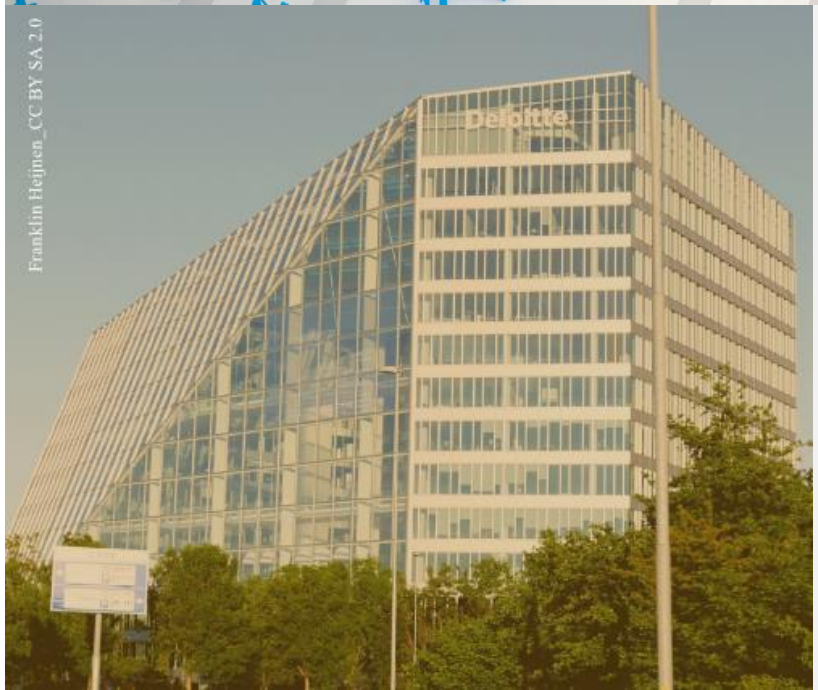
BIM and why it matters for fire safety

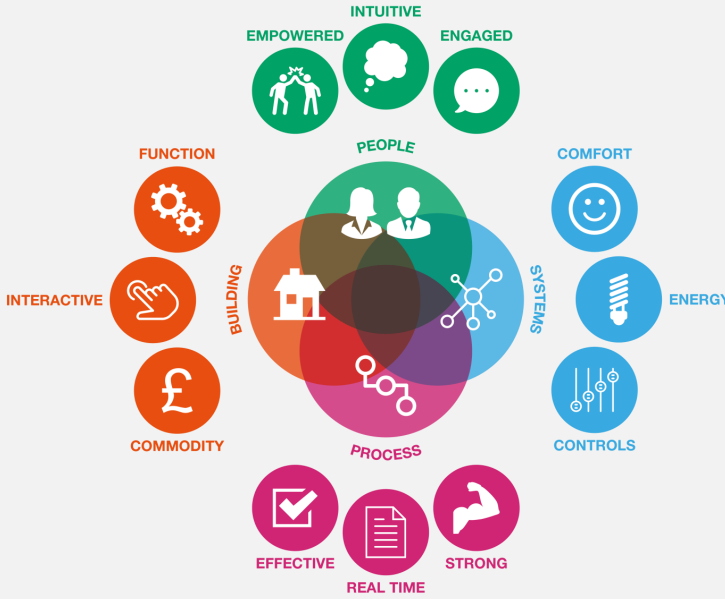
What the future could be






Web thickness (mm)
50
40
30
20
10
100
125
150
175
200
225
250
Concrete thickness (mm)
60 min
90 min
120 min
180 min
New query
Most similar
Intensity of background colour and contours indicate 'confidence' of prediction


Franklin Heijnen_CC BY SA 2.0


INTUITIVE
EMPOWERED
ENGAGED
FUNCTION
PEOPLE
COMFORT
INTERACTIVE
BUILDING
SYSTEMS
ENERGY
COMMODITY
PROCESS
CONTROLS
EFFECTIVE
REAL TIME
STRONG

BENEFITS OF DIGITAL

Full life-cycle of a building

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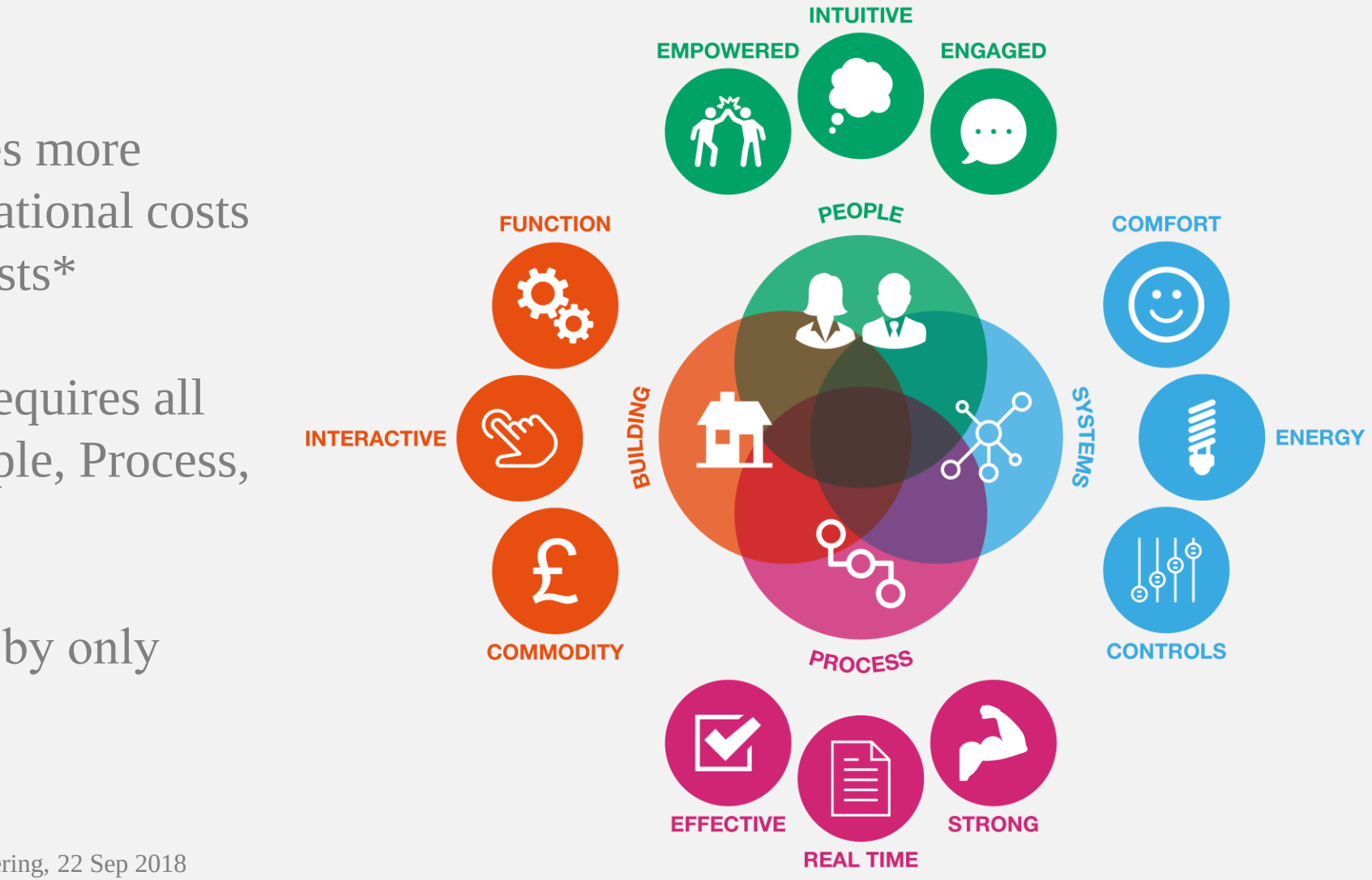
Between 5 and 6.6 times more money is spent on operational costs than on construction costs*

A successful building requires all four parts to work: People, Process, Systems and Building

Problems aren't solved by only doing one thing



*Office Building – Royal Academy of Engineering, 22 Sep 2018

BENEFITS OF DIGITAL

Predictive maintenance

ARUP

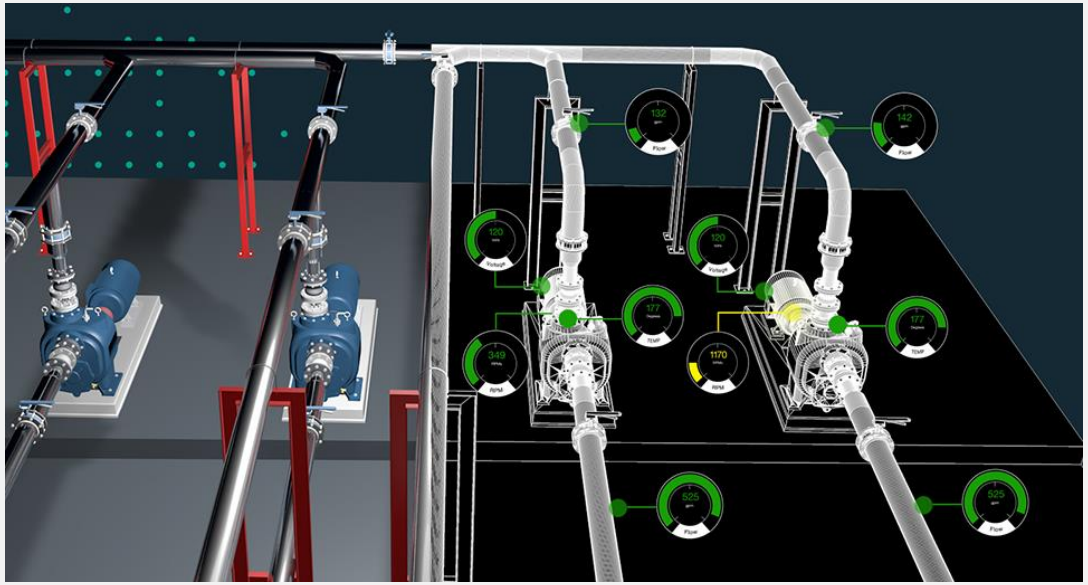
Upkeep of systems in large and complex buildings is an enormous task

Integrating Internet of Things (IoT) sensors – creation of a ‘photographic memory’ of fire safety assets over time

AI can be trained to recognise patterns and identify / investigate unusual trends

Inspections, maintenance and repair can be streamlined, prioritised and automated

