CS11273 – BIM for Health and Safety, It’s a No-Brainer

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@StefanMordue

Class summary

Too many people are killed and injured in our industry each year, despite the best efforts of all parties concerned. While many are utilizing Building Information Modeling (BIM) for efficiency gains and improved profit margins, perhaps fewer are considering health and safety. Even in times of economic downturn, construction is still one of the largest industry sectors. It is also one of the most dangerous and hazardous, and, despite the rate of injuries over the last 20 years being significantly reduced, construction remains a high-risk industry in which to work.

Although it is not new, BIM has seen a huge uptake in interest in recent years. This is partly as a result of government mandates, but mainly due to great leaps in technology. The incorporation of health and safety into BIM is neither something which is the exclusive preserve of the “technology generation,” nor is it something which is beyond designers. It is, as modern parlance would have it, a no-brainer.

Key learning objectives

At the end of this class, you will:

- Learn that a new approach to safety innovation is needed, and the potential to influence and prevent injuries decreases over time
- Understand some practical applications that can be developed at each stage of the construction process to improve health and safety
- Discover what information can be gathered and how can it be translated into something useful, which adds value
- Learn how BIM objects can play a fundamental part in information communication

Thank you, tack, Merci, ありがとう, gracias, Děkuji

TODAYS agenda

1. **Setting the scene**
2. **Opportunities for BIM and Health & Safety**
3. **H&S information within the BIM process**
4. **Interacting the model**
5. **Recording and presenting hazards and risks**

Before we start....

Who is this

GUY?

NBS

http://www.thenbs.com/


ROYAL INSTITUTE OF BRITISH ARCHITECTS
66
66
RIBA
London
RIBA
https://www.architecture.com/

ARCHITECTS' COUNCIL OF EUROPE
CONSEIL DES ARCHITECTES D'EUROPE

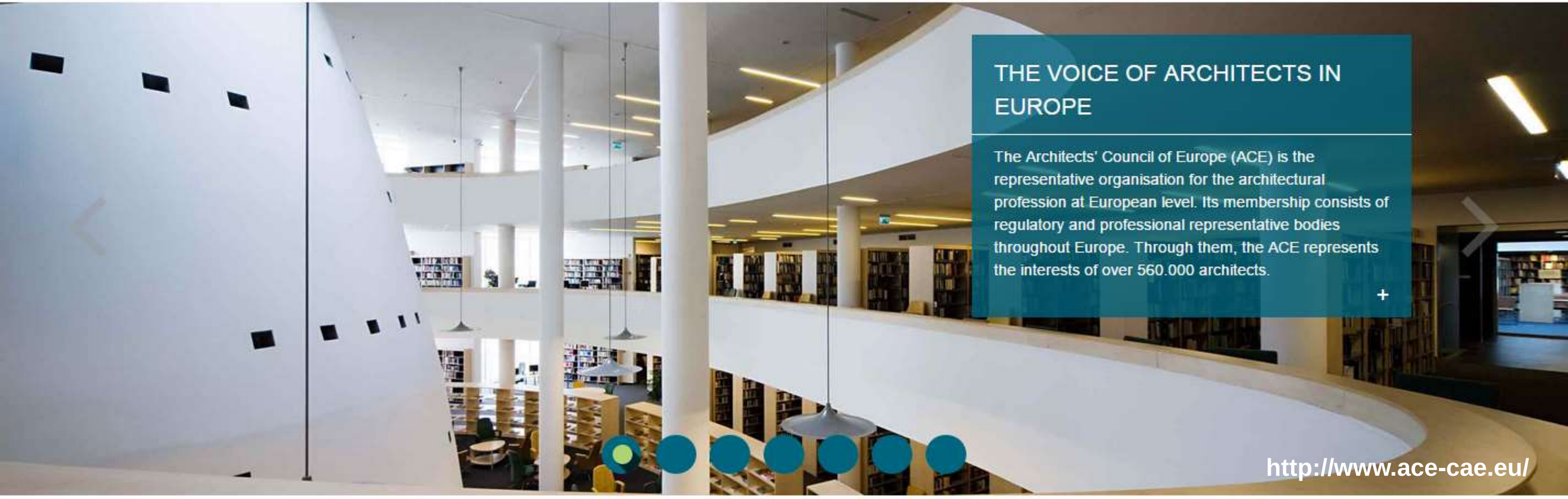
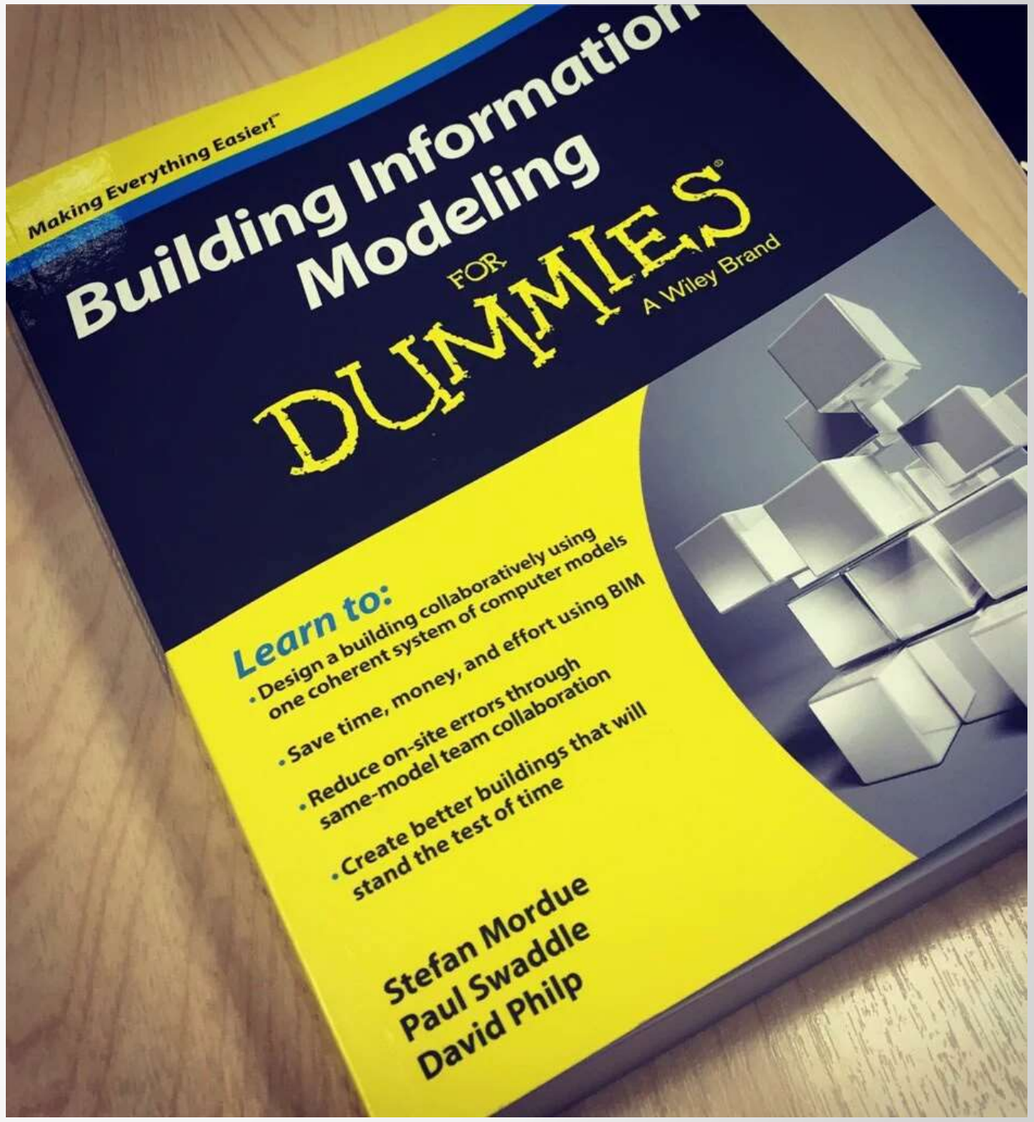


PHOTO CREDITS


Construction Industry Council
BIM2050
group

Published author

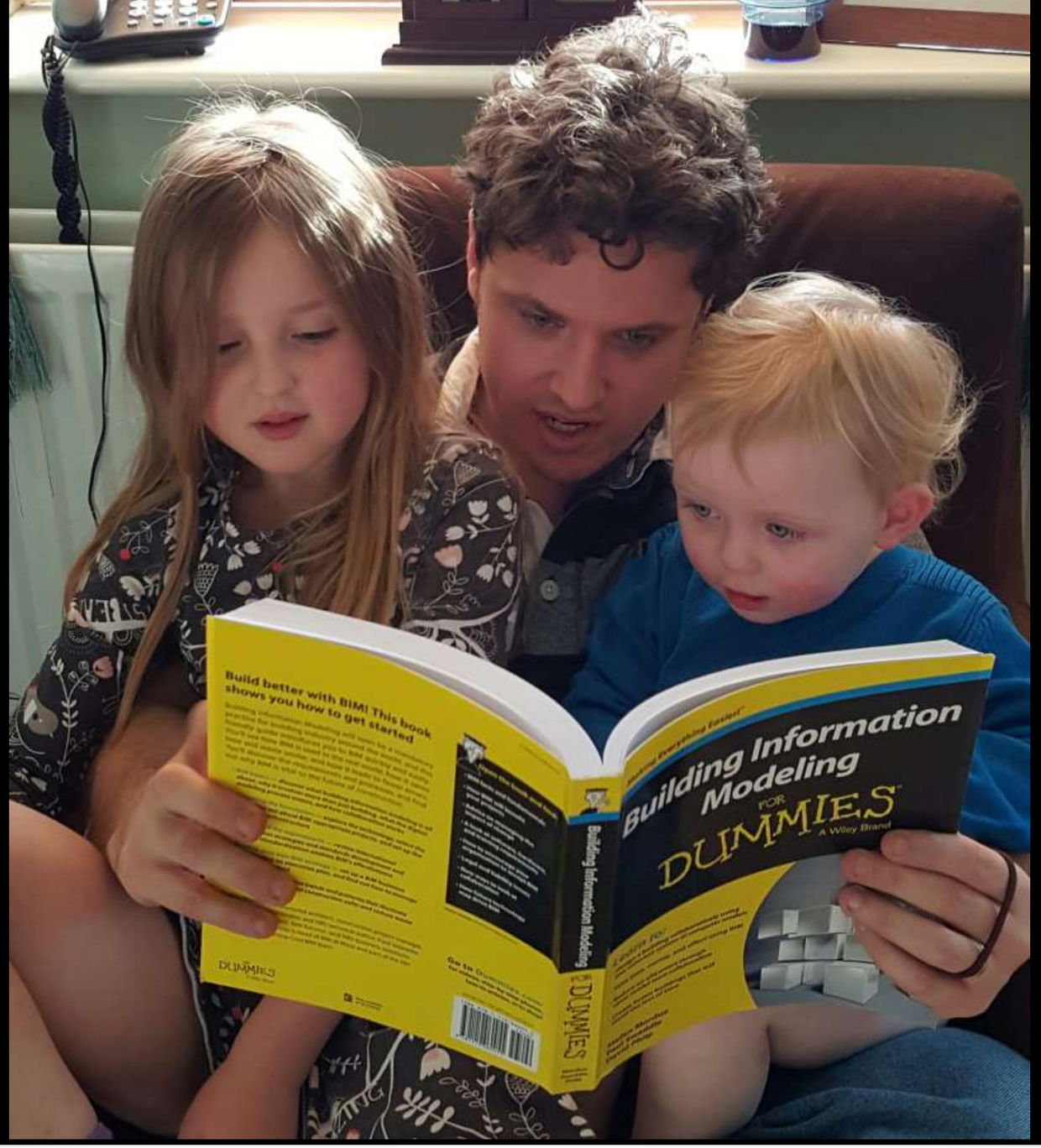
BIM for Construction Health and Safety (RIBA Publishing)



Building Information Modeling for Dummies (Wiley)

Setting the scene

Once upon a time .....



In a land far, far away....

What questions should we be asking?

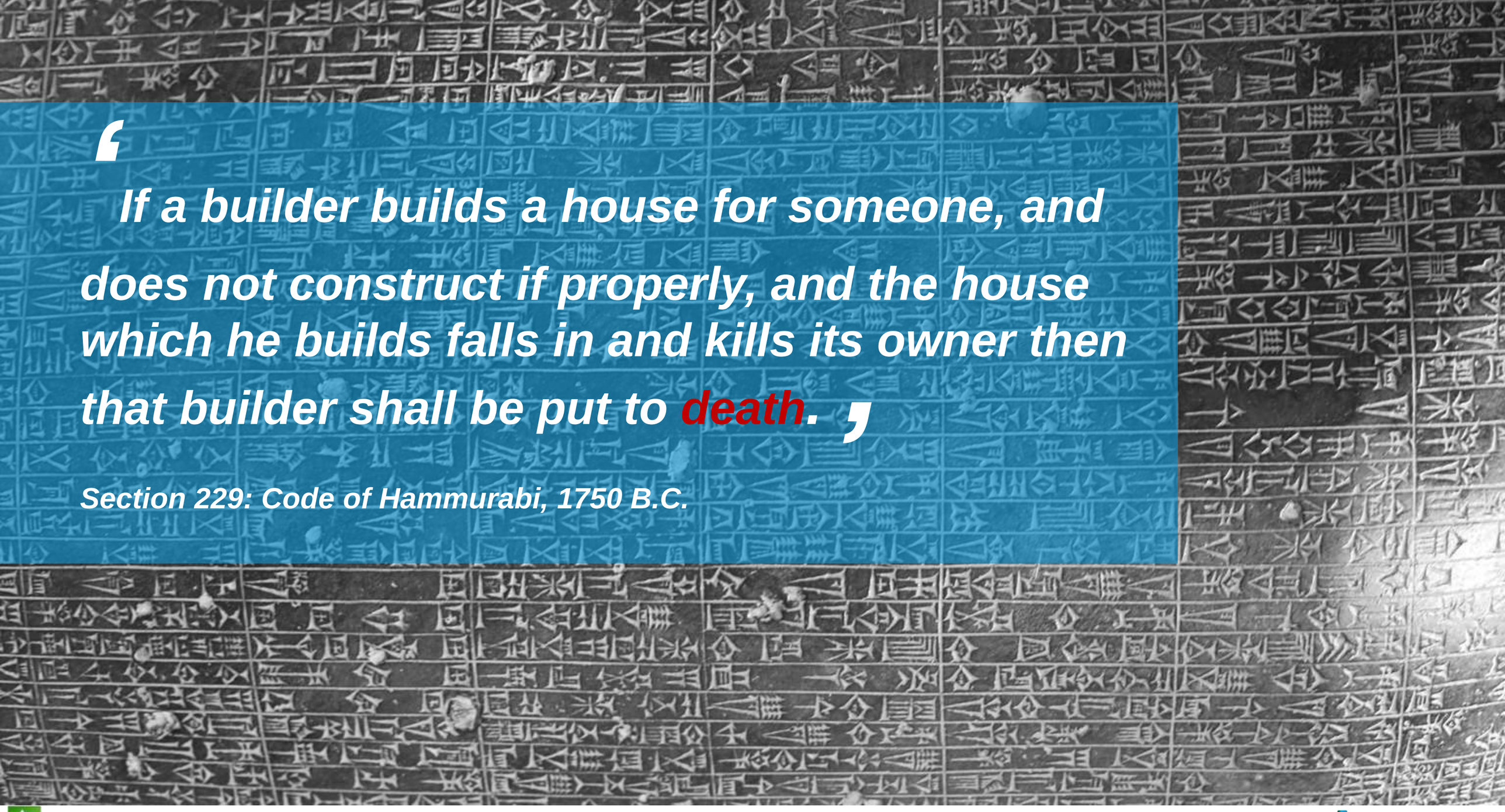
- ? **What information can be gathered**
- ? **How can it be translated into something useful**
- ? **New techniques & processes to be adopted?**
- ? **Can H&S info be embedded into BIM?**
- ? **What new skills are required?**
- ? **Digital Health & Safety file?**

Models are Not new

Image source: www.stpauls.co.uk

Babylonian Law

Image source: Iraqi Embassy website - Tower of Babel

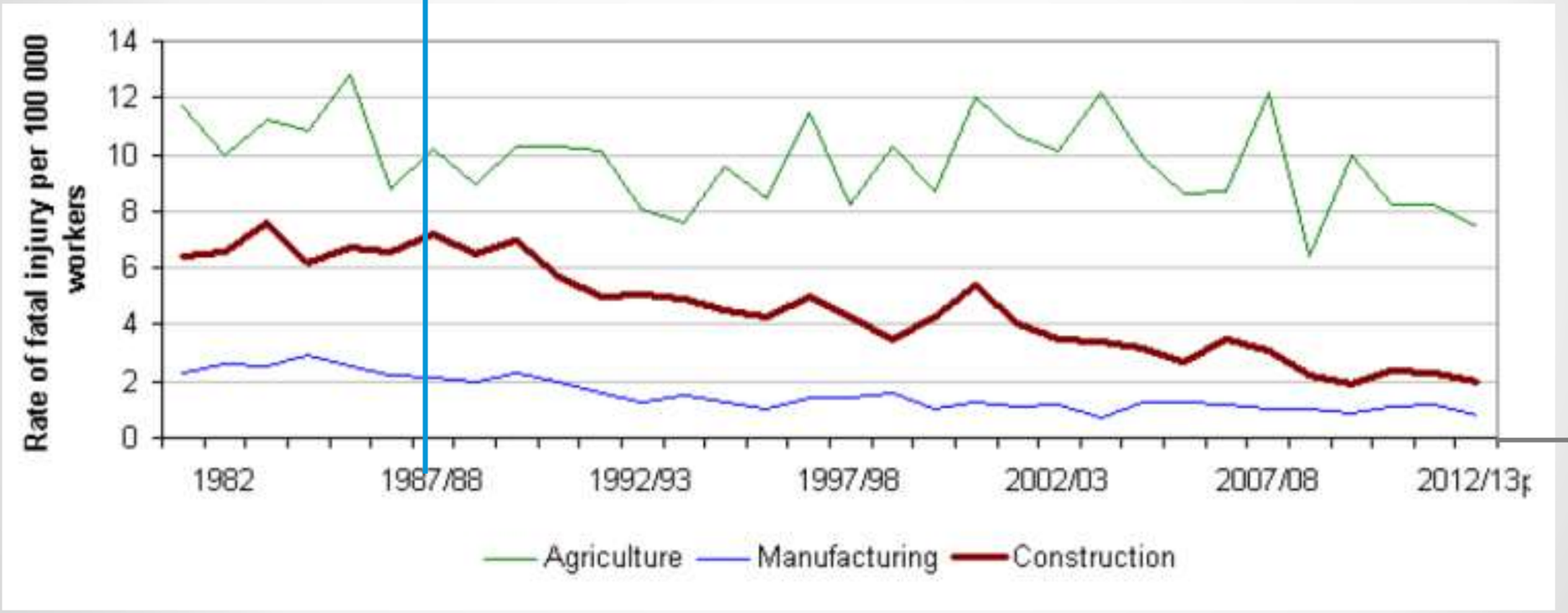


“If a builder builds a house for someone, and does not construct if properly, and the house which he builds falls in and kills its owner then that builder shall be put to death.”

Section 229: Code of Hammurabi, 1750 B.C.

Source: Rockefeller Center, New York (1932) Photography by Charles C. Ebbets

Risky business



Source: HSE

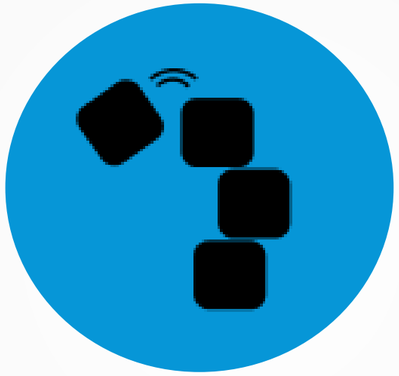
main causes
Of worker fatalities

Falls

59 %

Struck by falling/moving object

3%



Collapse / overturn

5%

Hit by vehicle

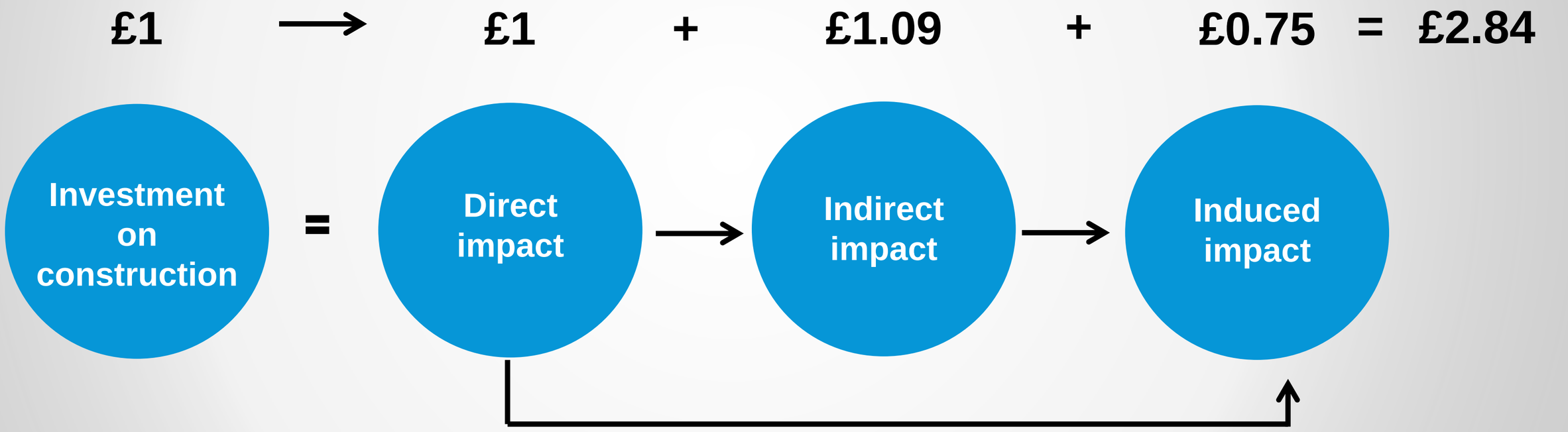
10%

Electricity

7%

Source: HSE

impact on
Economic activity



Source: ONS / UK contractors group

UK Government Construction Strategy

- Contains nearly 50 strategy objectives
- Aims to reduce government construction projects by 15/20%
- Savings based on research recorded and published over many years
- Announced UK governments intention to mandate BIM level 2 by April 2016
- BIM is just one ‘piece of the pie’

UK Government Construction Strategy

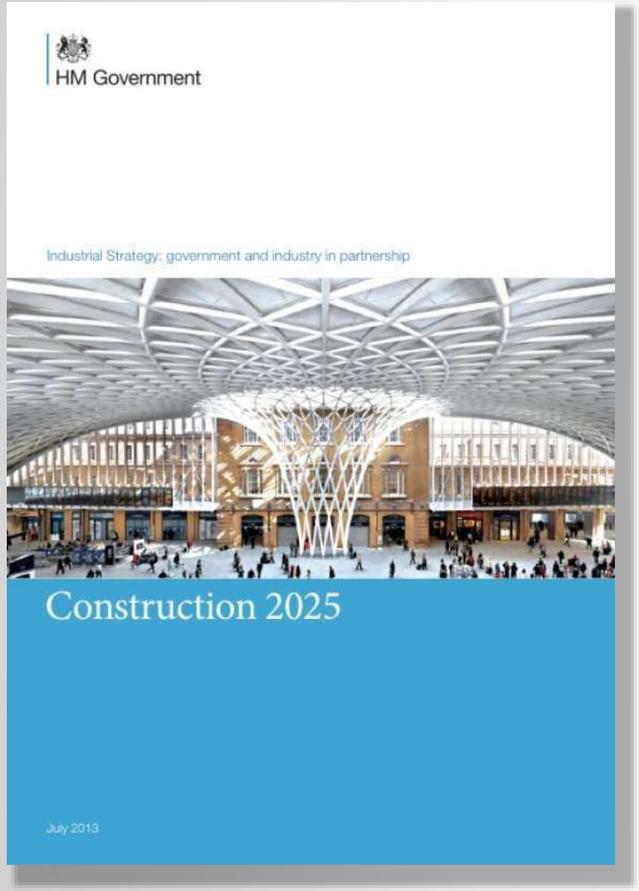
Efficiency = **13** **Times**

Waste = **11** **Times**

Value for money = **15** **Times**

Health and or Safety **0** **Times**

Construction 2025



Lower costs

33%

Faster delivery

50%

Lower emissions

50%

Improvements in exports

50%

‘An industry that attracts and retains a diverse group of multi-talented people, operating under considerably safer and healthier conditions, that has become a sector of choice for young people inspiring them into rewarding professional and vocational careers.’

Construction 2025 Strategy

Our vision for

2025

“Improve the image of the industry by inspiring young people and through a co-ordinated approach to health and safety and improving performance in the domestic repair and maintenance market.”

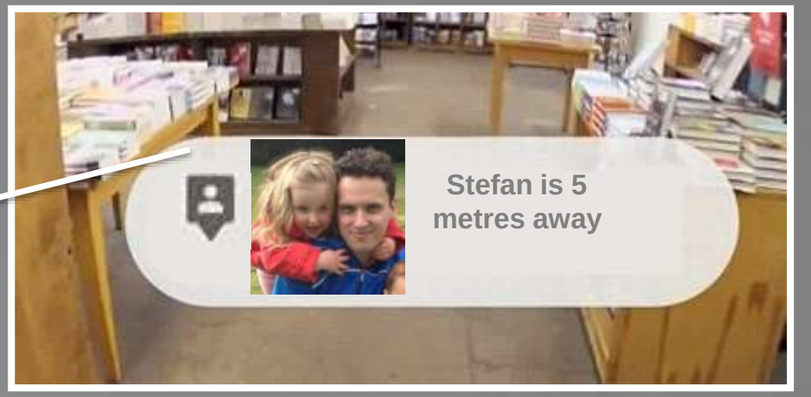
Construction 2025 Strategy

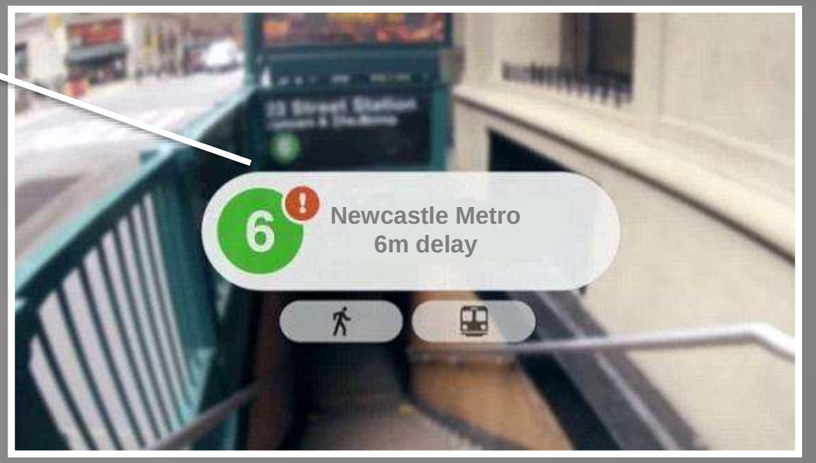
Our joint Commitments

Background Image: Robocop 1987

Technology is here

today





Source: Google glass

Practical application

Source: www.daqri.com/

The

Source: Shutterstock

Image source: highlightpress.com

The ideal VS The real deal


A man with a
White
van

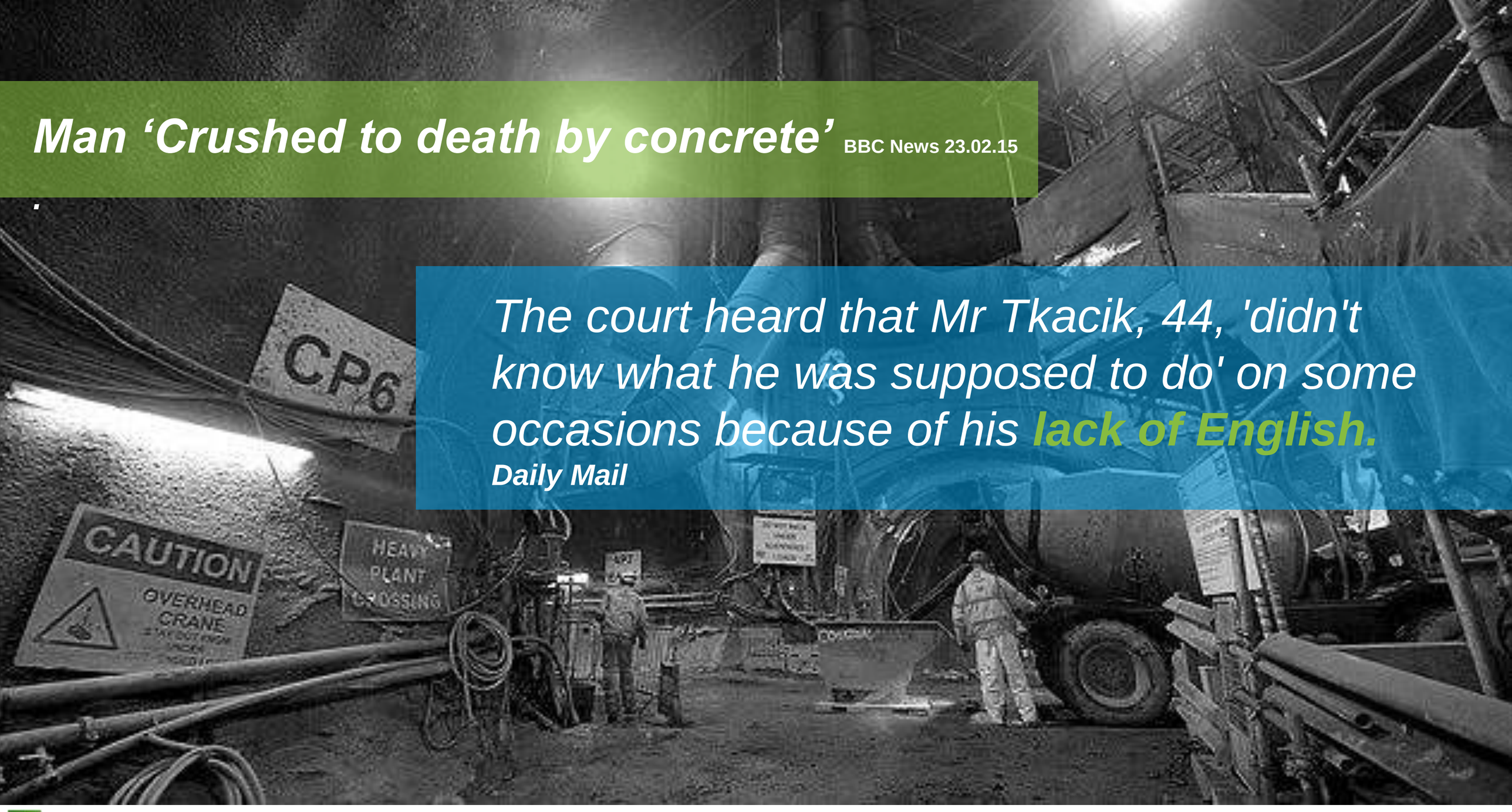
Opportunities for BIM and Health & Safety

Tracking & sensing

Image source: MyZone Worker Alert System

Training and communication

Source: VTT Technical Research Center of Finland



Man ‘Crushed to death by concrete’ BBC News 23.02.15

.