Microsoft HoloLens testing at Arup



Digital Twin © IBM Watson

BENEFITS OF DIGITAL

"Start with the end in mind"

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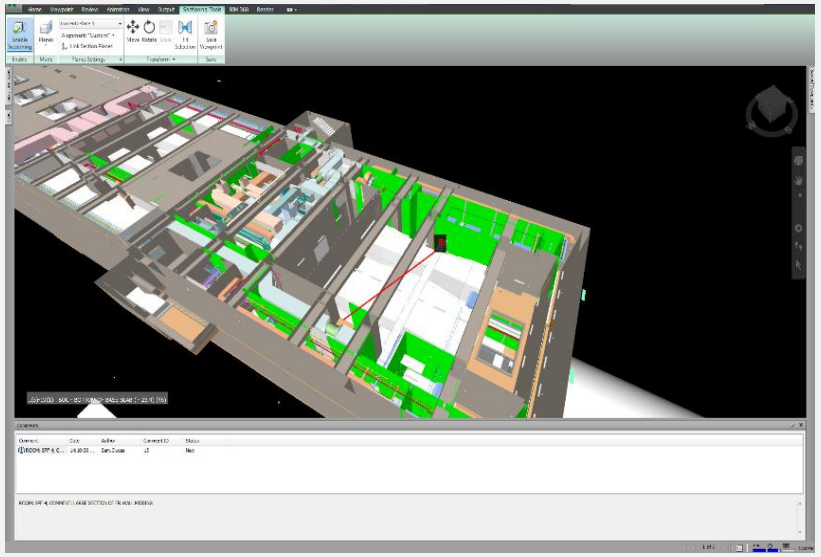

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To integrate fire safety throughout the whole building life-cycle, we must bridge the gap between these digital tools

This can be achieved through use of 'digital twins'

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Fire Safety and BIM

What is BIM?

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Building Information Modelling

Building Information Management

A way of working, a single source of truth

HMG hypothesis:

"significant improvements in cost, value and carbon performance through sharable asset information."

BENEFITS OF DIGITAL

BIM Maturity Level 2

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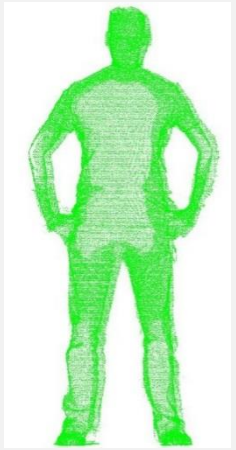
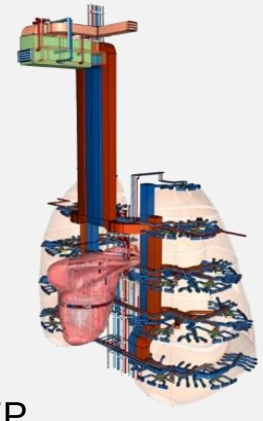
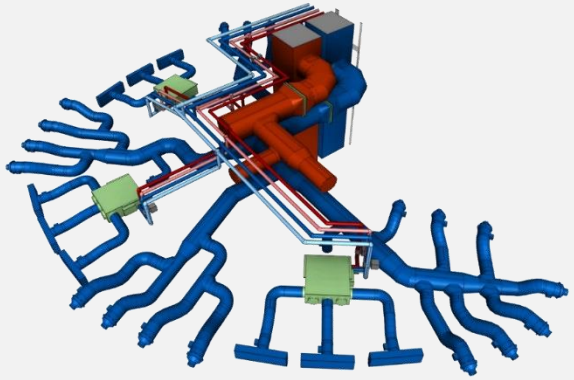


Architecture



MEP



Objects, Rooms and Spaces

Structure

Reports &
Sketches

SYSTEMS INTEGRATION

Who is involved in fire safety design?

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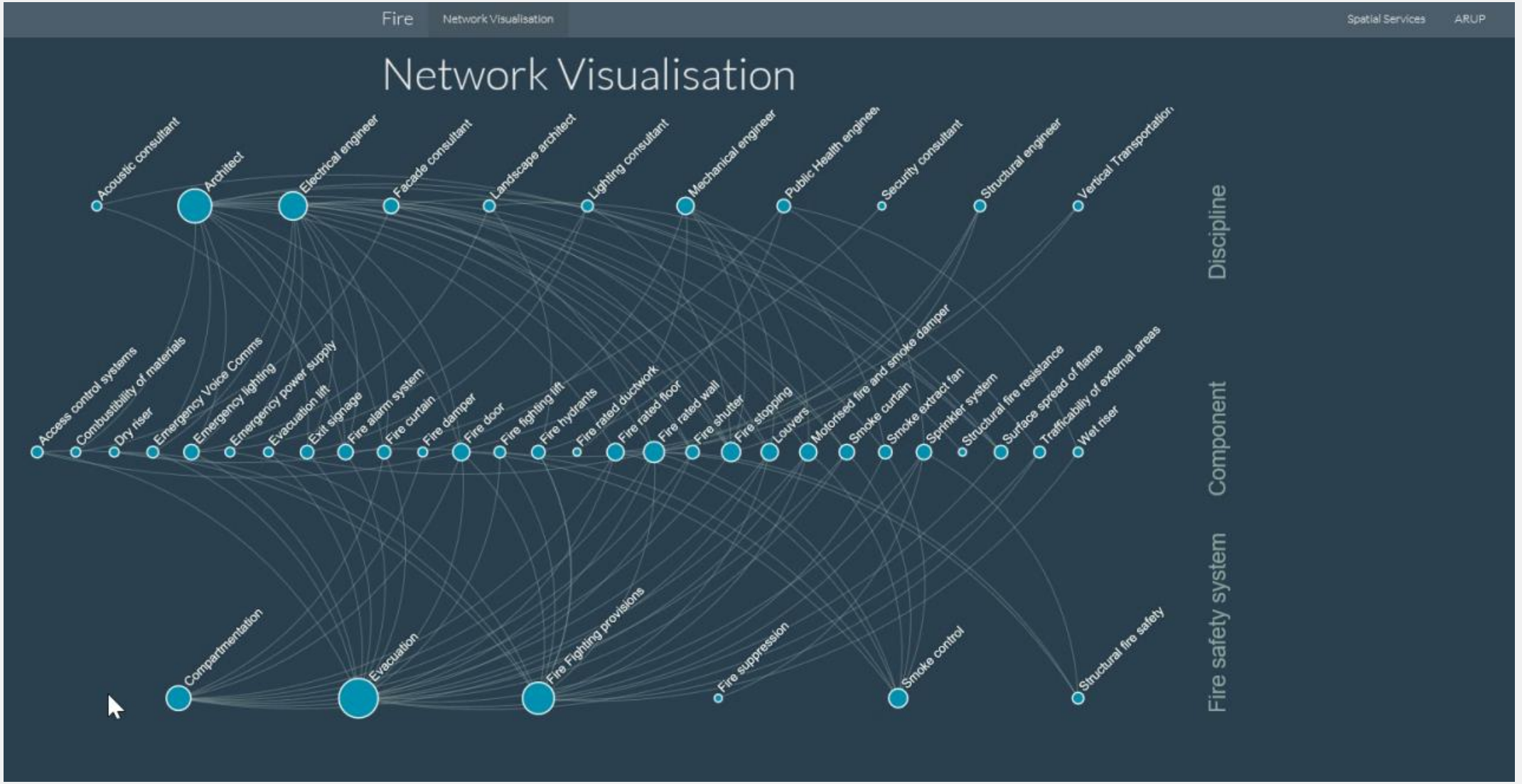

Fire Safety in BIM Level 2 Projects

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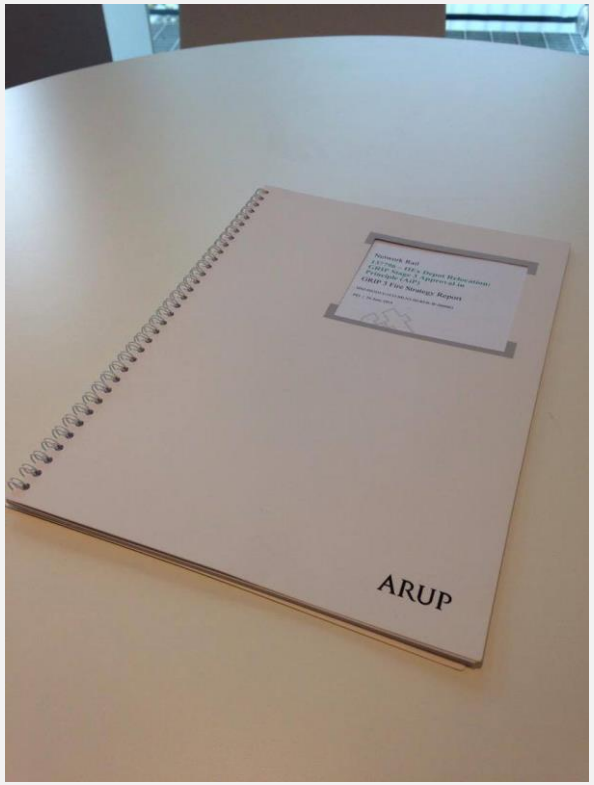
Too often still like this:



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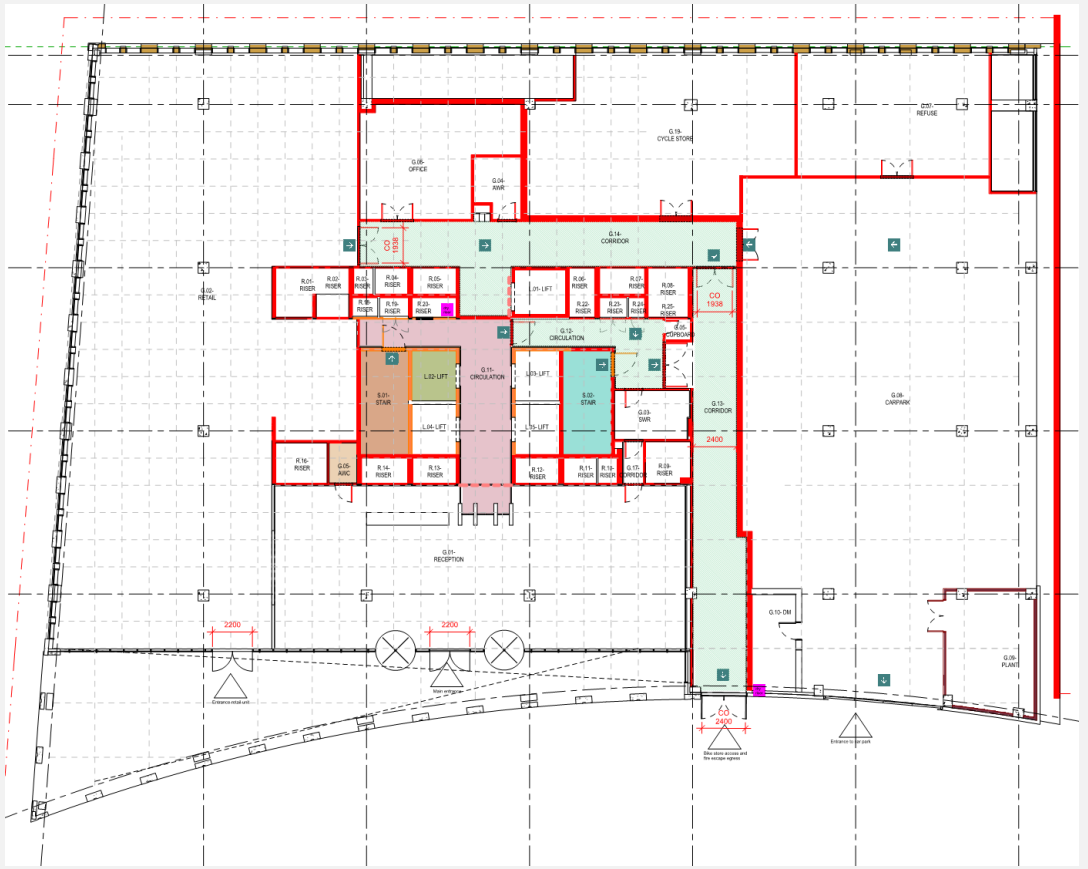

Fire Fighting and Escape

- Escape Corriddor
- Fire Control Centre
- Fire-fighting Lift
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- Required Fire Escape Signage

While the design team does this…

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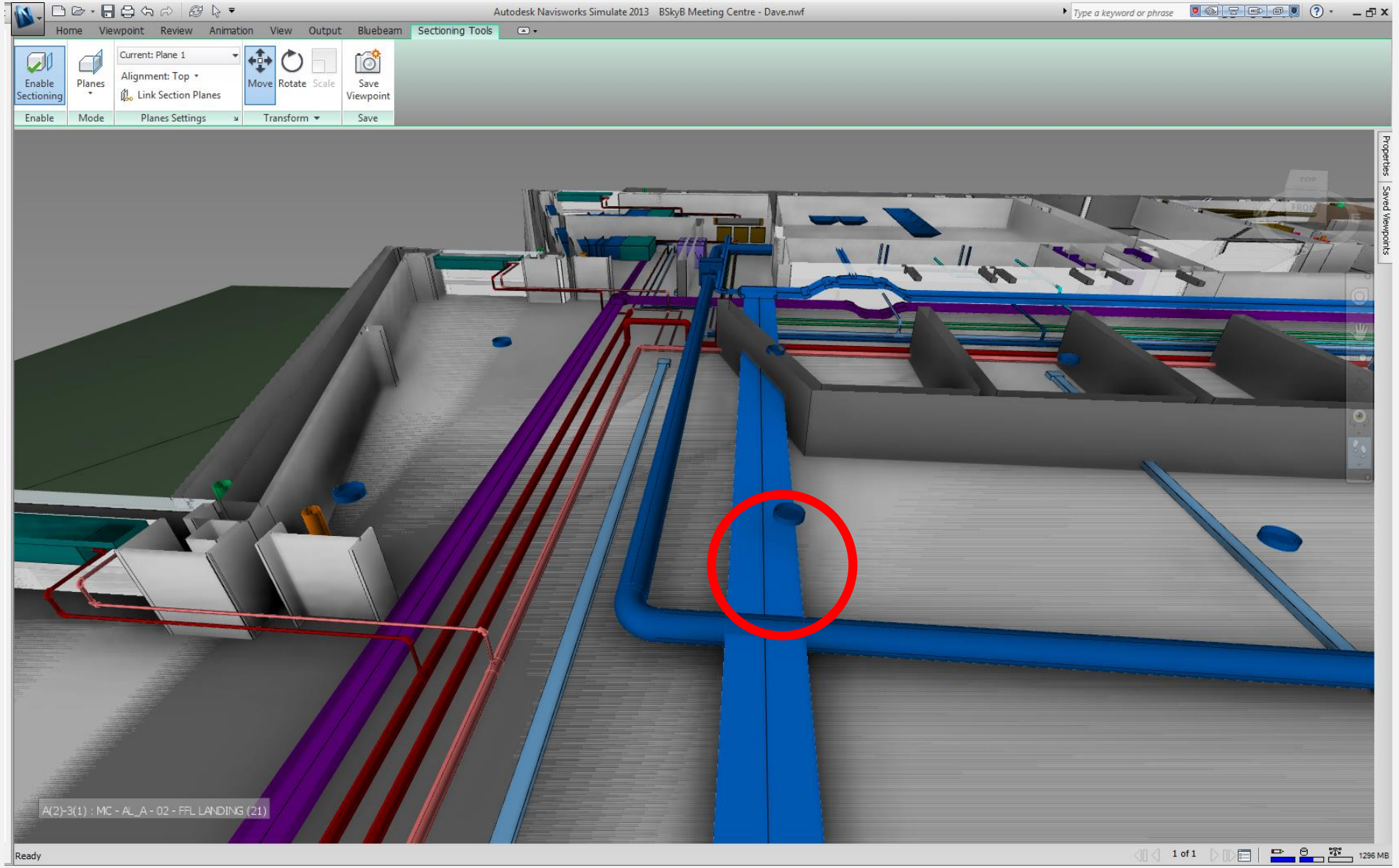

Level of safety information required – where is fire safety performance?

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Subject BIM Fire Safety Parameters

Date 26 September 2017 Job No/Ref

Table 1: Object Parameter Information

Objects	Information label	Value (text field)	Visual / graphic	Purpose of information	Responsible Party to include in REVIT model	Design stage information should be included
Walls	Required fire resistance rating	REI 240/240/240 REI 180/180/180 REI 120/120/120 REI 90/90/90 REI 60/60/60 REI 30/30/30 REI 30/30/15 RE 30/30 REI XXX/XXX/XXX	= 240 minutes fire resistant = 180 minutes fire resistant = 120 minutes fire resistant = 90 minutes fire resistant = 60 minutes fire resistant = 30 minutes fire resistant	Fire resisting construction used in the separation of one space from another to reduce fire spread within the building. Will define where services require fire stopping / dampers, and which doors are required to be fire doors. Forms part of the required fire safety information for the client to maintain and operate the fire safety precautions in their building.	Architect and Structural Engineer	RIBA Stage 3
	Life safety	Yes/no	N/A	Allows differentiation between fire compartmentation that may be provided for business continuity purposes	Architect and Structural Engineer	RIBA Stage 3
Floors	Required fire resistance rating	REI 240/240/240 REI 180/180/180 REI 120/120/120 REI 90/90/90 REI 60/60/60 REI 30/30/30 REI XXX/XXX/XXX	= 240 minutes fire resistant = 180 minutes fire resistant = 120 minutes fire resistant = 90 minutes fire resistant = 60 minutes fire resistant = 30 minutes fire resistant	Fire resisting construction used in the separation of one storey from another to reduce fire spread within the building. Will define where services require fire stopping / dampers. Forms part of the required fire safety information for the client to maintain and operate the fire safety precautions in their building.	Architect and/or Structural Engineer	RIBA Stage 3
	Life safety	Yes/no	N/A	Allows differentiation between fire compartmentation that may be		

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Fire Safety and BIM – **Learning by Doing**

Some examples…

Fire Safety in 3D models

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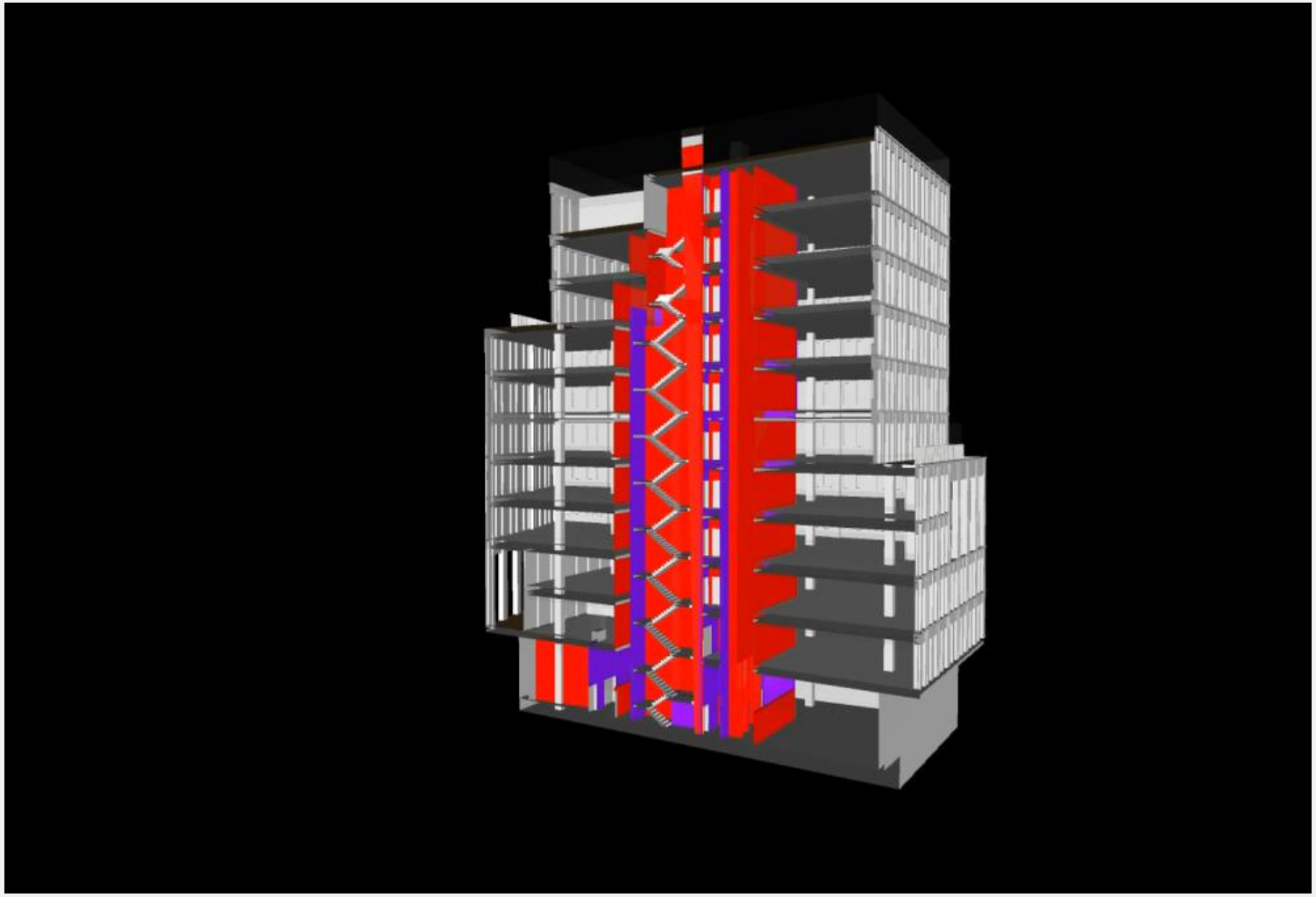
Selector		
FR 90		0
FR 120		0