The court heard that Mr Tkacik, 44, 'didn't know what he was supposed to do' on some occasions because of his ***lack of English.***

Daily Mail

Firm fined £60,000 for Fraserburgh roof death

***BBC* News 19.02.15**

*'In this case the difficulties arising from the **language** barrier resulted in **fatal** consequences.*

Image source: www.eveningexpress.co.uk

Image source: Balfour Beatty

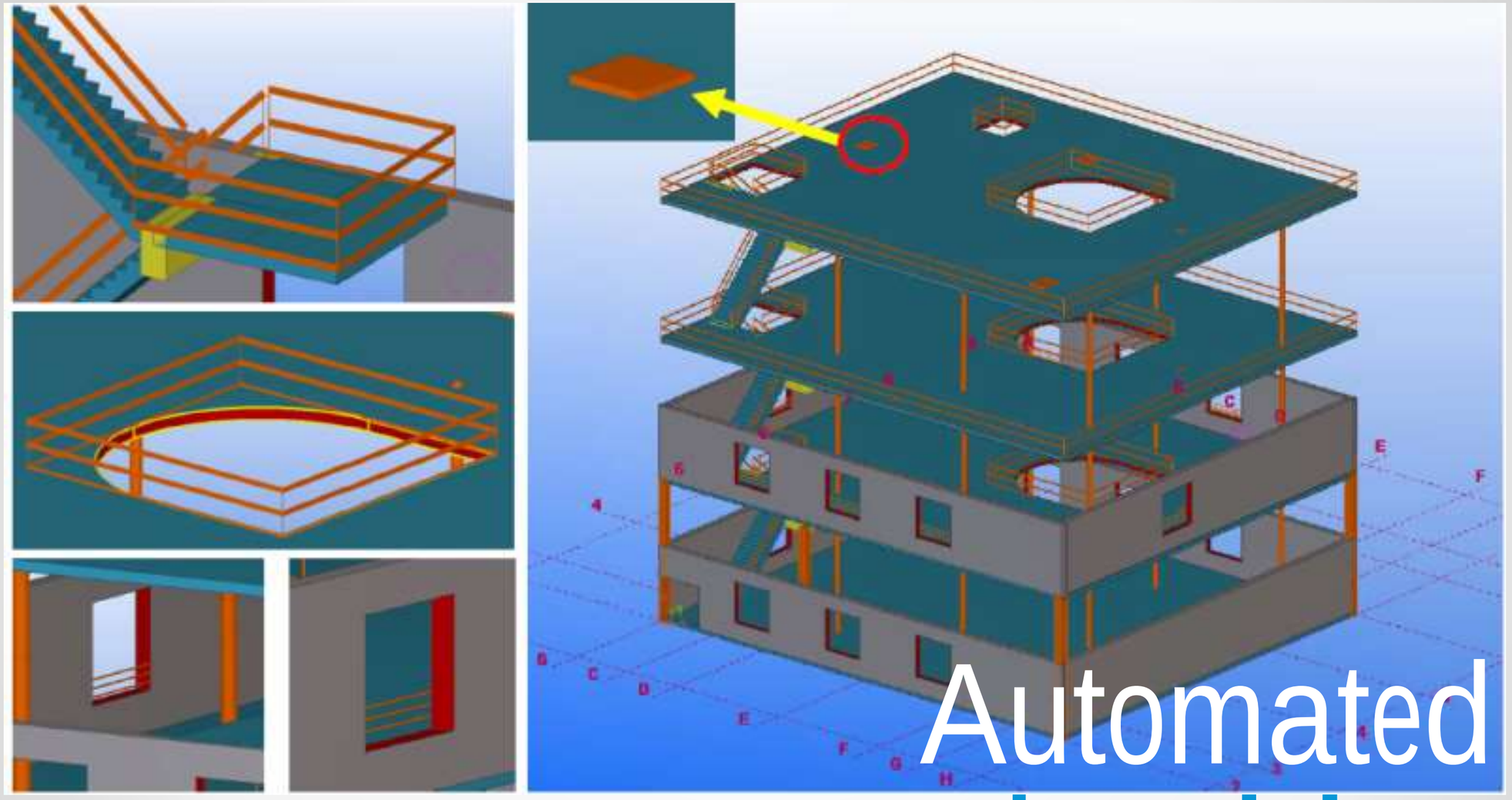
Toolbox planning

Simulation & Virtual reality

Source: Simulation centre, Coventry / Soluis

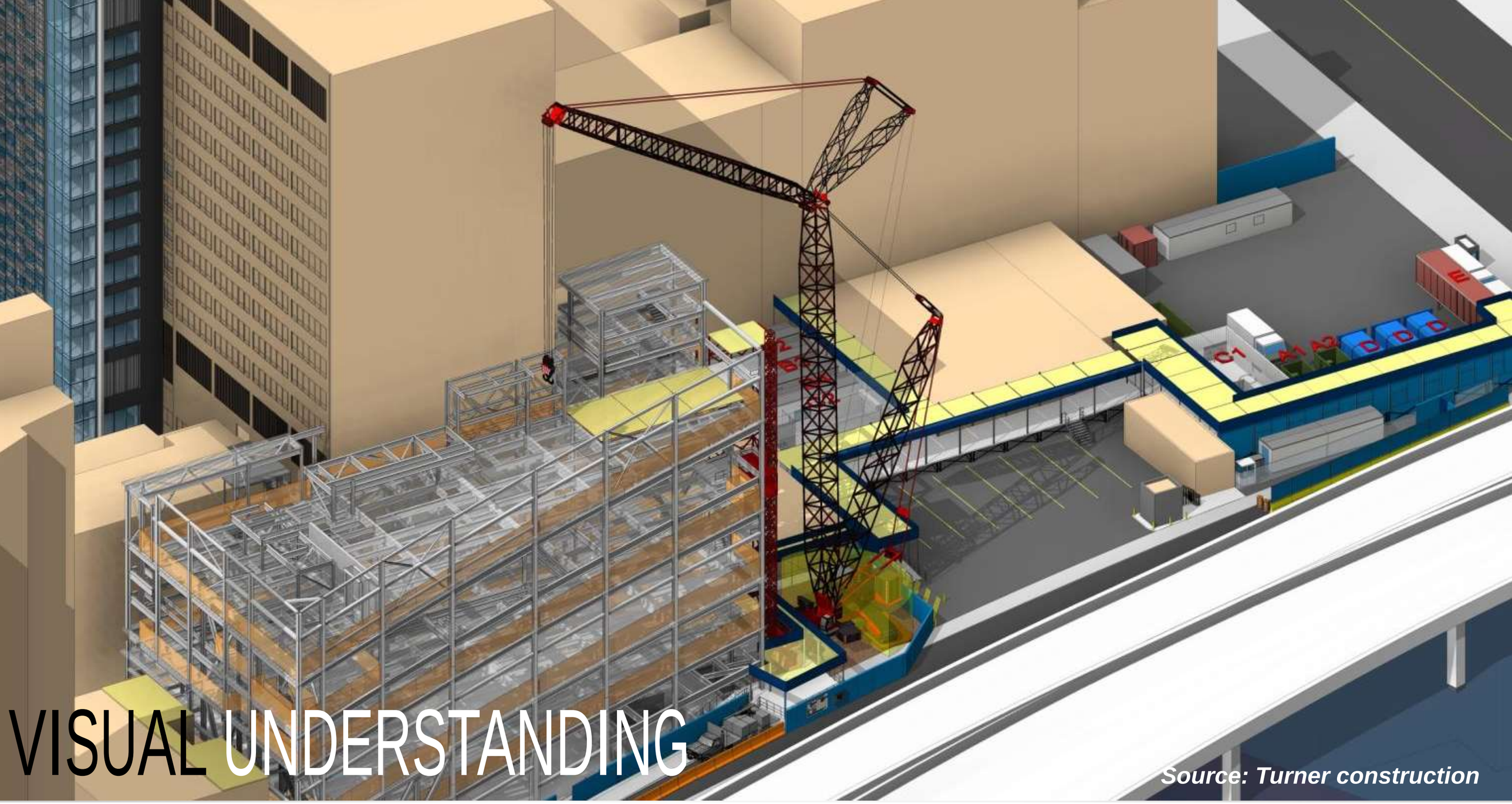
On site verification

Image source: Cross Rail



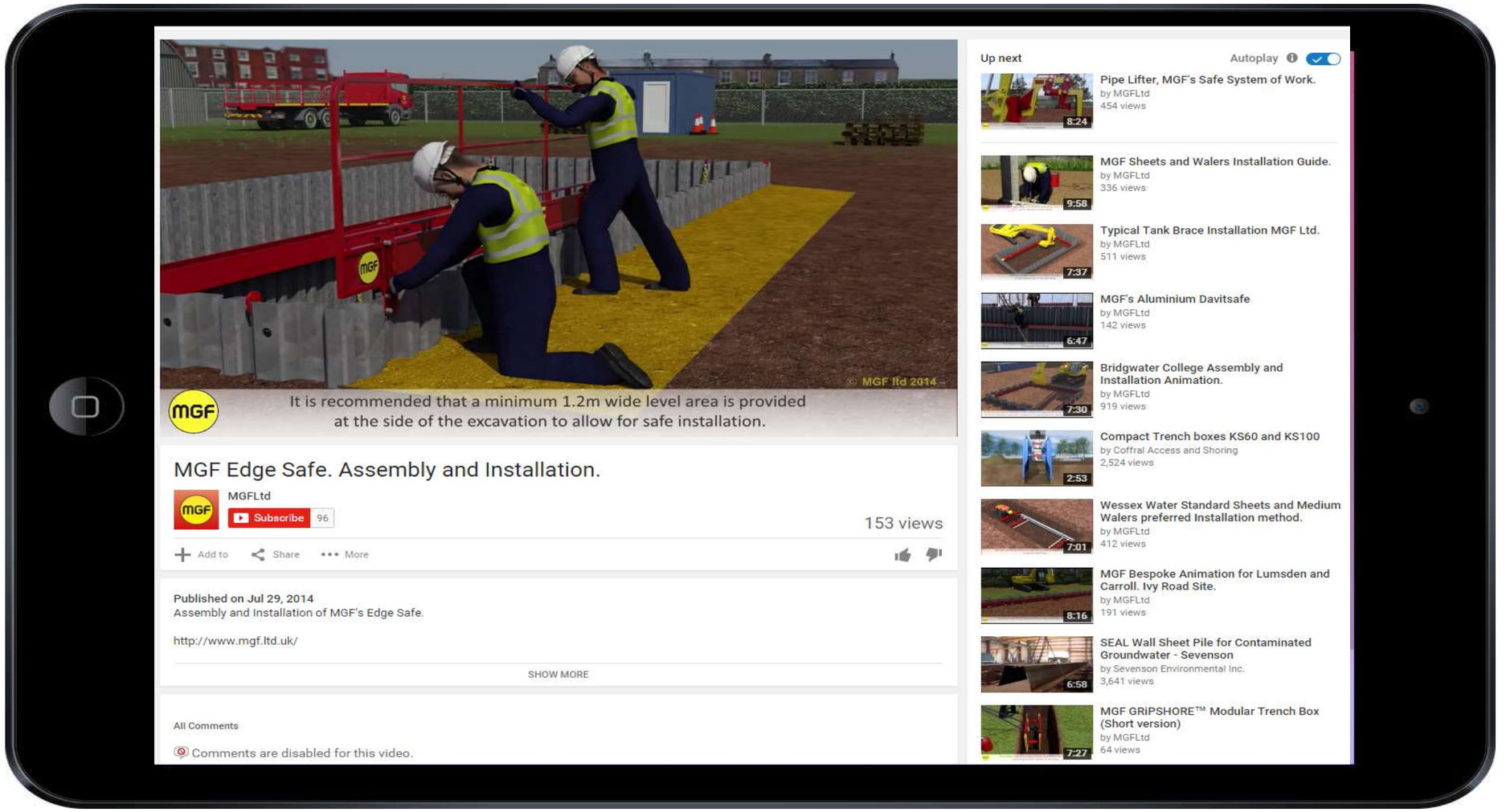
Automated checking

Source: Georgia Institute of Technology



VISUAL UNDERSTANDING

Source: Turner construction



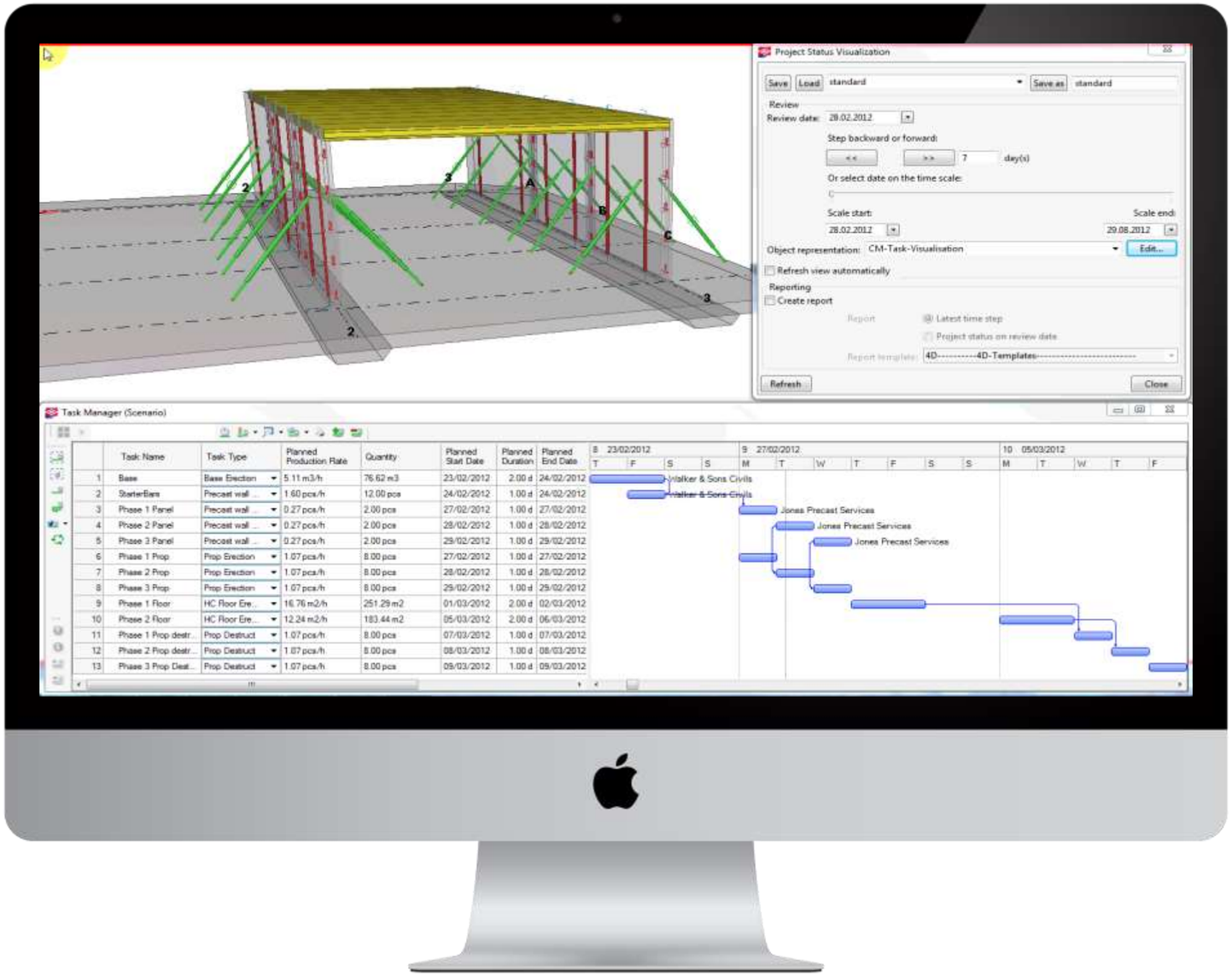
VISUAL UNDERSTANDING

Source: MGF / you tube

VISUAL UNDERSTANDING

https://www.youtube.com/watch?v=W2SsmTyA2a4

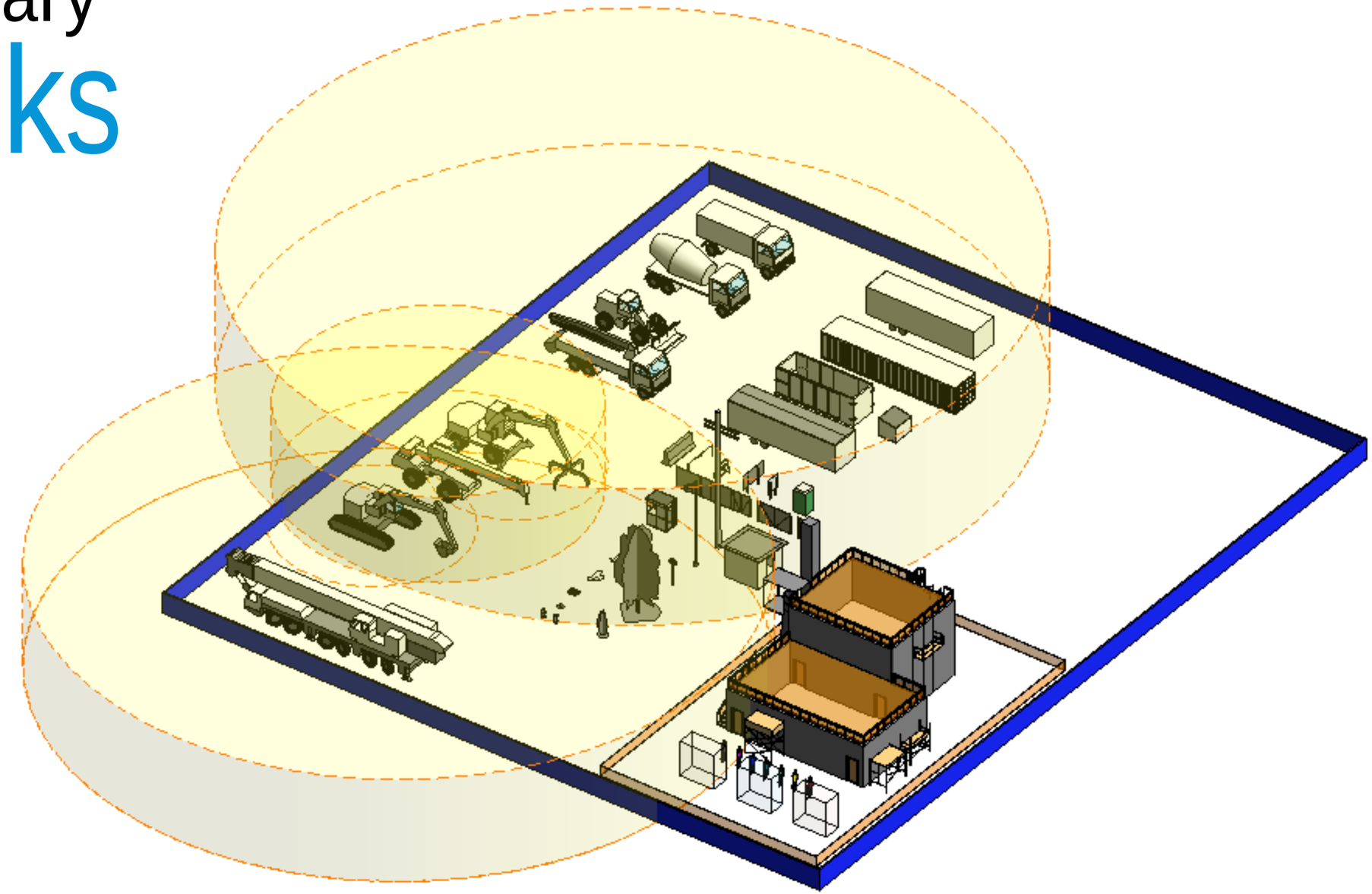
Source: MGF / you tube



VISUAL UNDERSTANDING

Source: Tekla

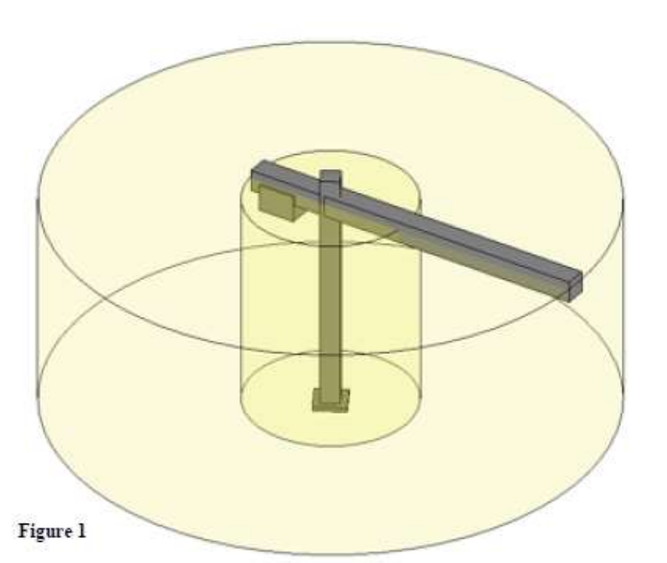
Temporary works



Source: NYC Department of Buildings

Temporary works

Level of Detail

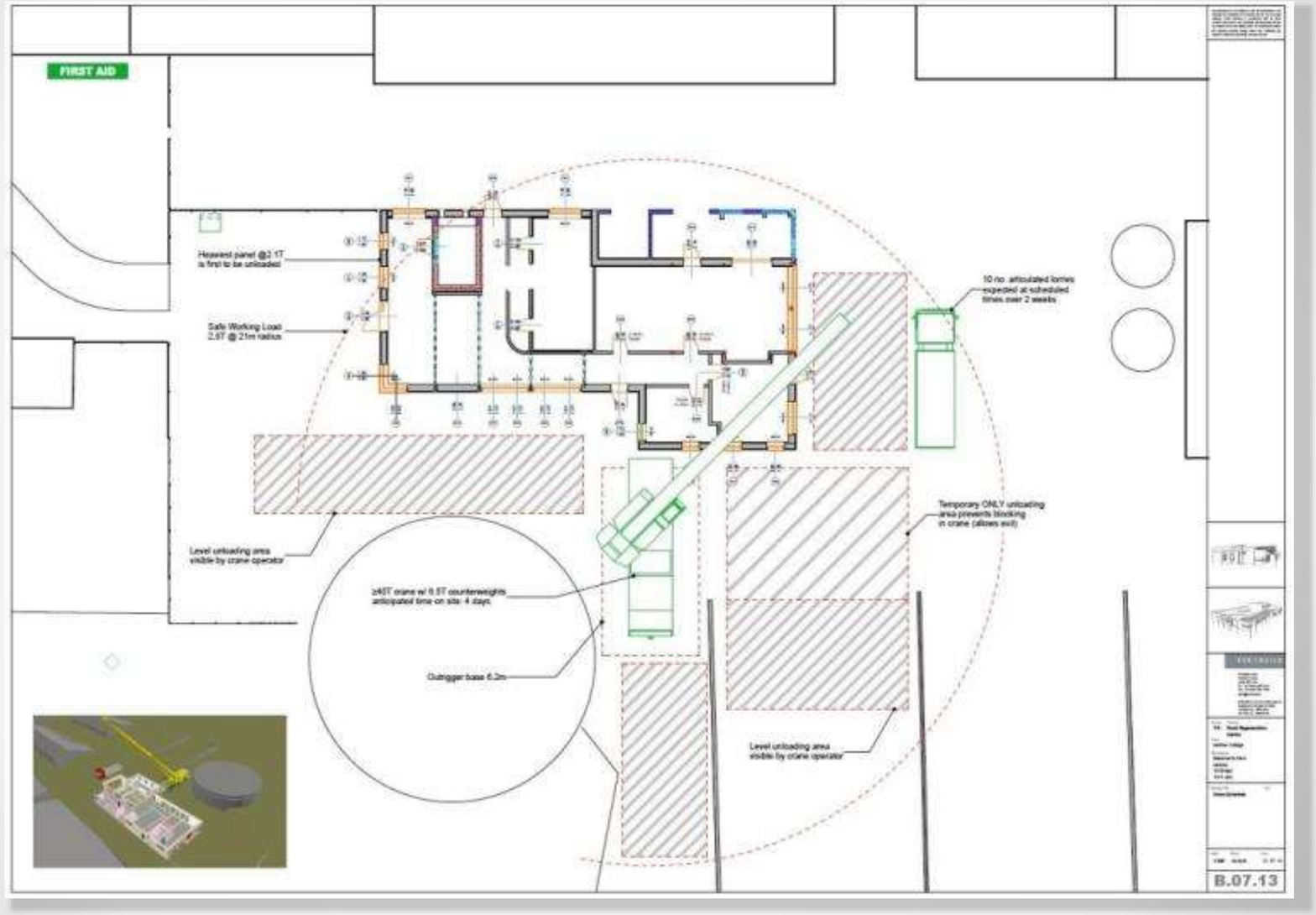


Level of Information

1. Type
2. Manufacturer
3. Permit number
4. Link to permit
5. Radius of swing/boom length
6. Load Capacity

Source: NYC Department of Buildings

Temporary works

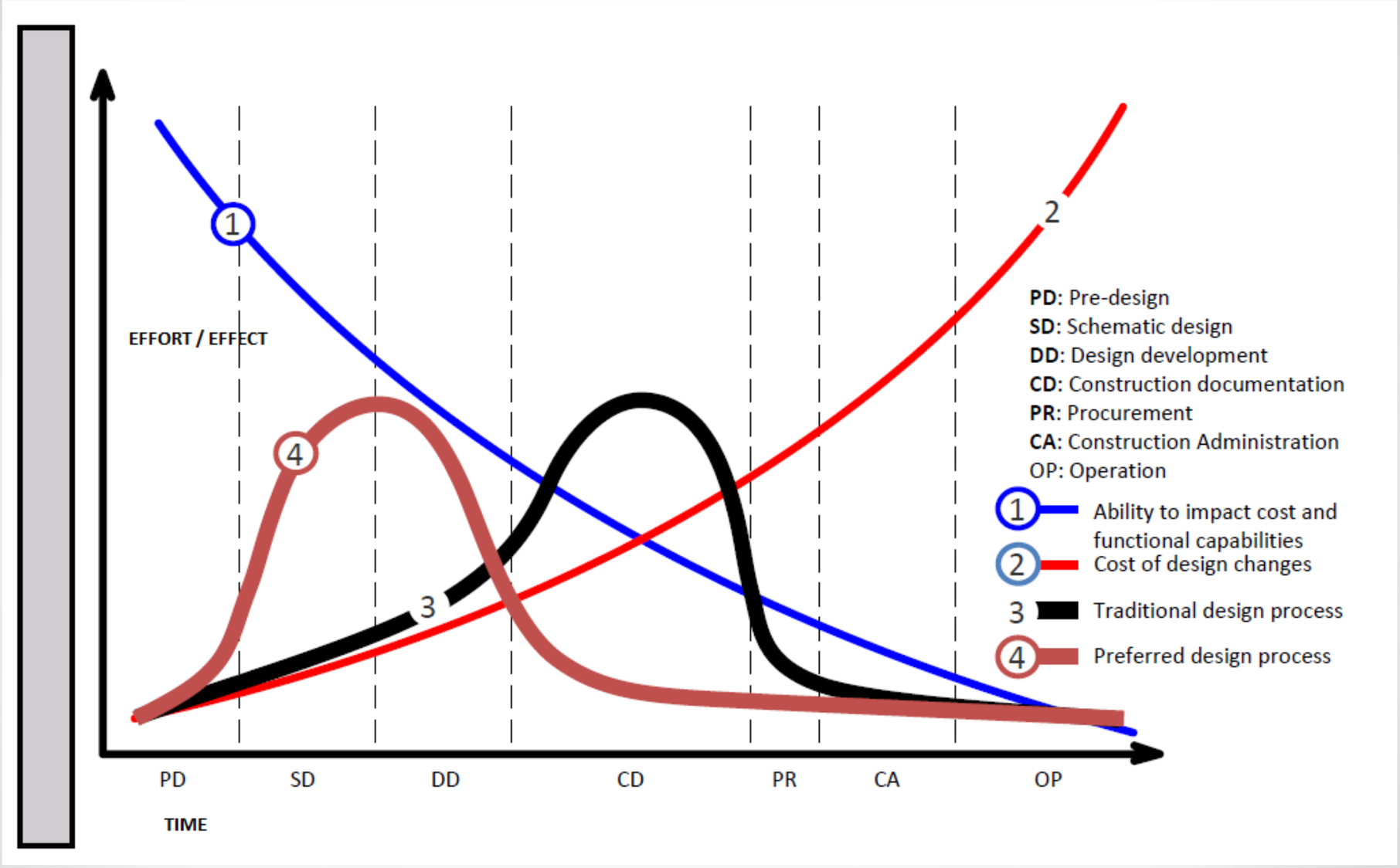


Source: Eurobuild

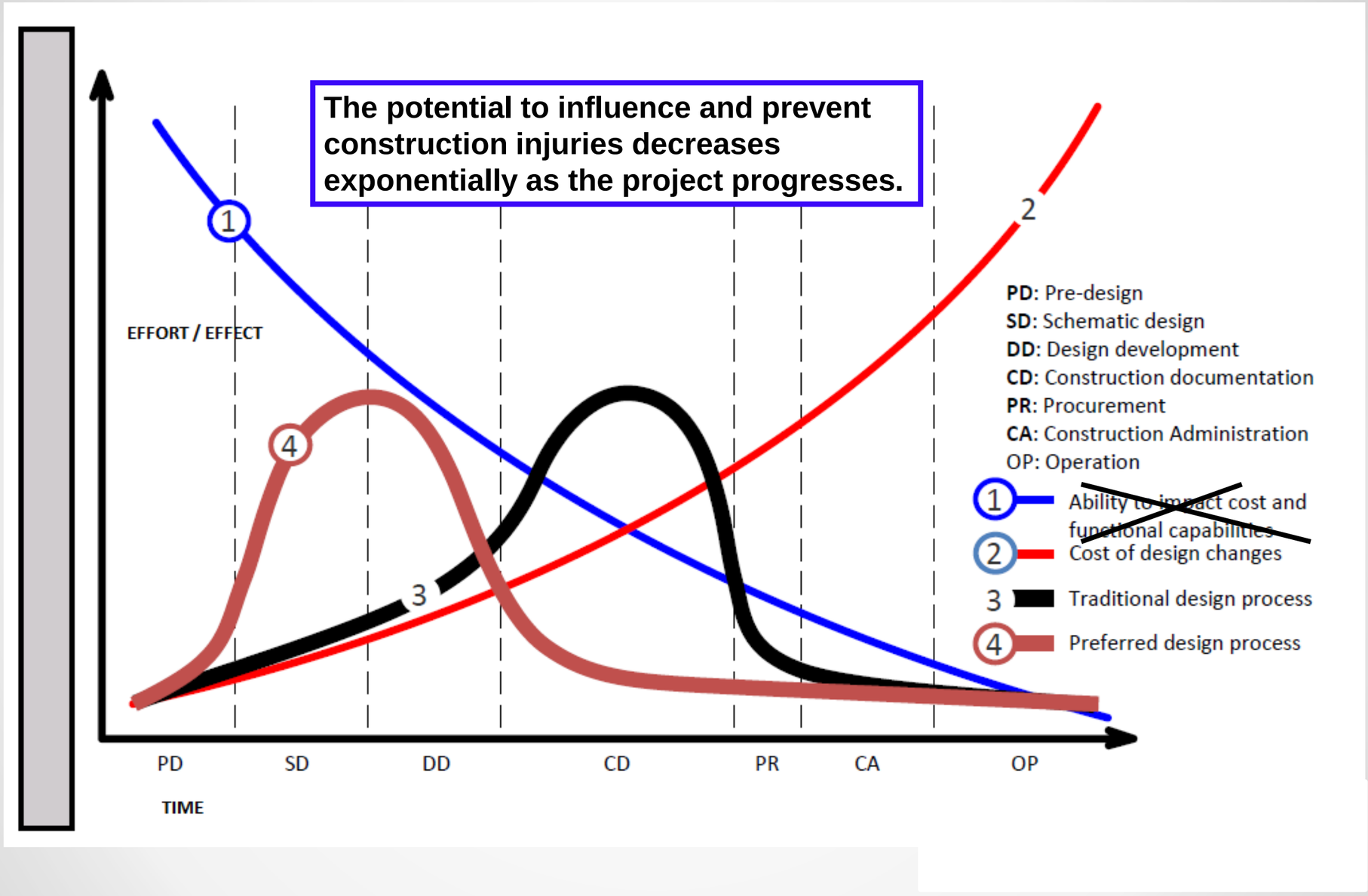
Vauxhall
London
January 2013

Empire state building 1945

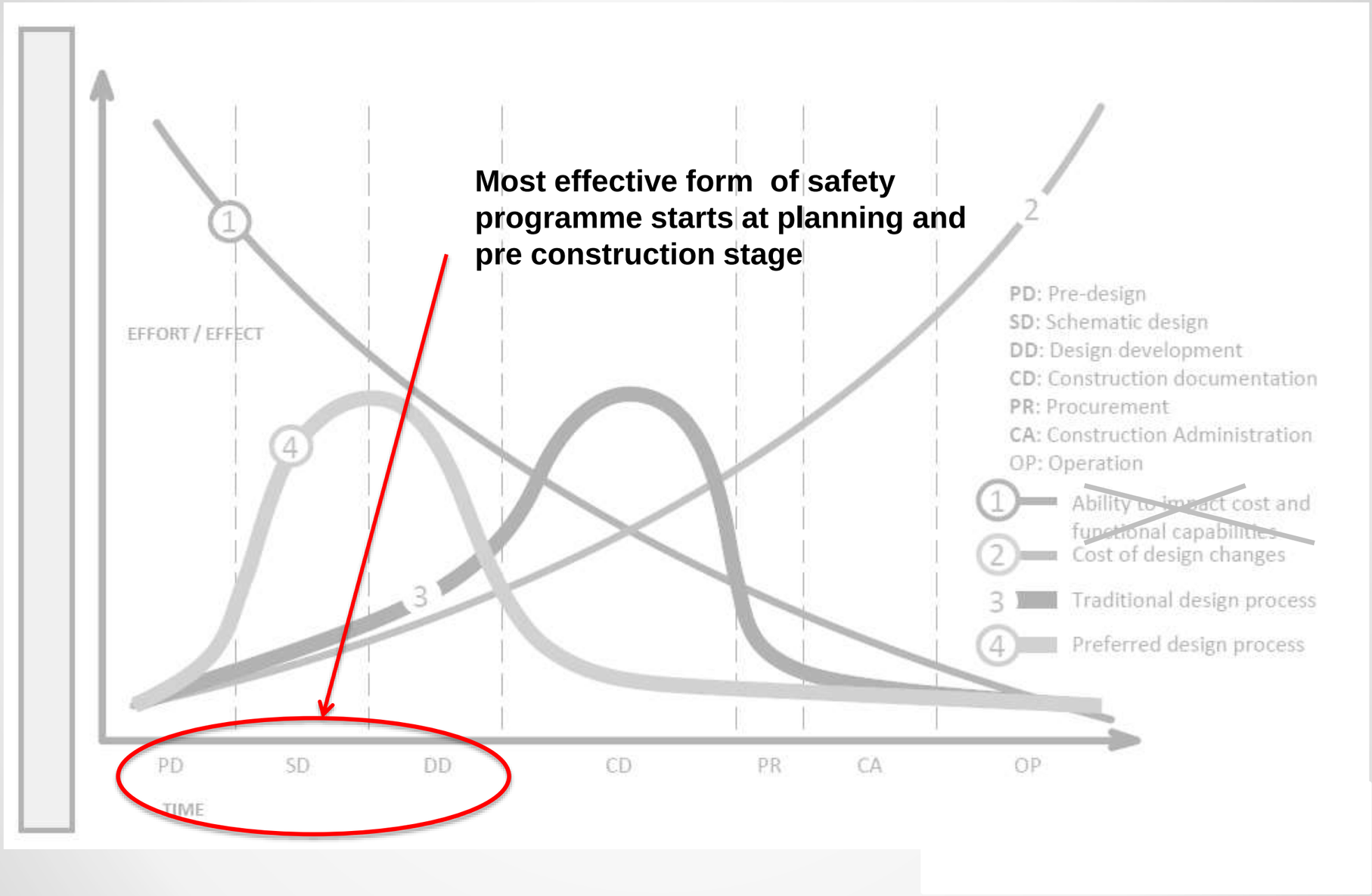
BUT…



Source: Adapted from Partick MacLeamy



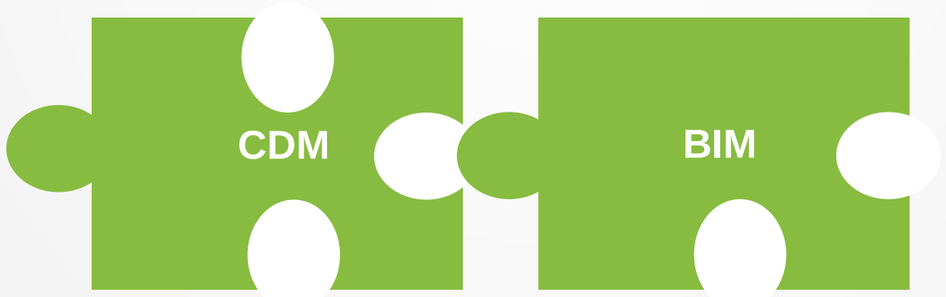
Source: Adapted from Partick MacLeamy



Source: Adapted from Partick MacLeamy

H&S information within the BIM process

CDM 2015 AND BIM A PERFECT FIT



Information exchange

RIBA Stage	Data Drop	
0	1	Identify key H&S risks and hazards. Prepare initial draft pre construction H&S information.
1 & 2	2	Reviewing the contents of the current H&S file.
4	3	Meet with design team and other parties involved to review any design changes that may have taken place from the concept design phase, review sequencing
5 & 6	4	Contractor to supply relevant info to update H&S file. Maybe more flexible under Government Soft Landings. H&S file prepared
7	5	Post Occupation – All relevant documents, certificates. Building Manual uploaded

Source: Mordue & Finch