BENEFITS OF DIGITAL

Fire Safety in 3D models

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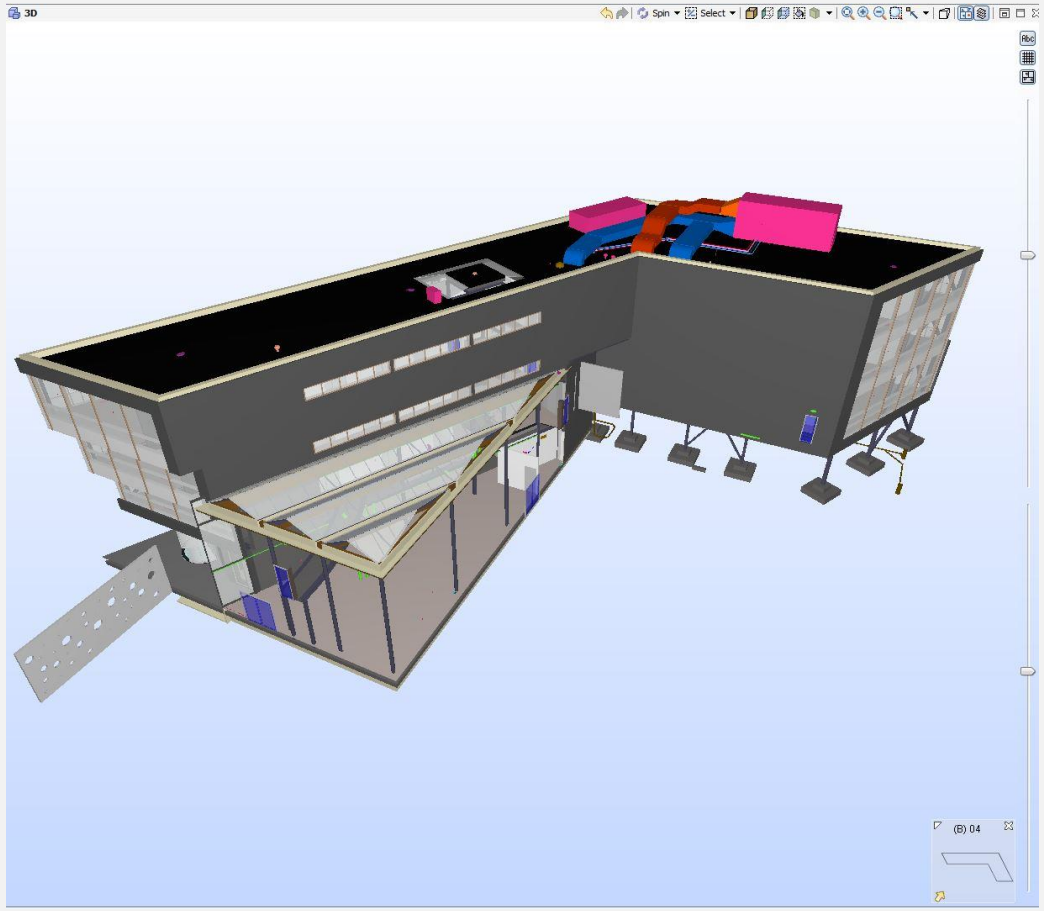
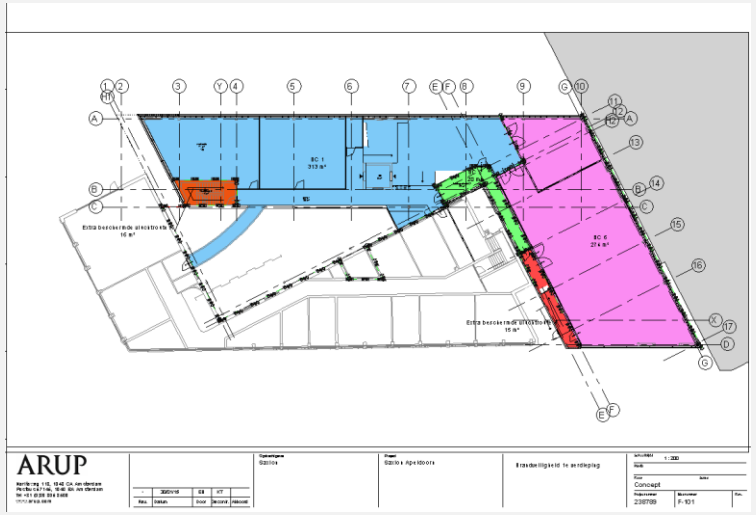


3D model

Information Takeoff

Takeoff Selected | Brandcompatimenten | Report

Component	Fire compartment	Number of zones	Volume	Area	Color
Space	BC 1	3	2,225.15 m3	570.94 m2	
Space	BC 10	1	33.46 m3	9.64 m2	
Space	BC 2	4	424.08 m3	102.09 m2	
Space	BC 3	1	22.89 m3	5.69 m2	
Space	BC 4	1	28.59 m3	7.11 m2	
Space	BC 5	1	24.43 m3	6.08 m2	
Space	BC 6	1	1,036.02 m3	294.25 m2	
Space	BC 7	1	1,246.20 m3	334.47 m2	
Space	BC 8	1	665.24 m3	173.01 m2	
Space	BC 9	1	1,163.88 m3	338.24 m2	
Space	Extra beschermde vluchtroute A	4	275.31 m3	73.37 m2	
Space	Extra beschermde vluchtroute B	3	194.40 m3	57.58 m2	



Spaces defined to capture fire compartments

BENEFITS OF DIGITAL

Fire Safety in 3D

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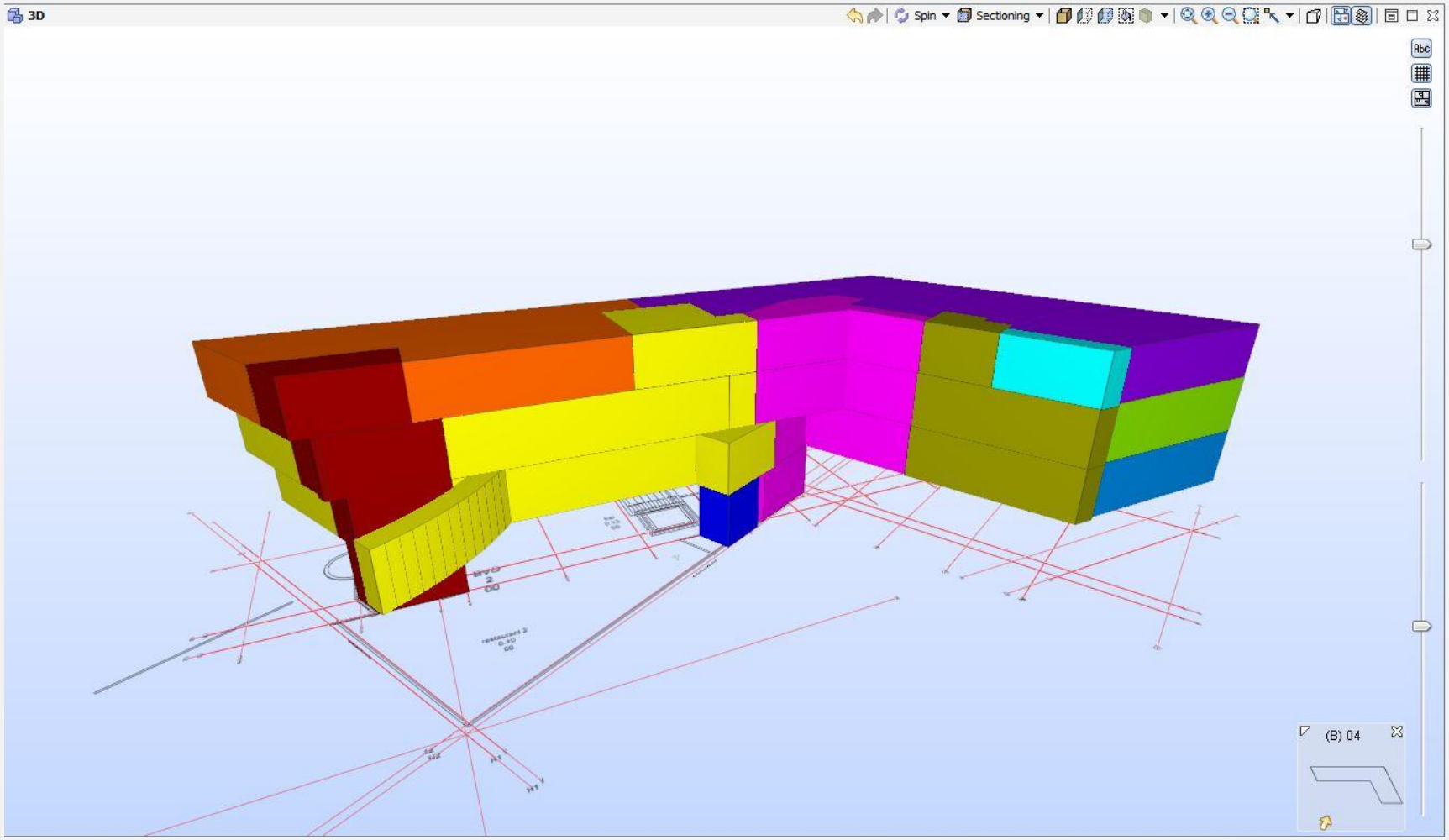