BIM Level 2 documents

BS 1192
Collaboration

PAS 1192-2
CapEx

PAS 1192-3
OpEx

BS 1192-4
COBie

PAS 1192-5
Security

PAS 1192-6 (Proposal)
Health and Safety

PROPOSAL

key benefits

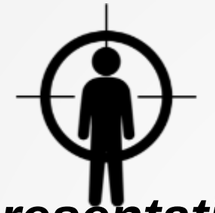
PAS 1192: Collaborative production of information Part 6:2015
Risk and hazard information for H&S

1. ***Consistent documentation, management and communication of H&S hazards and risks***
2. ***Improved tools for the detection, evaluation and an of H&S hazards and risks***
3. ***Reuse of beneficial H&S knowledge and experience through good information management and development of relevant data attributes.***
4. **Fewer costs and delays rising from data loss transcriptions**

Source: AEC3 / CIC BIM4H&S Group UK

PROPOSAL

document scope



1. ***Representation of H&S hazards, risks and factors***
2. ***The means to embed H&S through information and data management***
3. ***Key processes in the exchange and re-use of H&S information***
4. ***Dissemination of existing and beneficial H&S knowledge and experience***
5. ***Possible methods for mapping hazard factors to risks***
6. ***The benefits to cost, programme and carbon via effective use of H&S data attributes and provision of information***