Scripting to show fire compartment configuration in 3D

BENEFITS OF DIGITAL

Coordinating fire safety in Complex Buildings

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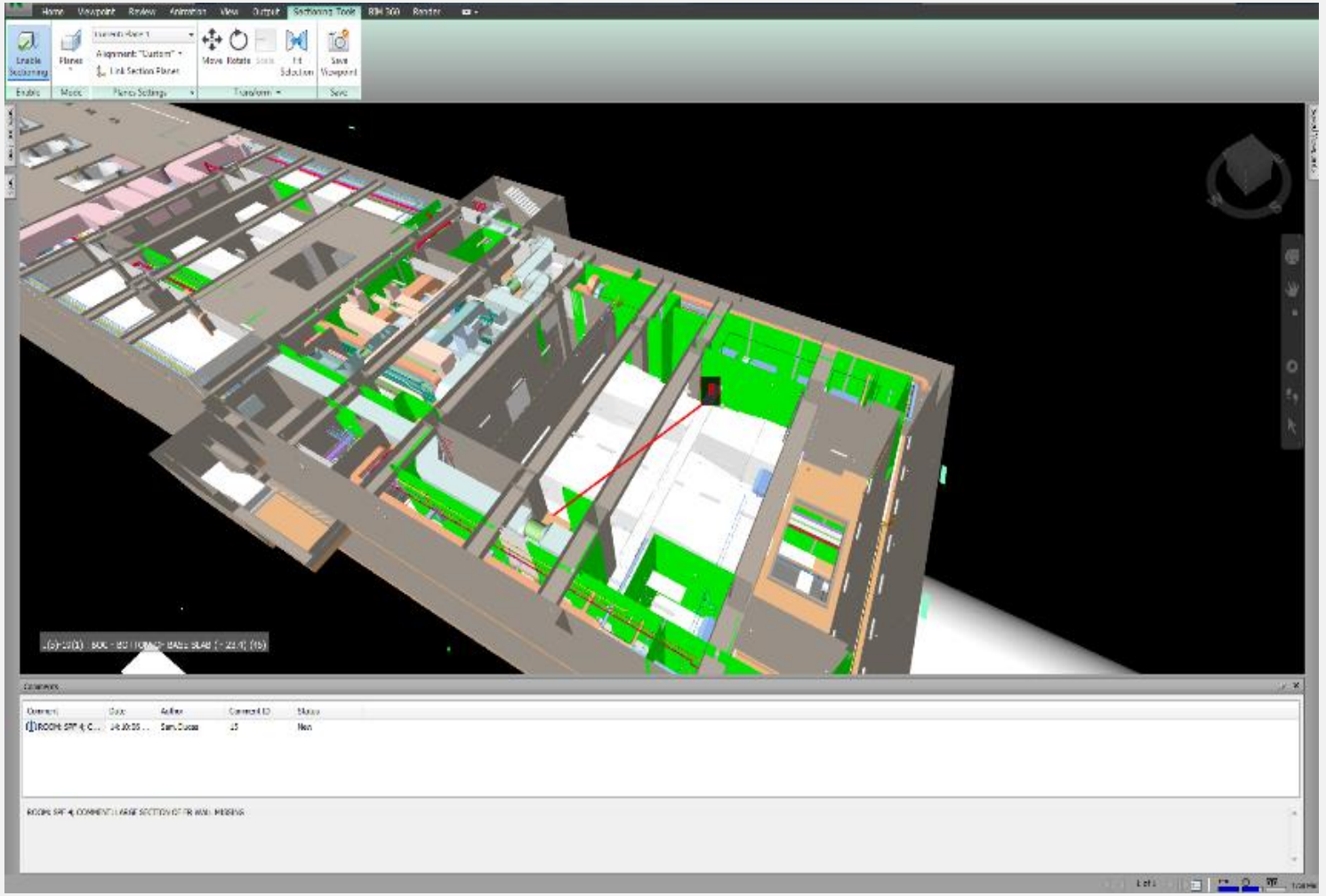
Working in 3D model to determine the continuity of the compartmentation

Navisworks software package was used to filter and colour code fire resisting construction



BENEFITS OF DIGITAL

Service Penetration Checking

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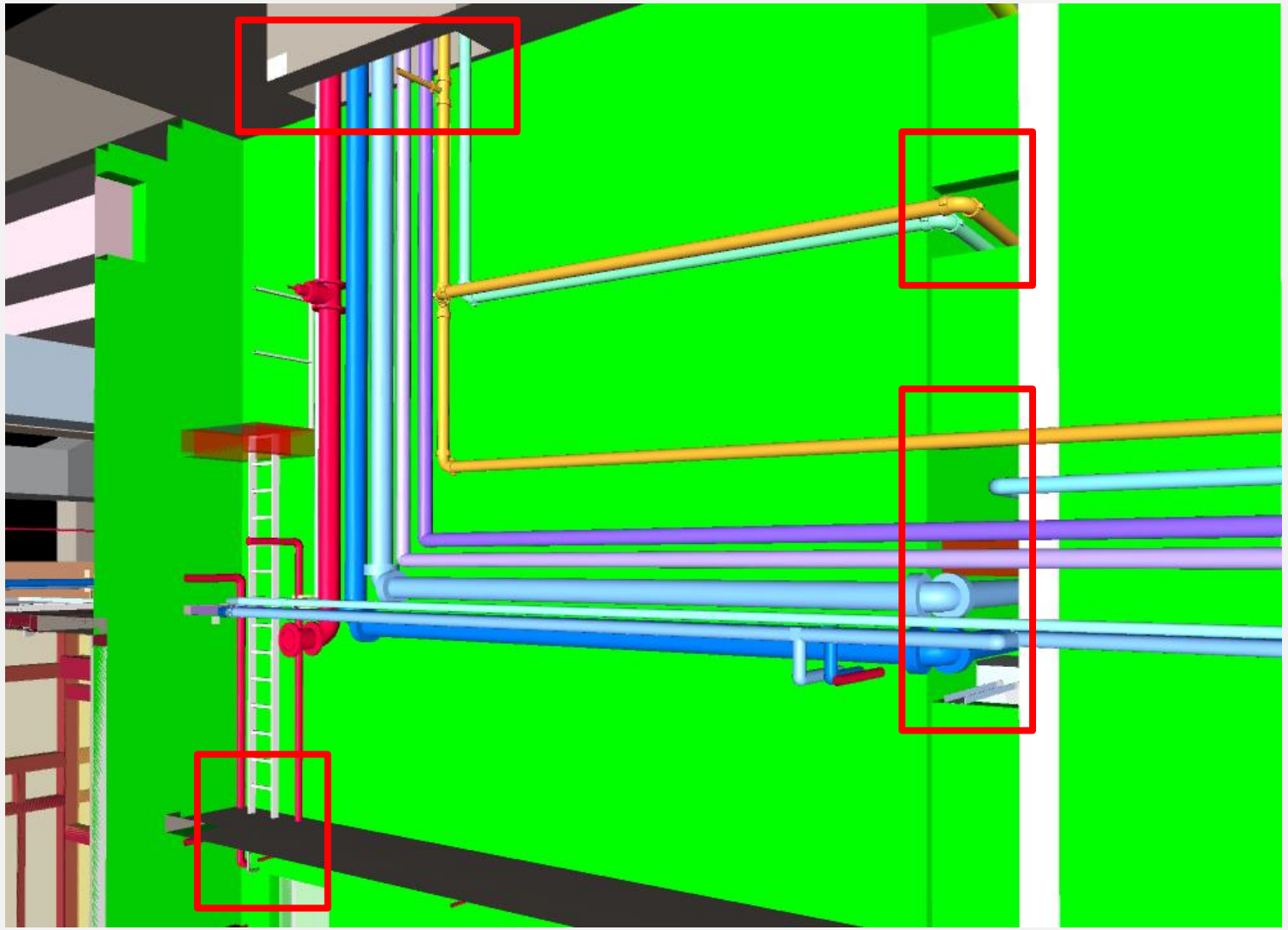

BENEFITS OF DIGITAL

Checking fire door performance visually

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Door Number	Door Type	Description	Fire Rating	Acoustic Rating	Thermal Insulated
A3-L01-D01	DRS-211	STAIRCASE	FD60S		n/a
A3-L01-D02	DRS-215	RISER	FD60S	35dB (Rw)	n/a
A3-L01-D03	DRS-215	RISER	FD60S	35dB (Rw)	n/a
A3-L01-D04	DRS-215	RISER	FD60S	35dB (Rw)	n/a
A3-L01-D05	DRS-214	REFUSE CHUTE	FD30S	40db (Rw)	n/a
A3-L01-D06	DRS-212	CORRIDOR	FD30S		n/a
A3-L01-D07	DRS-213	RISER LOBBY	FD60S	35dB (Rw)	n/a
A3-L01-D08	DRS-201	RISER	FD60S	35dB (Rw)	n/a
A3-L01-D09	DRS-201	RISER	NFR	35dB (Rw)	n/a
A3-L01-D10	DRS-201	RISER	FD60S	35dB (Rw)	n/a
A3-L01-D11	DRS-201	RISER	FD60S	35dB (Rw)	n/a
A3-L01-D12	DRS-201	RISER	FD60S	35dB (Rw)	n/a
A3-L01-D13	DRS-212	CORRIDOR	FD30S		n/a
A3-L01-D14	DRS-211	STAIRCASE	FD60S		n/a
A3-L01-D15	DRS-215	RISER	FD60S	35dB (Rw)	n/a
A3-L01-D16	DRS-215	RISER	FD60S		n/a
A3-L01-D17	DRS-215	RISER	FD60S		n/a
A3-L01-D18	DRS-214	REFUSE CHUTE	FD30S	40db (Rw)	n/a
A3-L01-D19	DRS-212	CORRIDOR	FD30S		n/a
A3-L01-D20	DRS-212	CORRIDOR	FD30S		n/a
A3-L01-D21	DRS-201	RISER	FD60S	35dB (Rw)	n/a
A3-L01-D22	DRS-201	RISER	FD60S	35dB (Rw)	n/a
A3-L01-D23	DRS-201	RISER	FD60S	35dB (Rw)	n/a
A3-L01-D24	DRS-201	RISER	FD60S	35dB (Rw)	n/a