Source: AEC3 / CIC BIM4H&S Group UK

Background Image: **Michaelmolloy.co.uk**

Thinking about hazards

Process Hazards

Activity Hazards

Location Hazards

Legalisation Hazards

Emergency Hazards

Source: Peter Nicholas

LINKING DATA

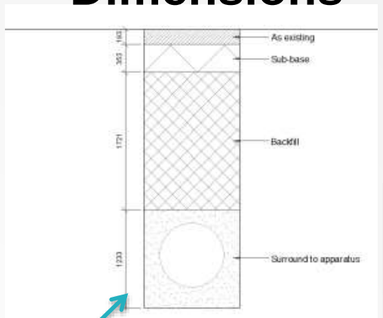
LINKING DATA

LINKING DATA

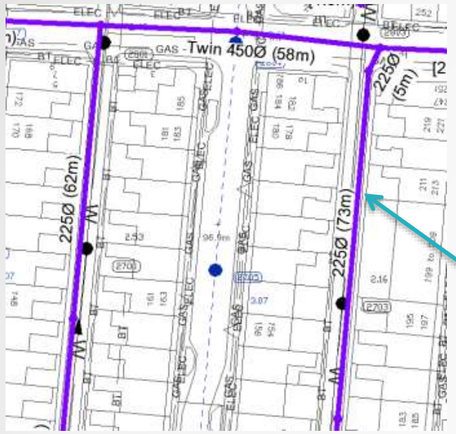
Interacting with the model

Understanding BIM objects

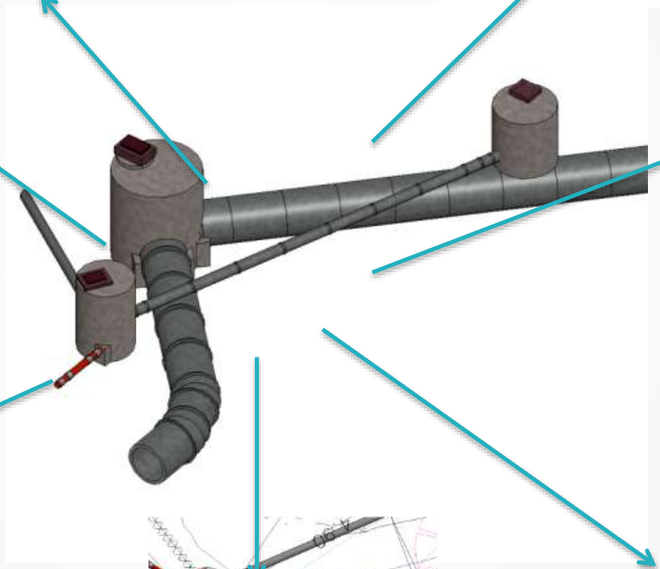
Dimensions

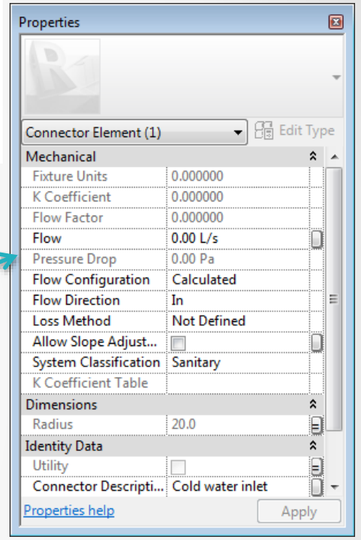


Maintenance



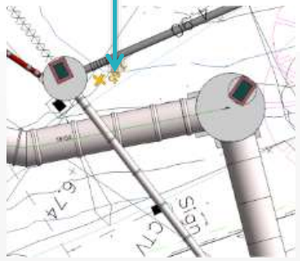
Clearance





Parametric

Performance

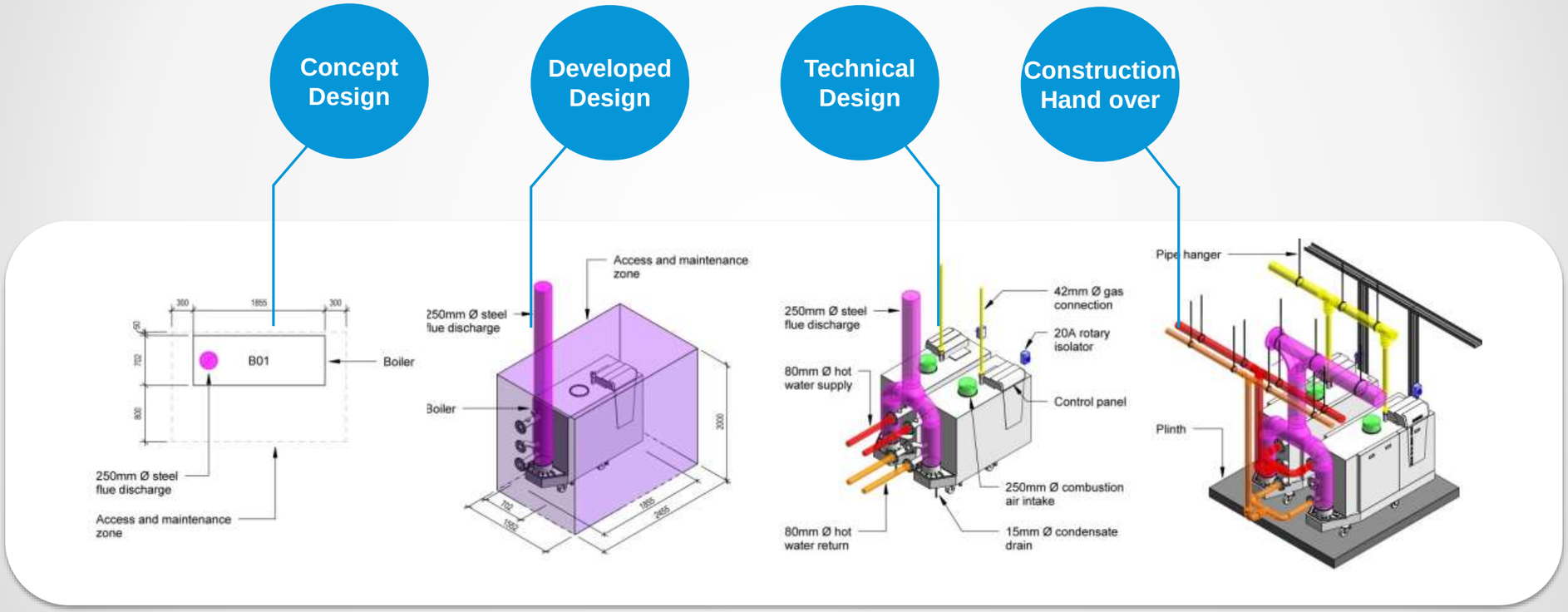


Connections

Identity

Source: NBS National BIM Library

Information increase

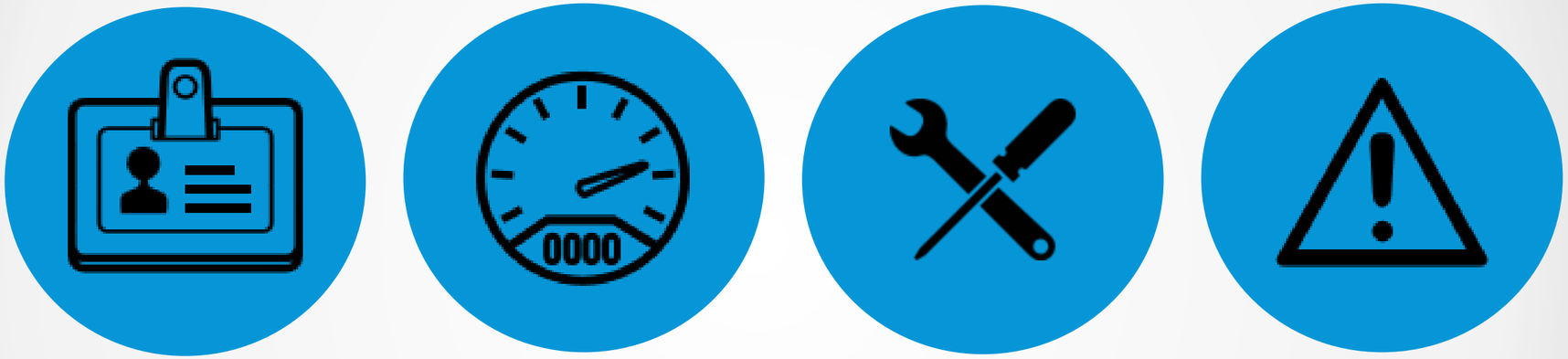


Project Time Line

Source: NBS BIM Toolkit

BIM objects and Non graphical data

LINK COSH* DATA SHEETS?



ID INFORMATION	PERFORMANCE INFORMATION	MAINTENANCE/ INSTALLATION	RISKS & HAZARDS
What Am I?	How do I perform	How am I cared for?	How dangerous am I?

** The Control of Substances Hazardous to Health regulations 2002*

Clearance zones

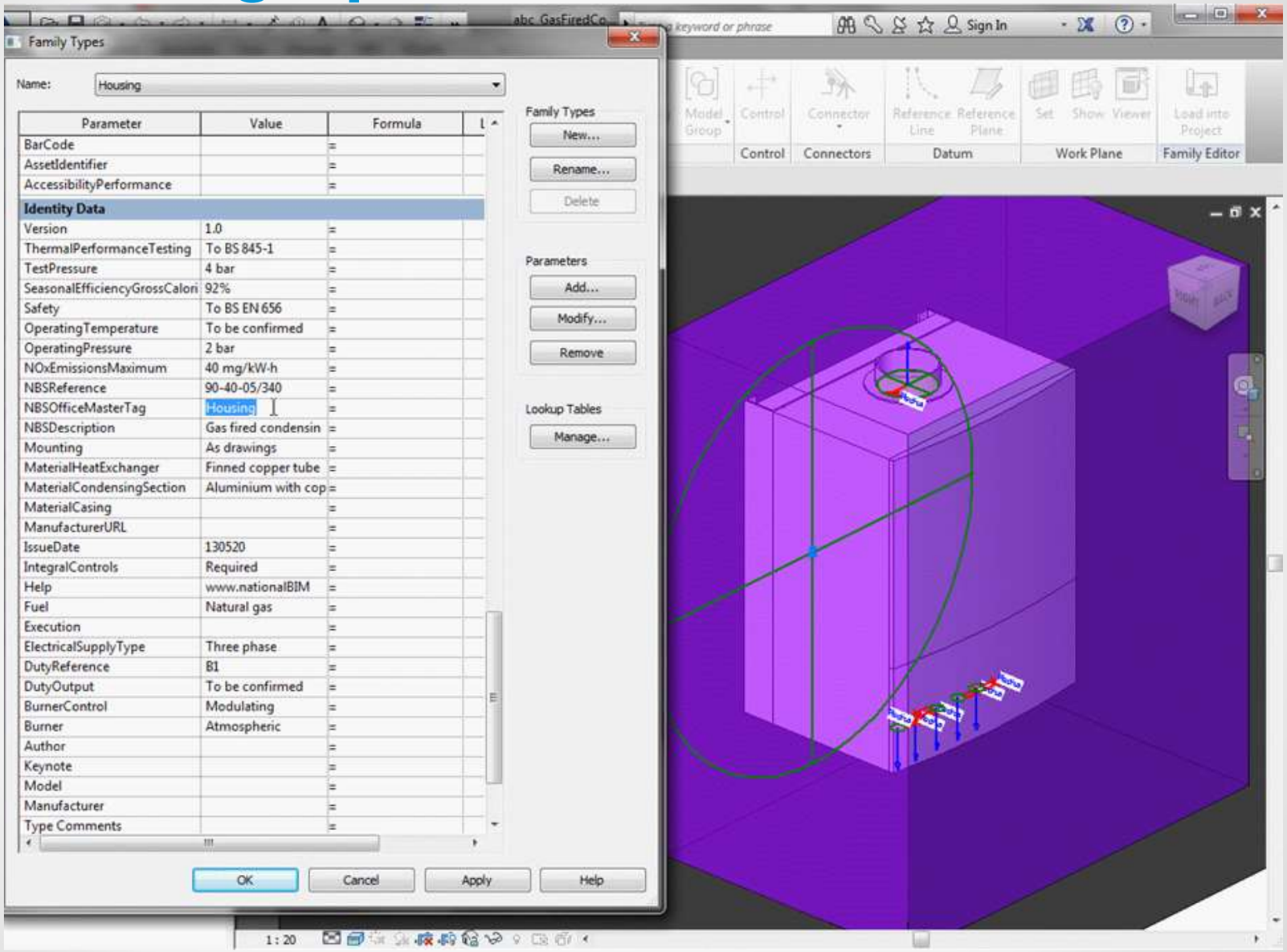
Data cupboard

The Electricity at Work Regulations
Working space, access and lighting

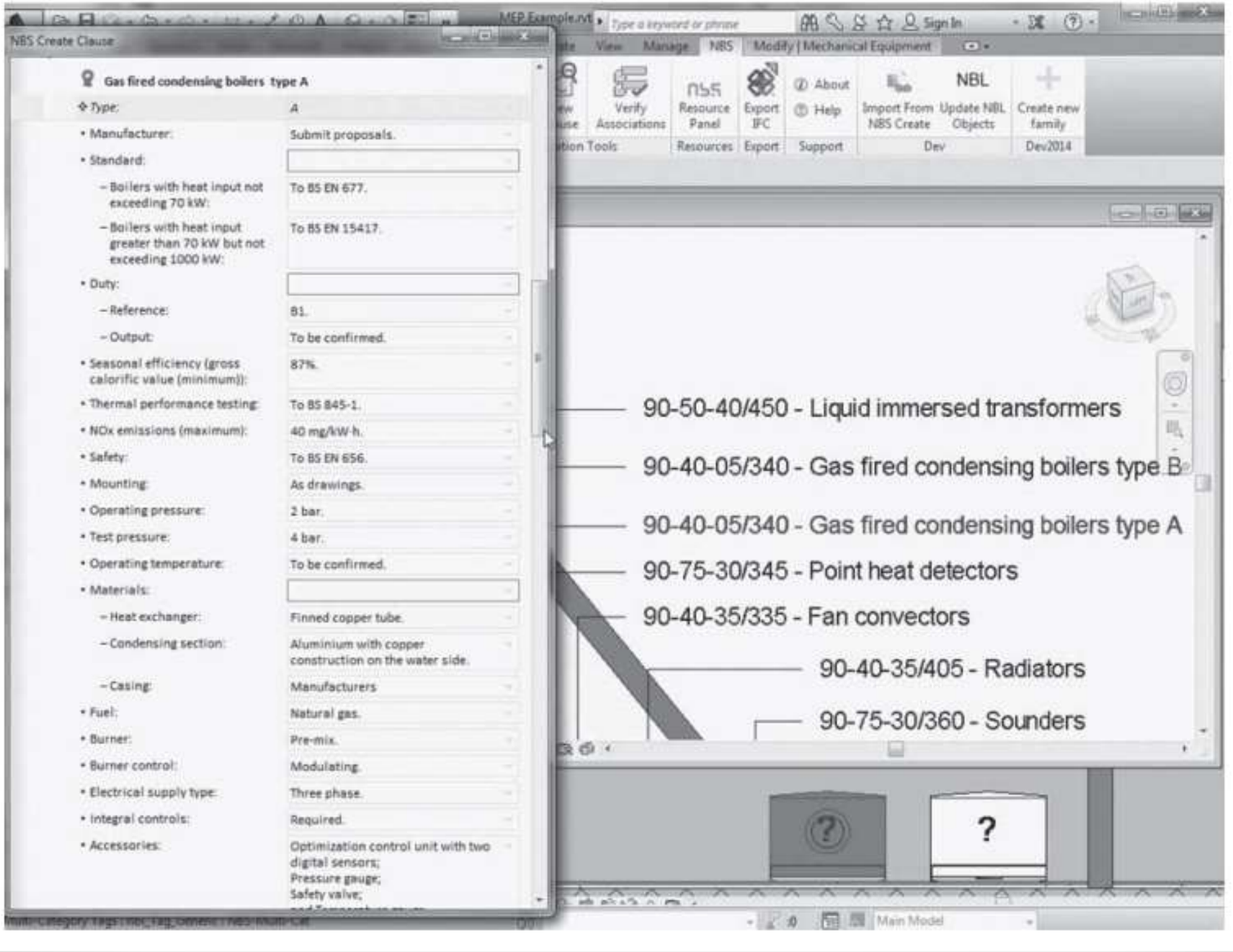
"For the purposes of enabling injury to be prevented, adequate working space, adequate means of access, and adequate lighting shall be provided at all electrical equipment on which or near which work is being done in circumstances which may give rise to danger".

Assume minimum of **100 mm** clearance to sides and **500 mm** clearance at top of unit for heat dissipation. Assume **1 m clear** zone in front of data equipment cabinet when doors are in the fully open position.
Where side and/ or rear access panels are fitted, provide **1 m** clearance.

BIM objects and graphical information

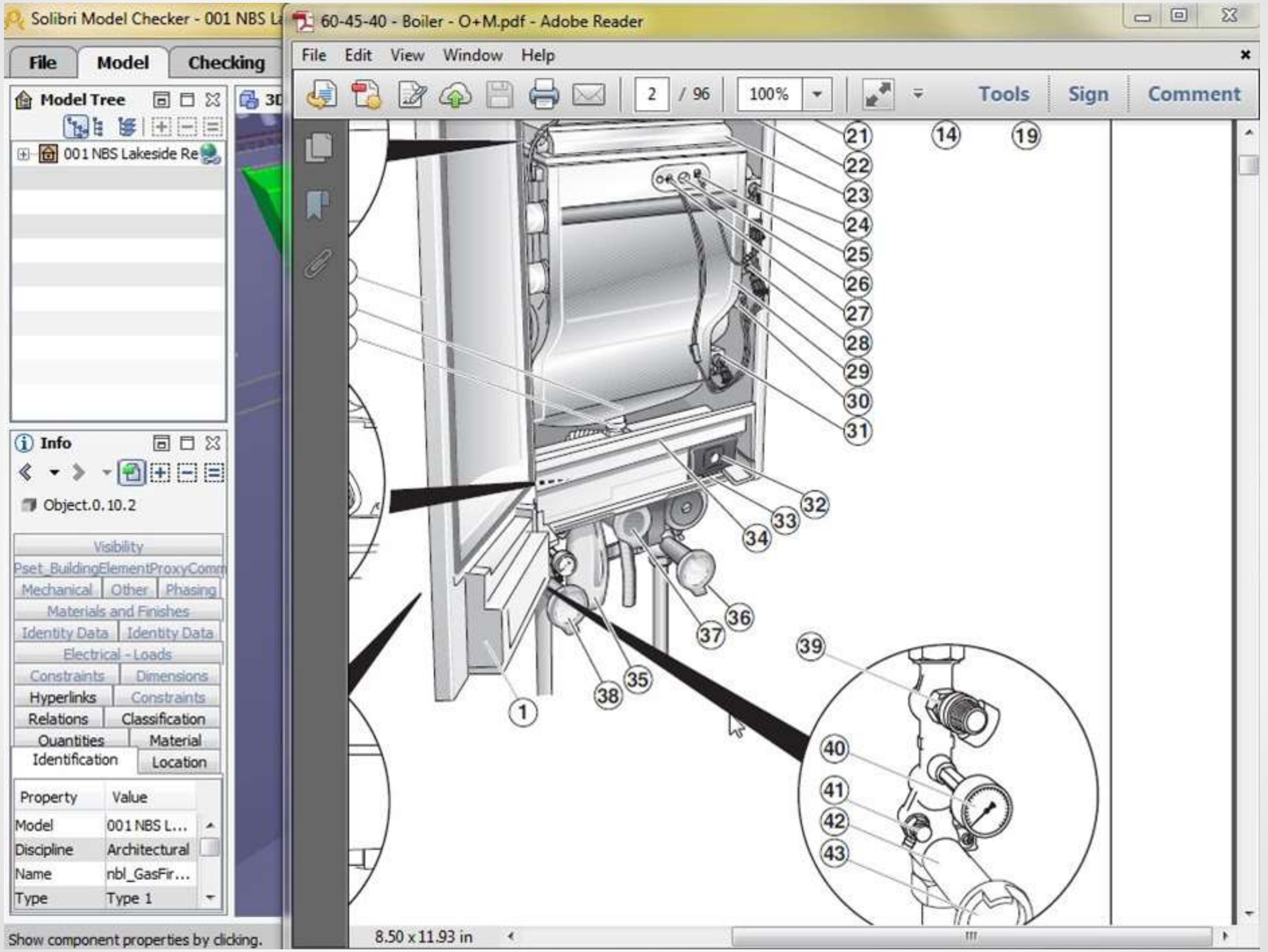


Linked data



Source: NBS Create

Maintenance of information



Source: Solibri

Sources of health and safety information

Design assessment and Design risk management

1. ***Identify the hazards***
2. ***Decide who might be harmed***
3. ***Evaluate the risks***
4. **Record and implement your findings**
5. **Review your assessment**

Source: HSE HSG 150

Clash detection and avoidance

CLASH BETWEEN PIPES AND STEEL BEAM WEB	IDENTIFY THE HAZARD (associated with clash not being identified prior to construction)	ASSESS THE RISK Severity (cost, programme, welfare, health and safety) x likelihood	REDUCE / CONTROL (associated with clash not being identified prior to construction)
Fire	Post-(flame)-cut holes (hot works) through steel web once erected	High severity / low likelihood	Provide correct PPE, fire extinguishers and hot-works permits
Falls	Site operative falling from height	Medium severity / low likelihood	Access platforms, harness and handrails
Falling Material	From steel plates, tools, equipment, etc.	Medium severity / medium likelihood	Correct PPE, and create safe working zones
Collapse	Beam design inadequately, from temporary props / supports and platform collapse for site operative	High severity / low likelihood	Additional beam design, provide propping and temporary supports

Table 4.02: Clash between pipes and steel beam web

Source: ARUP Associates

Developing tools for Design Risk Management - Industry Foundation Class (IFC)

Property Set Name	Pset_Risk
Definition	*An indication of exposure to mischance, peril, menace, hazard or loss. There are various types of risk that may be encountered and there may be several risks associated to an instance of a Process, Product or Spatial Element. This incorporates the values of a risk analysis matrix satisfying AS/NZS 4360.*

Pset_Risk

Name	Data Type	Definition
Risk Type	• BUSINESS • HAZARD • HEALTHANDSAFETY • INSURANCE	The predefined types of risk from which the type required may be set.
Nature Of Risk	(free text)	An indication of the generic nature of the risk that might be encountered.
Assessment Of Risk	• ALMOST CERTAIN • VERY LIKELY • LIKELY • VERY POSSIBLE • POSSIBLE • SOMEWHAT POSSIBLE • UNLIKELY • VERY UNLIKELY • RARE • OTHER	Likelihood of risk event occurring.
Risk Consequence	• CATASTROPHIC • SEVERE • MAJOR • CONSIDERABLE • MODERATE • SOME • MINOR • VERY LOW • INSIGNIFICANT	The level of severity of the consequences that the risk would have in case it happens.
Risk Rating	• CRITICAL • VERY HIGH • HIGH • CONSIDERABLE • MODERATE • SOME • LOW • VERY LOW • INSIGNIFICANT	A general rating of the risk that may be determined from a combination of the risk assessment and risk consequence.
Risk Owner	• DESIGNER • SPECIFIER • CONSTRUCTOR • INSTALLER • MAINTAINER	A determination of who is the owner of the risk by reference to principal roles of organizations within a project.
Preventive Measures	(free text)	Preventive measures to be taken to mitigate risk.

Pset_Risk

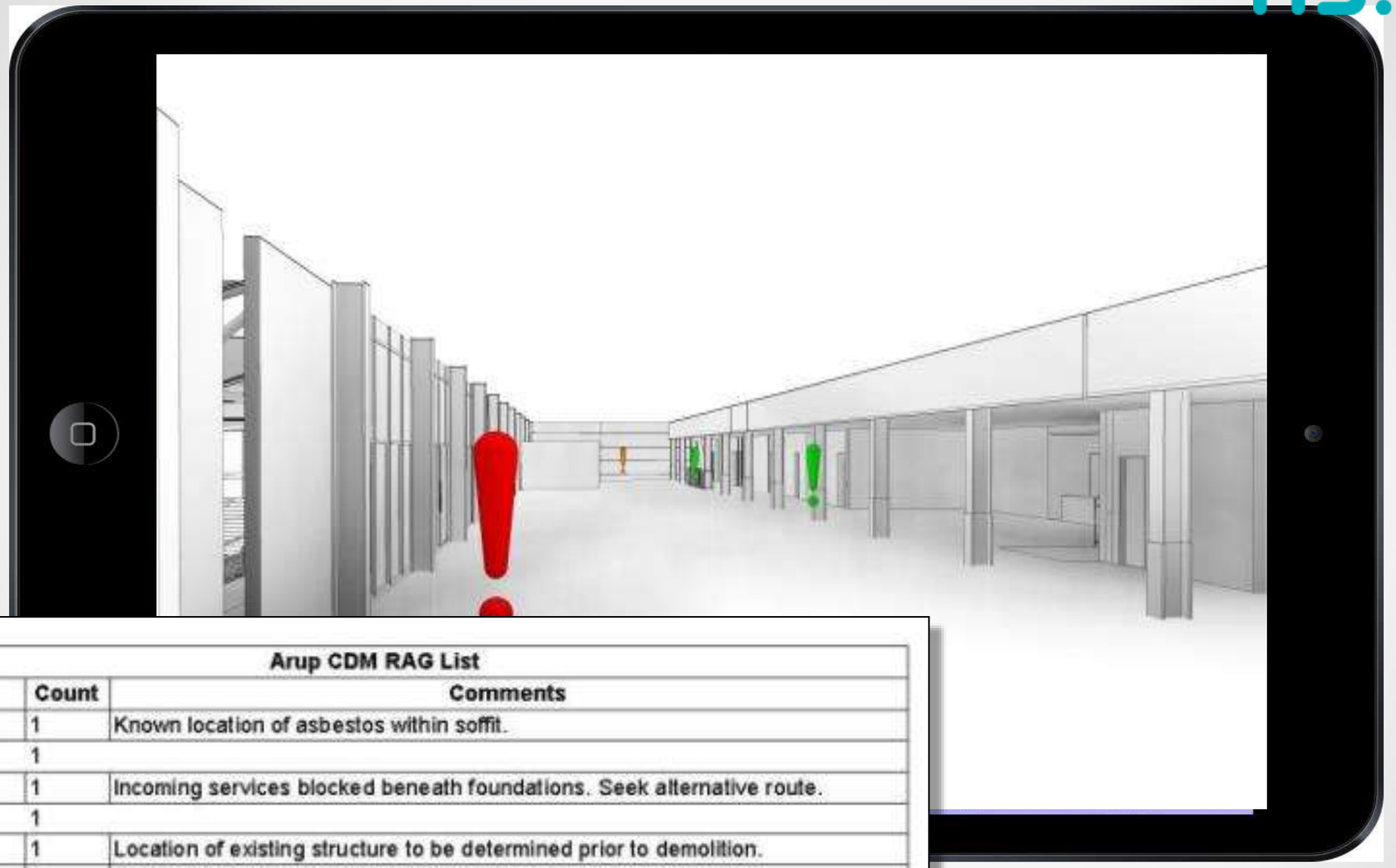
PROPERTY SET NAME	PSET_RISK	
Fire	An indication of exposure to mischance, peril, menace, hazard or loss. There are various types of risk that may be encountered and there may be several risks associated with an instance of a Process, Product or Spatial Element. This incorporates the values of a risk analysis matrix satisfying AS/NZS 4360.	
NAME	**DATA TYPE**	**DEFINITION**
Risk Type	Health and Safety	The predefined types of risk from which the type required may be set
Nature of Risk	Installation of boiler plant on roof	An indication of the generic nature of the risk that might be encountered
Assessment of Risk	Very possible	Likelihood of risk event occurring
Risk Consequence	Major	The level of severity of the consequences that the risk would have if it happens
Risk Rating	Moderate	A general rating of the risk that may be determined from a combination of the risk assessment and risk consequence
Risk Owner	Designer	A determination of who is the owner of the risk by reference to principal roles of organisations within a project
Preventive Measures	Fall-arrest system, installation outside of normal working hours	Preventive measures to be taken to mitigate risk

Table 4.03: Example of an IFC risk property set

Source: Mordue & Finch

Recording & presenting Risks and Hazards

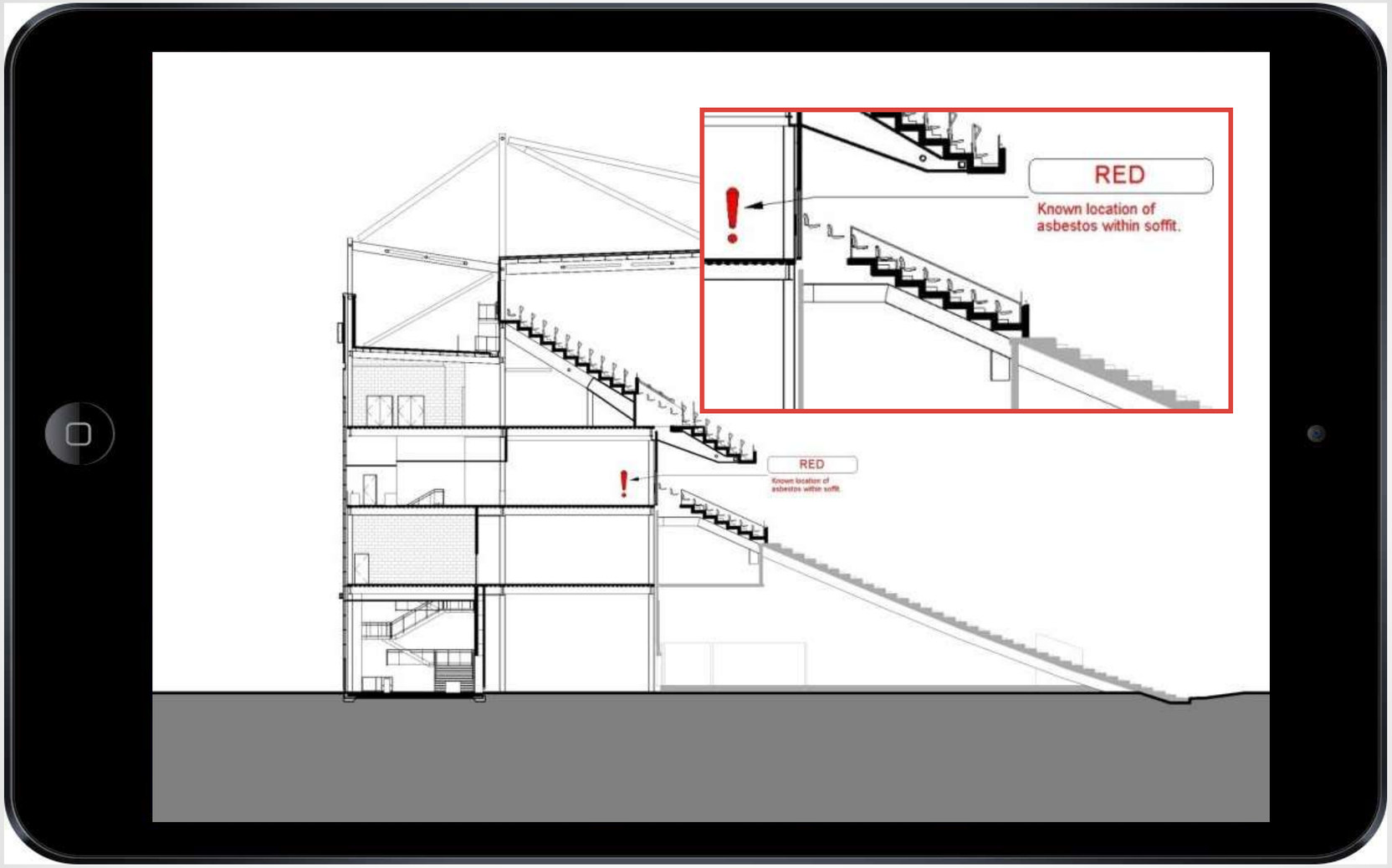
Visualization of risks



Arup CDM RAG List		
Type	**Count**	**Comments**
RED	1	Known location of asbestos within soffit.
	1	
AMBER	1	Incoming services blocked beneath foundations. Seek alternative route.
	1	
GREEN	1	Location of existing structure to be determined prior to demolition.
GREEN	1	Headroom issue with bracing resolved.
GREEN	1	Maintenance access to H/L light fitting above via motorised drop fittings to FFL.
	3	