Fine tuning naming conventions

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File Edit Format View Help

```
# This is a Revit shared parameter file.
# Do not edit manually.
*META   VERSION MINVERSION
META    2       1
*GROUP  ID      NAME
GROUP   1       Fire protection
*PARAM  GUID    NAME    DATATYPE        DATACATEGORY    GROUP   VISIBLE DESCRIPTION     USERMODIF
PARAM   c390090f-865c-489f-855e-3a2ed7dcab70    Space_Fire_Smoke Control Zone   TEXT                                                    ystem will be
PARAM   9aaf0e19-c921-41f7-8431-835ad993a741    Space_Fire_Evacuation Lift                                                              intended to be us
PARAM   86407720-567a-4074-bcd8-8c3e3d38be2a    Specification_Fire_Requi                                                                 etermines the operating pro
PARAM   5a192023-5b24-4791-ace8-f51275180679    Space_Fire_Fire                                                                         ow the detection system will be zon
PARAM   4aa20124-47d2-4d82-9e62-199f8f4c0dcb    Specifi                                                                                 etermines the activation type of an active
PARAM   cdba7a25-05e5-432a-b4c7-a0ec903dcfd7                                                                                            Defines the location of fire control centre
PARAM   4effa438-ec2e-419f-8f60-c25d357                                                                         1       Defines the design occupant load based on fi
PARAM   10e0333b-4501-4cf5-8e6b                                                 TEXT            1       1       Determines the method of exp
PARAM   88ff3e3b-637c-4                                                 YESNO           1       1       Identifies a protected corridor, lob
PARAM   1601694                                                 1       1       Defines a building or parts of a building, that are
PARAM                                   ighting Lobby   YESNO           1       1       Identifies that the lobby is required for in
PARAM                                   tion_Fire_Available Egress Capacity     INTEGER         1       1       Sets out the maximum permitt
PARAM                                   pace_Fire_Suppression Zone      TEXT            1       1       Defines how the suppression system will be
PARAM                                   Specification_Fire_Protection Scheme    TEXT            1       1       The method of achieving the required
PARAM                                   Space_Fire_Floor Space Factor   NUMBER          1       1       Defines the anticipated area taken up per pe
PARAM                                   Specification_Fire_Required Fire Resistance     TEXT            1       1       Fire resisting construction
PARAM                                   Specification_Fire_Orientation of Installation  TEXT            1       1       Determine whether the elemen
PARAM                                   Specification_Fire_Fire exit    YESNO           1       1       Determine storey exits to a place of safety
PARAM   570ec76c-0229-4a09-831b-8e6acbcb79a5    Specification_Fire_Life Safety  YESNO           1       1       Allows differentiation between elements that
PARAM   e33ffb85-e6f0-4086-a317-4b70a998186b    Specificatioon_Fire_Required Exit Width LENGTH          1       1       Minimum clear egress width required
PARAM   871a2c87-fb00-45da-a9a5-5611c68420f3    Specification_Fire_Reaction to Fire     TEXT            1       1       Allows differentiation between produ
PARAM   3b4ef28f-499e-4c32-a329-e2d25261d873    Space_Fire_Maximum Permitted Occupant Load      INTEGER         1       1       Defines the maximum permitte
```

BIM is also about data bases, naming conventions, data categories

Design Coordination – H&S warning signs

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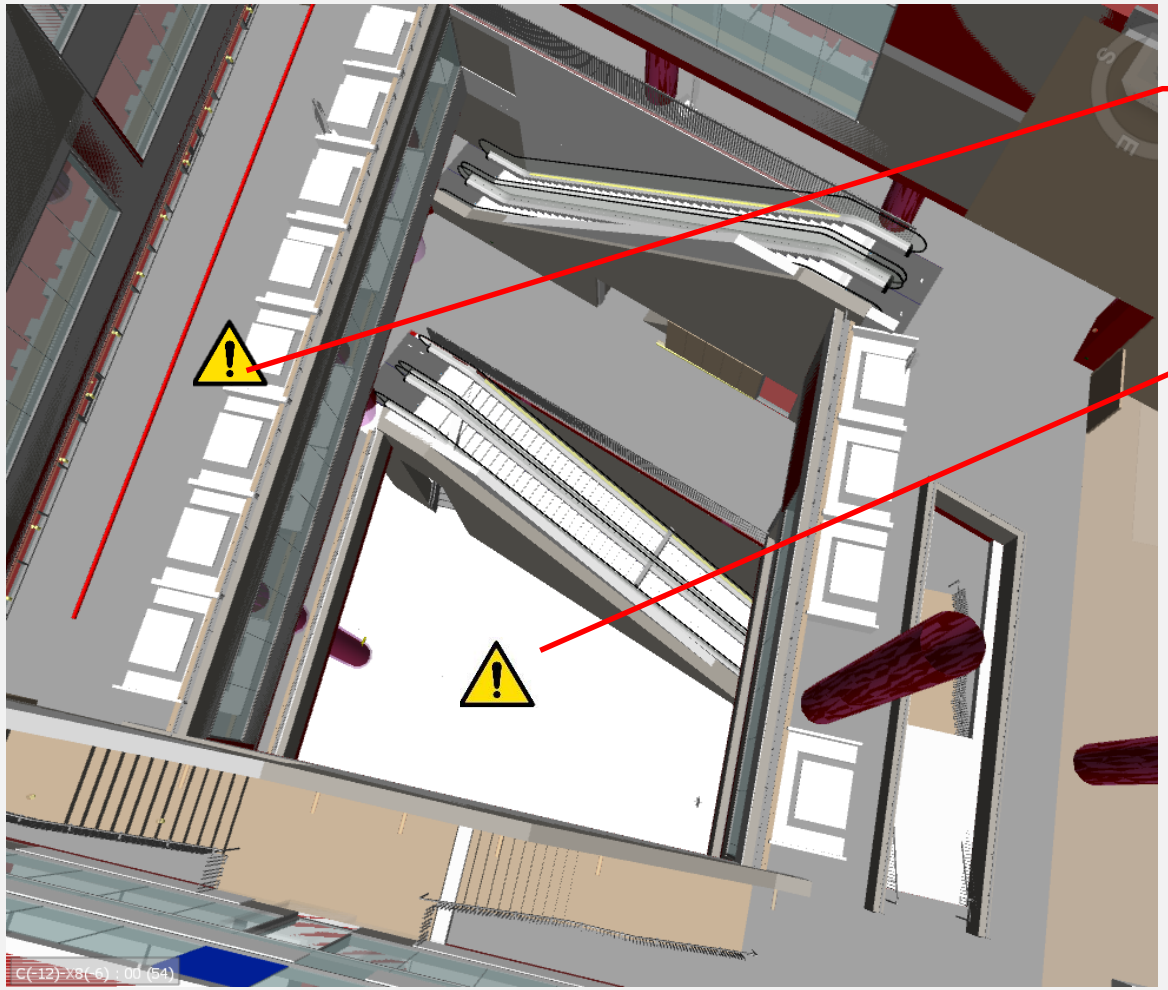

Fuel load control at atrium breakout spaces

Fuel load control at the atrium base

Linked to central risk register

New BIM Workflow

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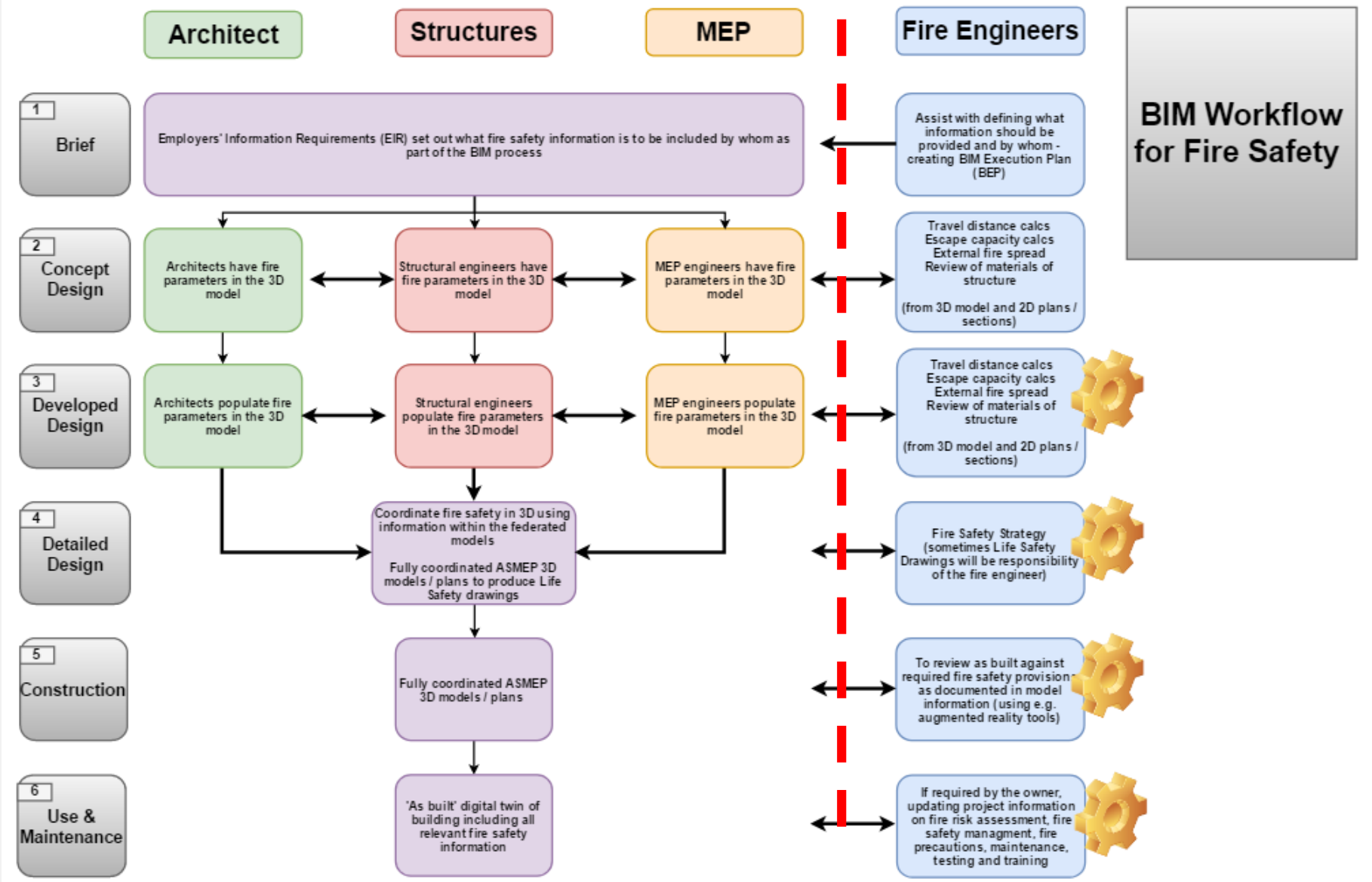

Fire Safety in BIM Level 2 Projects

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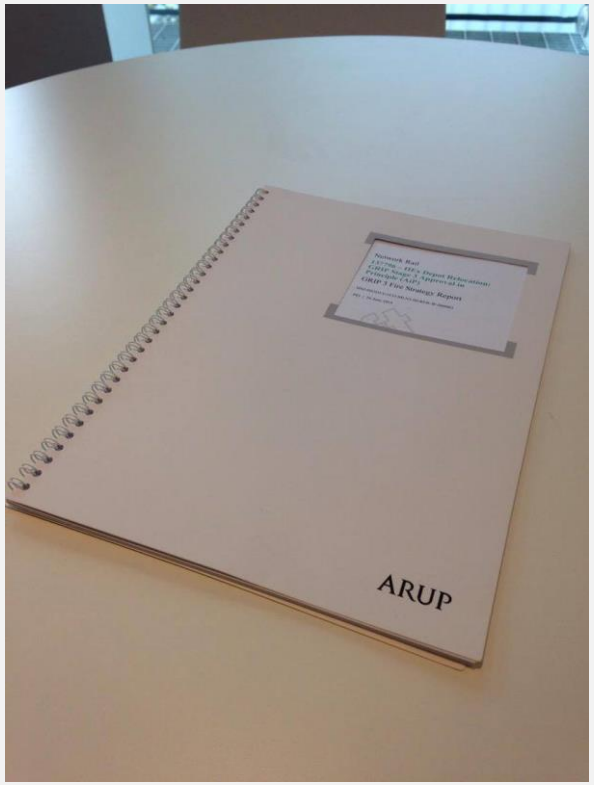
Too often still like this:



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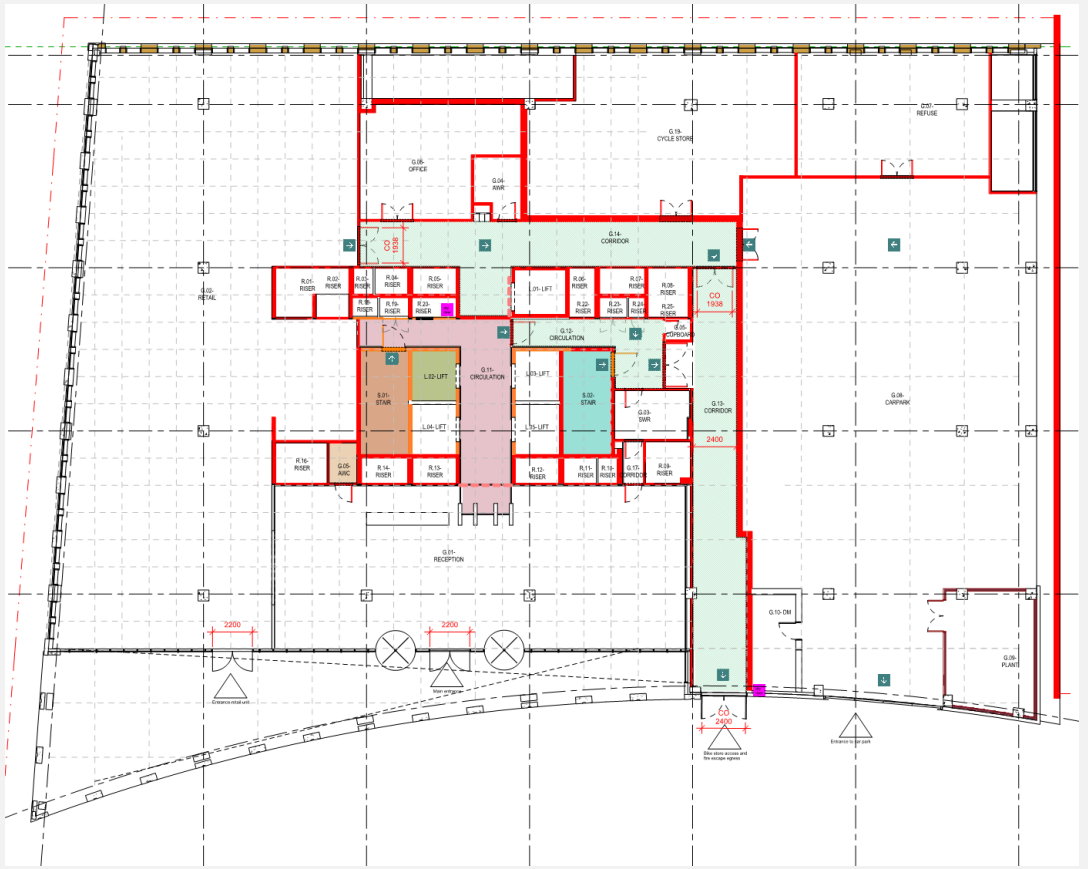

Fire Fighting and Escape

- Escape Corriddor
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- Fire-fighting Lobby
- Fire-fighting Stair
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New BIM Workflow

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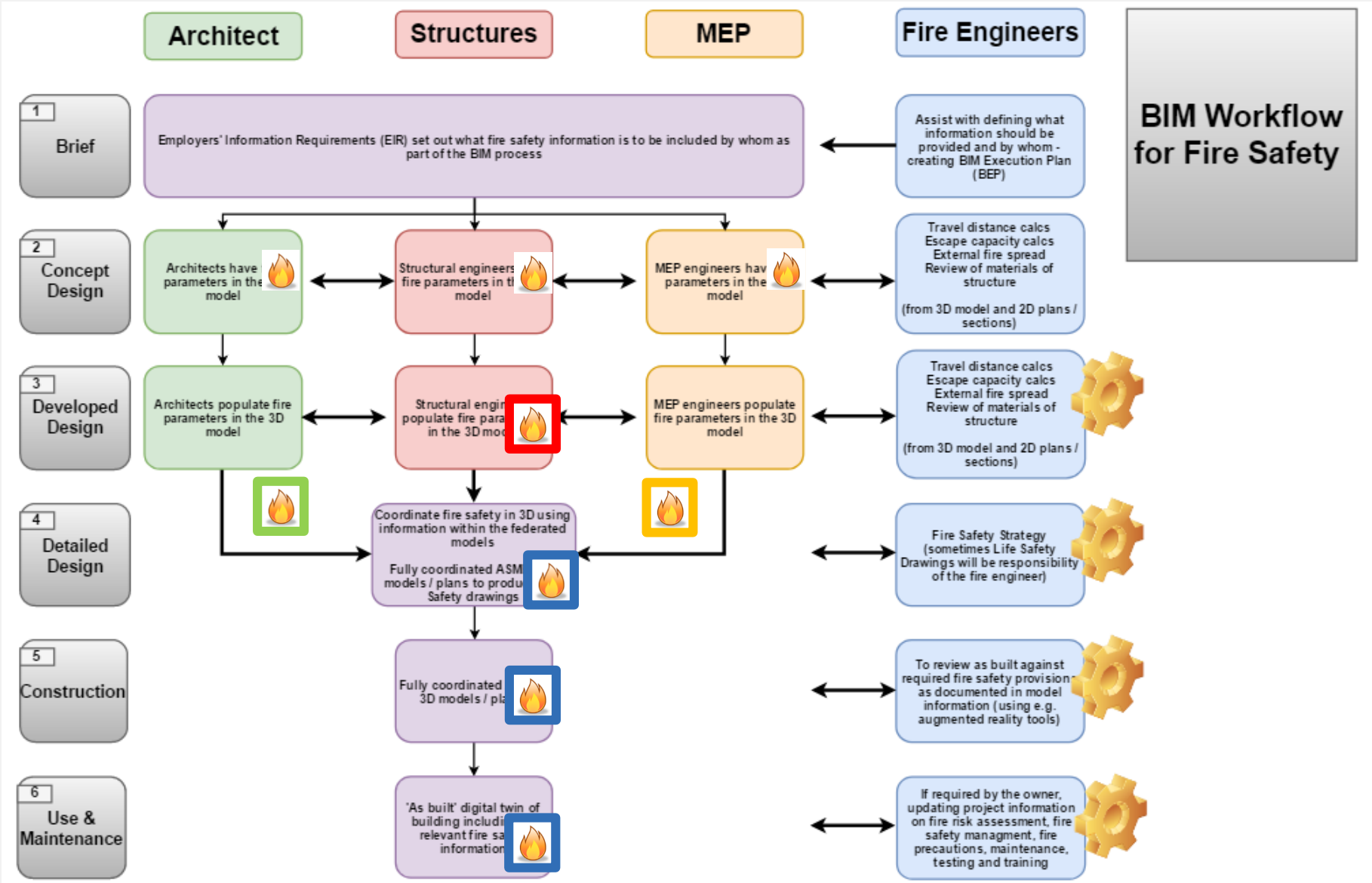

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Fire Safety and BIM – **Future**

BENEFITS OF DIGITAL

Automated Compliance Checking

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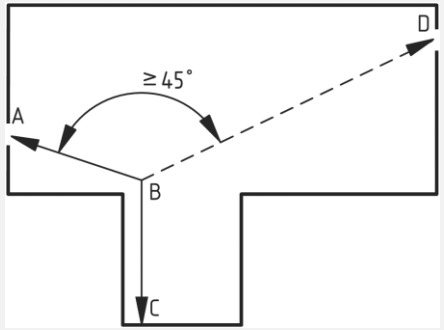
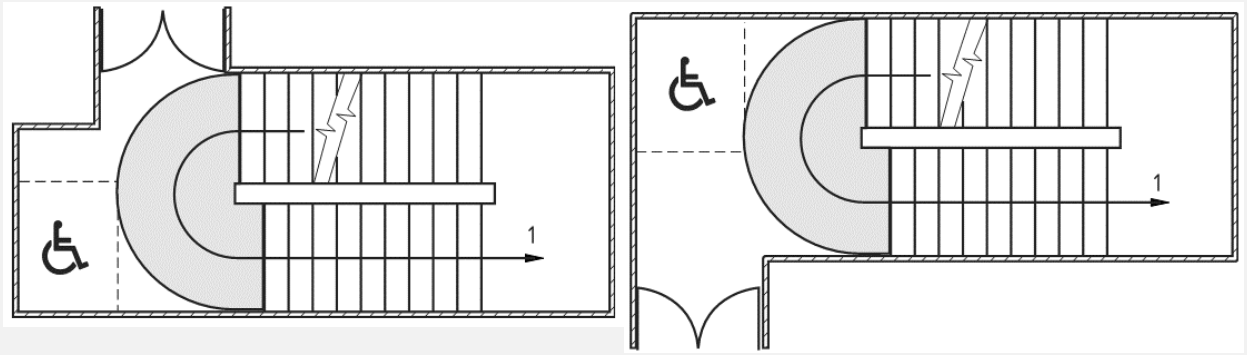