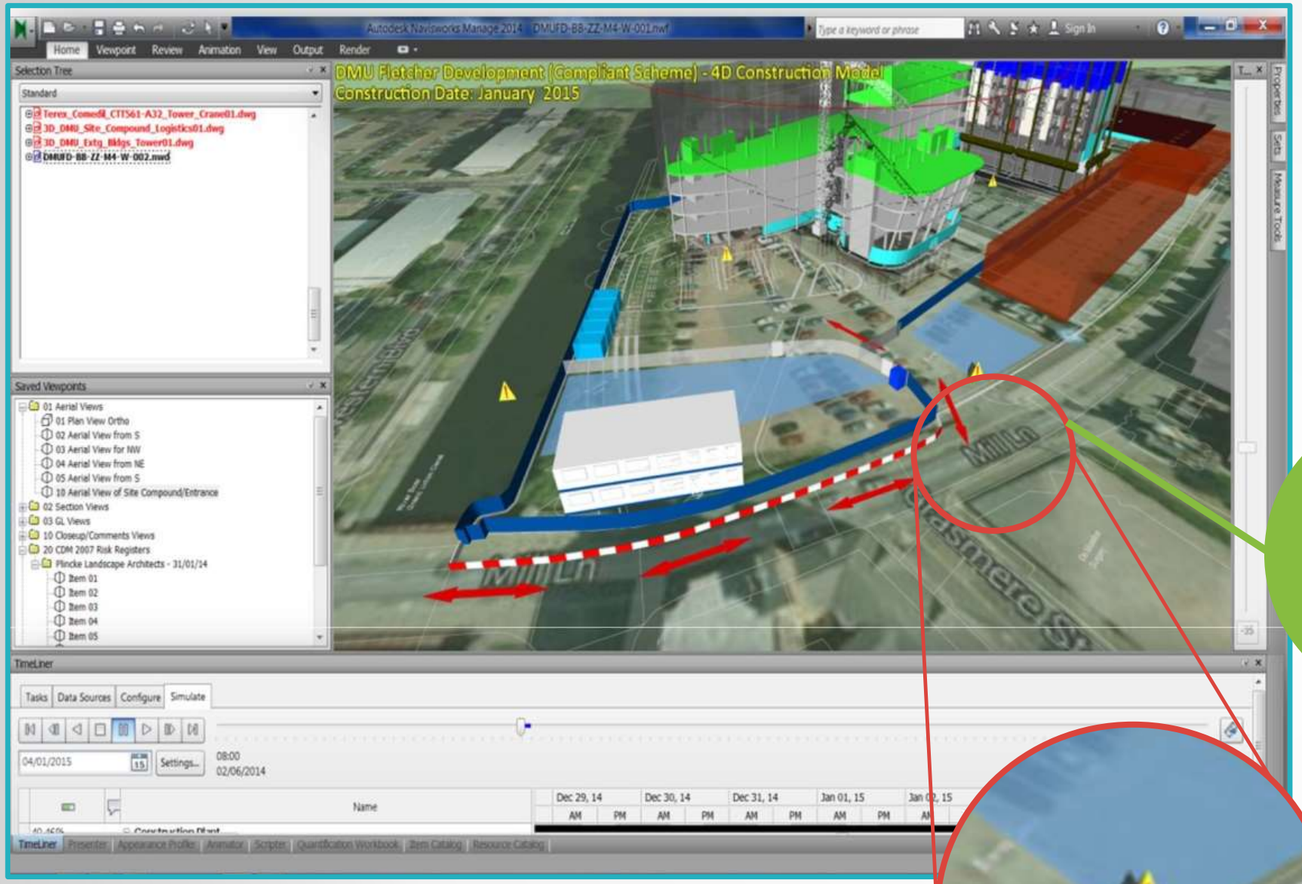
Source: ARUP Associates

Visualization of risks



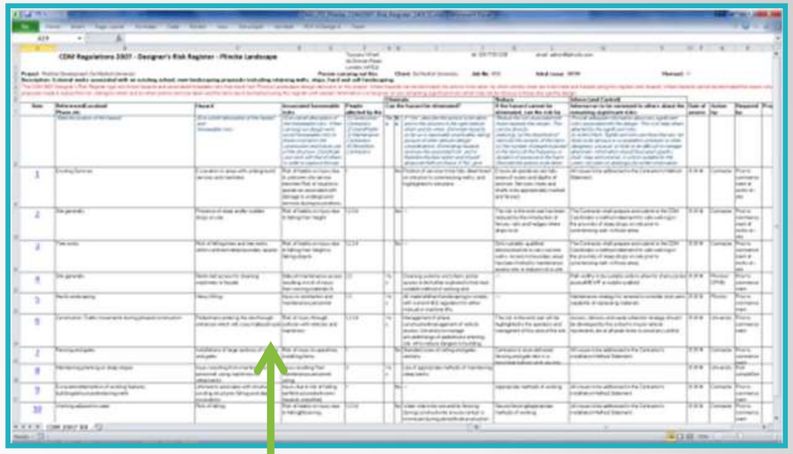
Source: ARUP Associates

Visualization of risks



4D Model with Safety Health Environment Symbol Markers

Hyperlink



Supply Chain CDM Register

Site Entry Photomontages

Shared risk register, COBie – Issues tab

RISK RATING

RISK ASSESSMENT

RISK CONSEQUENCE

Column	Issue
Name	Fall1
CreatedBy	Stefan.mordue@thenbs.com
CreatedOn	2015-11-04T11:08:38
Type	Safety
Risk	Very High
Chance	Has Occurred
Impact	Very High
SheetName1	Component
RowName1	Intermediate floor 2
SheetName2	Job
RowName2	Material storage 23
Description	Risk of structural or balance failure
Owner	bjerold@je.com
Mitigation	Warnings to be relayed to operatives

ISSUE TIED TO OBJECT

HYPERLINK TO FURTHER INFO

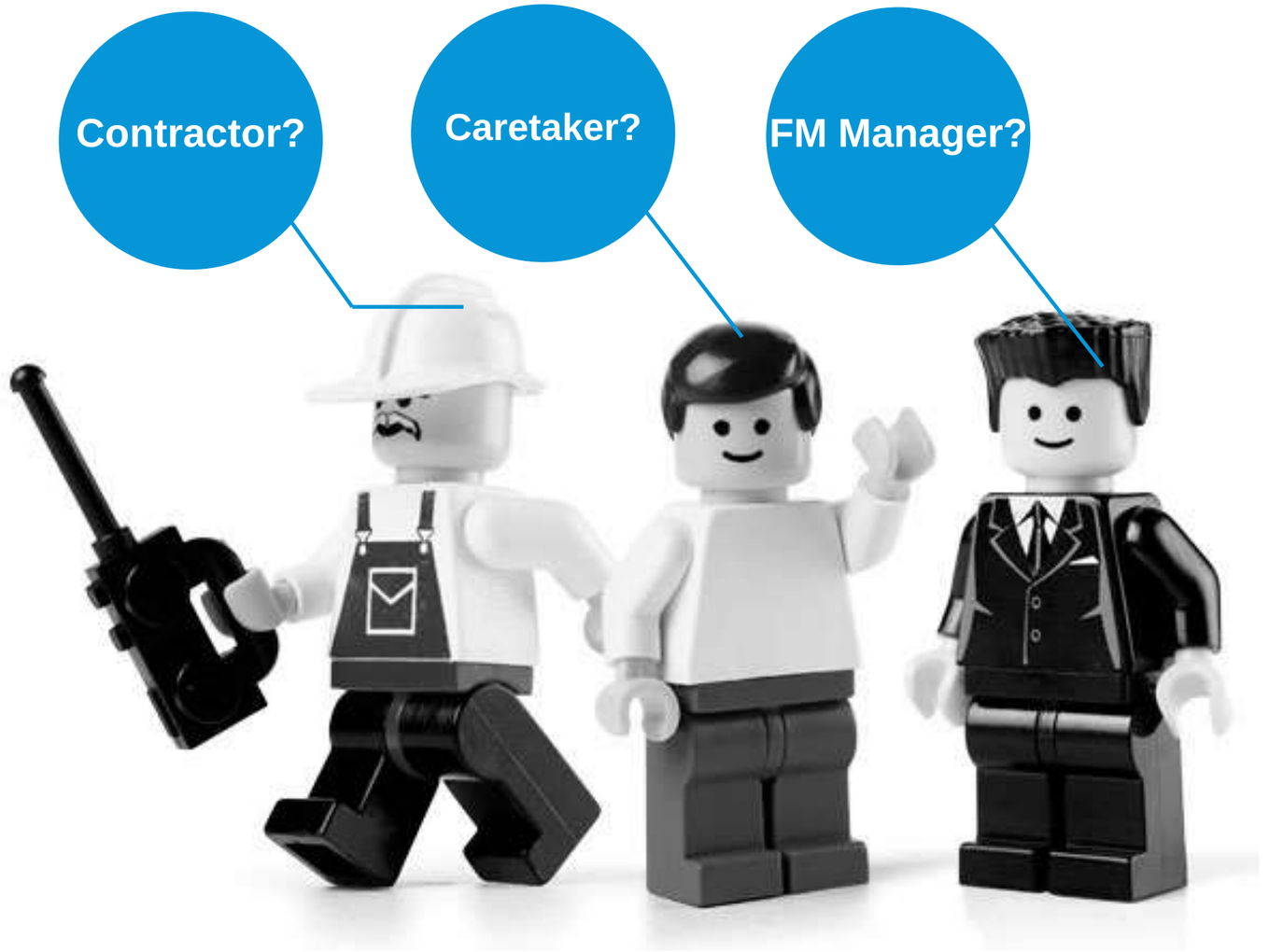
Source: AEC / Nick Nisbet

Working with information in the model

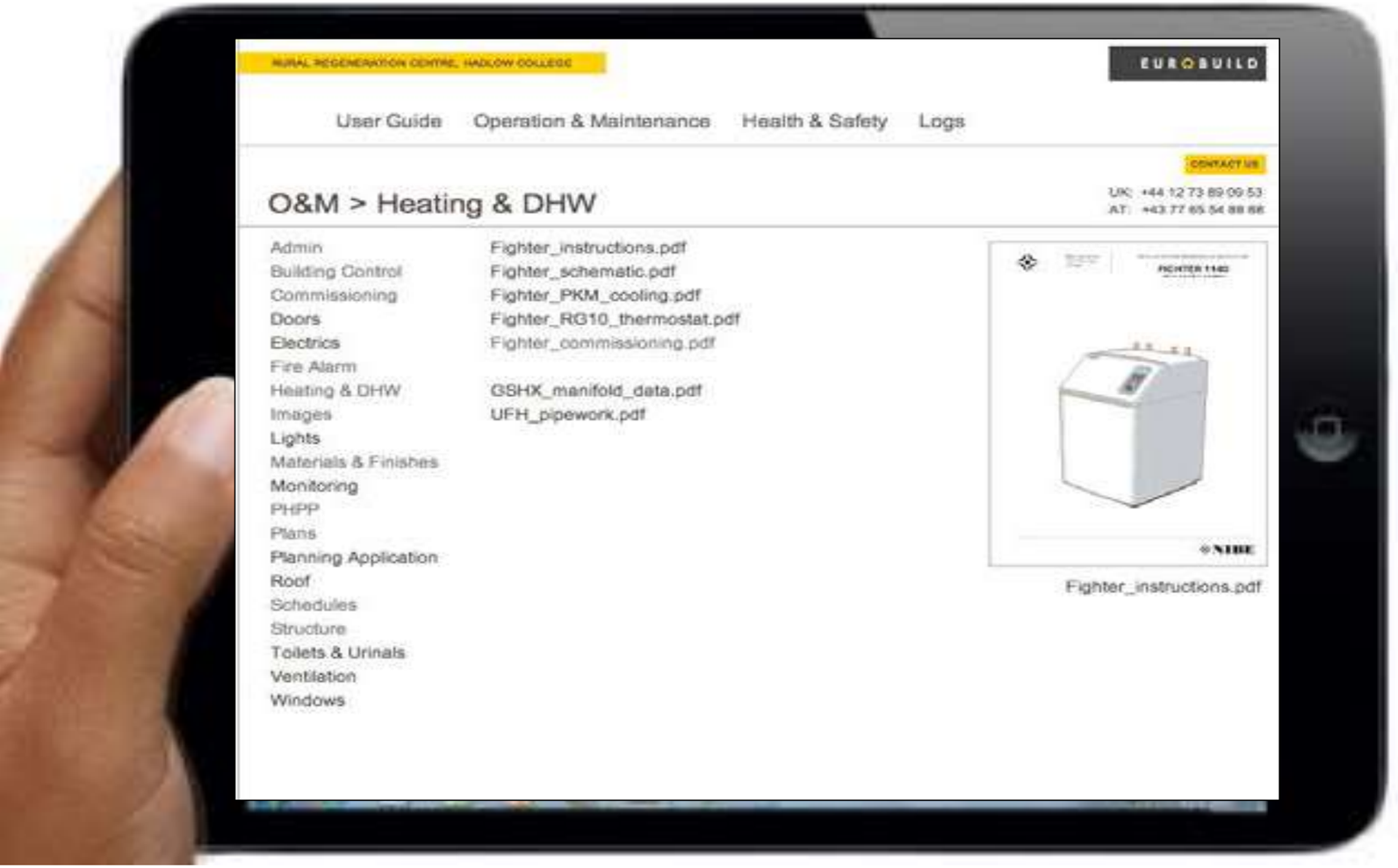
Its here

SOMEWHERE !

How is the information for?



Digital health & safety file?



Health & Safety File

+

Operation & Maintenance file

+

Guides & certificates

Source: Eurobuild

‘Experience in other industries (for example, ICT, retail and manufacturing) suggest that failure to understand and adapt human behaviour, rather than technology, is the biggest impediment to collaborative working.’

Sir Michael Latham – Constructing the team, 1994

“The biggest danger is that we get bogged down in a technical discussion, when BIM is a behavioural change programme more than anything else.”

David Philp – Head of BIM implementation Cabinet Office

END.

Keep in touch…

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