Travel Distance



Refuge location

Hose Reach

Services in Fire Fighting Shafts

Dampers in Protected Corridors / Stairs

Fire Rating of Hazard Rooms

Mechanical Smoke Extract - Air Change Rates

Natural Smoke Ventilation Area

Combustible Insulation in Facades

Creating of plans showing fire ratings to rooms

BENEFITS OF DIGITAL

High accuracy construction monitoring

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Source: https://connect.bim360.autodesk.com/drones-in-construction-projects

BENEFITS OF DIGITAL

Digital twins for fire safety

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BENEFITS OF DIGITAL

Fire safety management on the go

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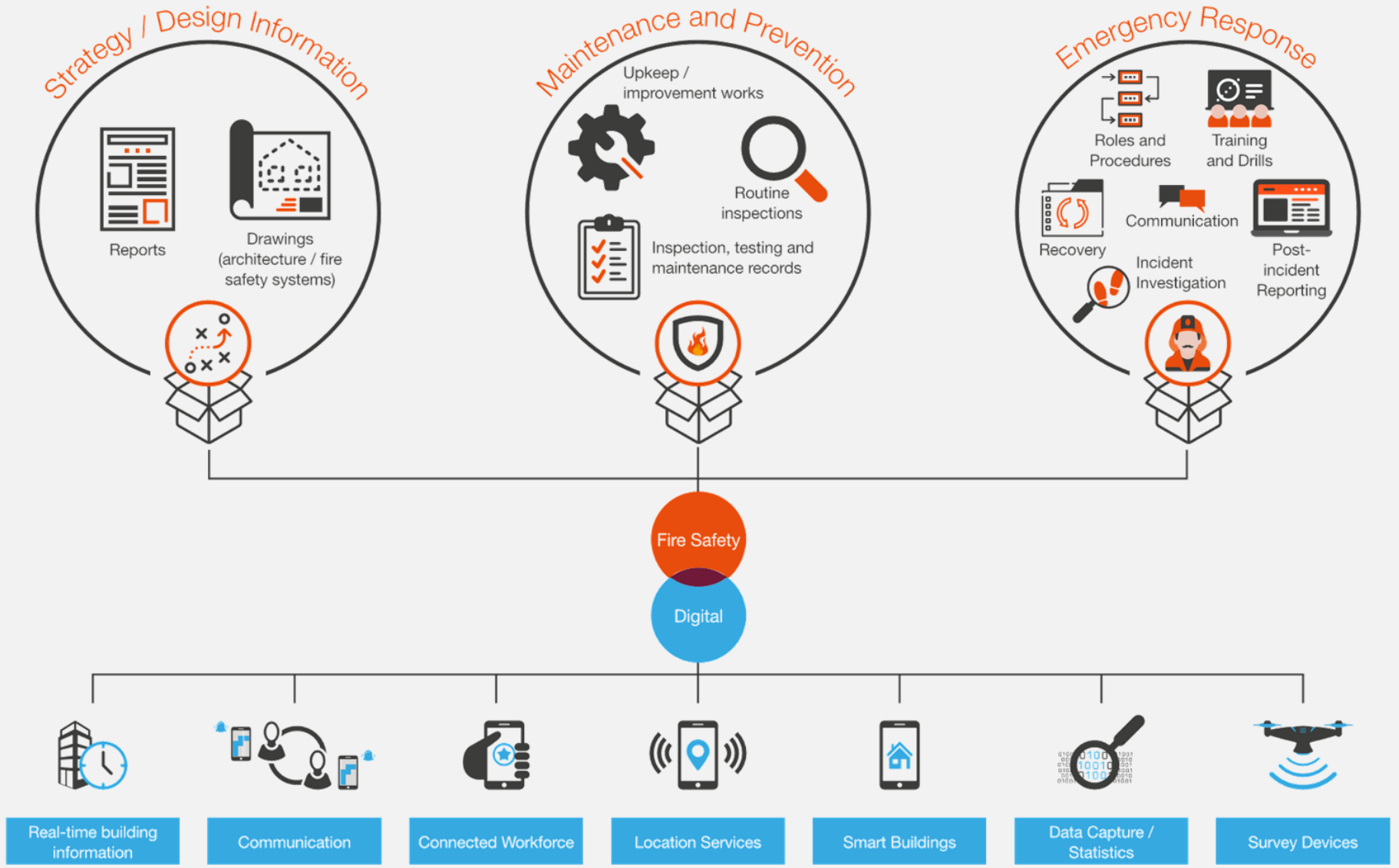


BENEFITS OF DIGITAL

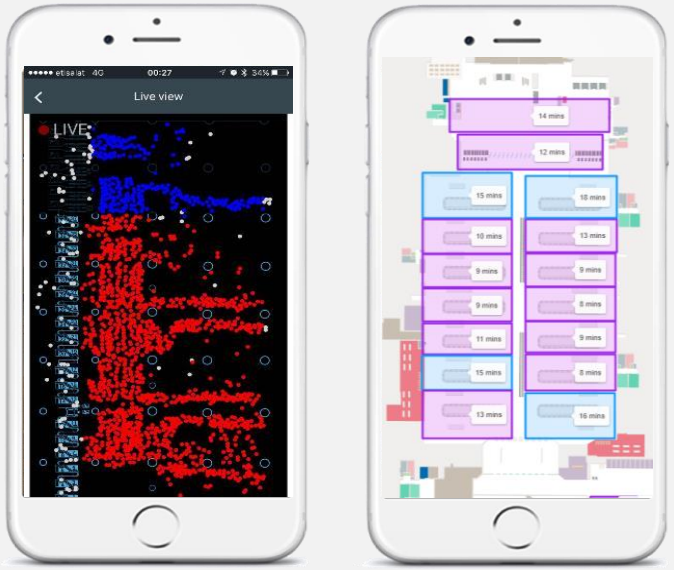
Real-time visualization

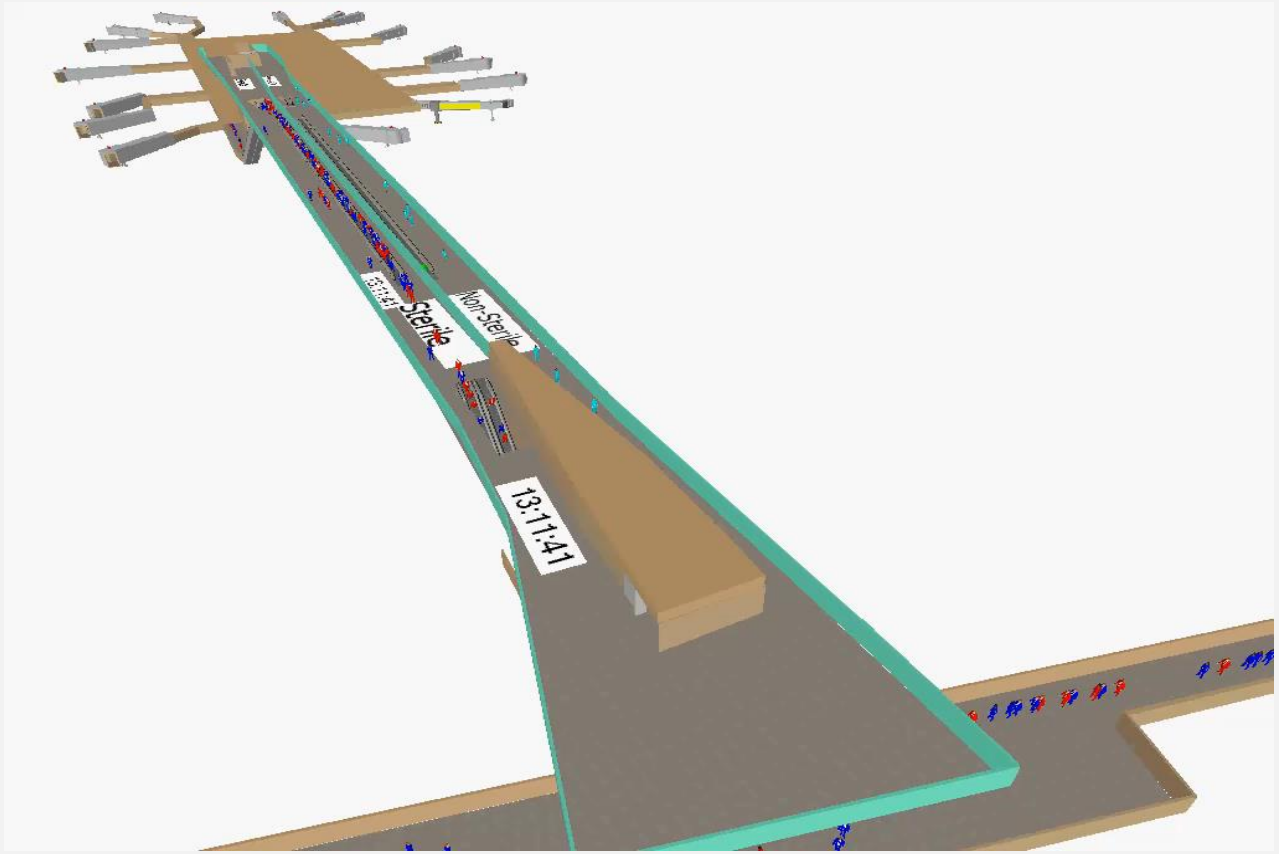
ARUP

Crowd management in real time

Outside the control room

Dynamic solutions as events unfold





AR and QR

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Hololens Testing at Arup

[…] *If AR is harnessed for use with current firefighting gear and procedures, the potential for lifesaving, improved fire operations and firefighter safety is immense.*

[fire&rescue magazine Q3/2016]

In Summary

ARUP

BIM is about **Information Management** and **how we work**

Better fire safety information makes buildings safer

Users need to get involved to **shape the fire safety information** in BIM

More detailed guidance is needed as to **who should provide what fire safety information and when**

Thank you