AIMCH

TRANSFORMING HOW WE BUILD HOMES

Work package 5:
Design Standardisation Studies & Product Families

February 2021

mtc Manufacturing Technology Centre
L&Q
Construction Scotland Innovation Centre
Forster Group
Stewart Milne Group
Barratt Developments PLC Building Excellence Since 1958
Industrial Strategy
UKRI UK Research and Innovation

EXECUTIVE SUMMARY

This work package was delivered in the main by the AIMCH developer partners. By working collaboratively and sharing information on current standard house design portfolios, technical specifications, construction preferences and brand attributes, a means to consider standardisation at company and AIMCH consortium level was derived.

MTC provided independent facilitation, transferring standardisation approaches and methodologies, common place with the automotive and manufacturing industry, to drive innovation through standardisation and the creation of interchangeable common product families, that the AIMCH developers and wider housing industry can benefit from.

The work package developed a methodology for the down selection and prioritisation of housing standardisation opportunities within housing design and supply. The down selection process identified 19 overall standardisation opportunities, which were shortlisted to 9 primary areas of interest.

Through a final weighting and ranking selection system 5 core standardisation areas were identified for detailing analysis.

Detailed Design Standardisation Studies & Product Family Recommendations, were completed for the following areas:

1. External Apertures – Windows & Doors
2. Staircases & landings – excluding handrails/ newels
3. Wet rooms – Bathrooms, En-suites and WC's
4. Service Cupboards – Electrical/Utilities Areas and Hot Water Storage Spaces
5. Storey Heights – Considered with the DFMA Guide (excluded from this report)

The findings from the standardisation studies, thought to be the first of their kind, confirmed the lack of standardisation that currently exists across the AIMCH developers housing portfolios. This presents a great opportunity to review new approaches and thinking on how best to embrace standardisation, focused on areas of opportunity identified through the down selection process.

The studies analysed in detail the influences, drivers, and reasons that block standardisation. Detailed mapping exercises were undertaken of the current state variability, and where coalescence to common sizes and approaches, can facilitate standardisation. The work concludes by presenting standard product family recommendations that can be used by the AIMCH developers to review current and future housing portfolios.

Future housing designs will be commercially evaluated, through detailed desk top commercial analyse, the cost effectiveness of this approach and the standardisation solutions created. To support the commercial evaluations an innovation call to the supply chain market will be completed. This will seek suppliers keen to engage and exploit the standardisation considerations evolved from this work package. It is anticipated that suppliers will welcome the opportunity to engage and facilitate further collaboration, overcoming any technical challenges and developing a viability point, attractive to the AIMCH developer partners.

It is hoped that once promising solutions are technically robust and commercially attractive, these will be trialled on live developments/plots with the AIMCH developer partners. Outcomes from trials will be commercially evaluated within WP8 and findings reported.

Standardisation of sub-assemblies and the creation of product families, within housing design, as a mainstream industrialised process, is a significant shift for the AIMCH developers and wider industry. This will take many years to embrace, embed and deliver to the scale, capability and benefits shown by the automotive sector. However, these innovative collaborative studies, believed to be the first of their kind, show real promise in the potential to embrace standardisation as a positive attribute and not as a perceived negative thing.

AIMCH partners are already seeing business opportunities where this work can be exploited within their businesses. In the case of Stewart Milne Homes, the recommendations have been utilised in the creation on a new housing range for deployment within the business in the next 12-36 months. Similarly, L&Q have adopted the information for the standardisation of their medium-high rise apartments developments, where there is strong potential for offsite manufactured modular bathroom pods, to be commercially viable at scale and beneficial to construction on site.

AIMCH ambition is through the creation and exploitation of future industrialised housing design, that embrace standardisation and MMC, yet deliver high quality, functional and appealing homes, AIMCH will fuel a path to delivering more homes, at an affordable cost.

BACKGROUND & OVERVIEW

Standardisation is critical to an effective industrialised housing approach. The automotive industry has shown how standardisation can be leveraged to derive significant business benefits, such as lowering costs, increasing productivity and improving quality, whilst providing a framework of flexibility, that is valued by car purchasers.

Within WP5, led by the AIMCH developer partners, the team have undertaken studies of existing housing portfolios to better understand the level of current standardisation that exists and how best to design solutions, that yields greater future standardisation, by developing common components/sub-assemblies or design parameters, that maximises design standardisation, whilst retaining high quality designs, within their current and future housing solutions.

An early part of the work delivered, was to manage the differing developer attitudes, approaches, ideas, supply chains and brand characteristics relating to standardisation. MTC provided an independent facilitation role, leveraging their expertise in delivering collaborative standardisation solutions, within the automotive sector transferring skills and approaches, which were then used by the AIMCH developer partners.

The work delivered a standardisation methodology and ranking system, leading to detailed studies of key areas of standardisation interest, by each of the AIMCH developer partners, including suggested standardised components or sub-assemblies, known as product families. These product families can be developed further, through collaborative engagement with supply chains and creation of industrialised kit of parts, suitable for use within future housing designs & in the creation of Industrialised Housing Pattern Books.

STANDARDISATION DOWN SELECTION METHODOLOGY

A key challenge for the AIMCH developer partners was a methodology to derive the most effective things to standardise.

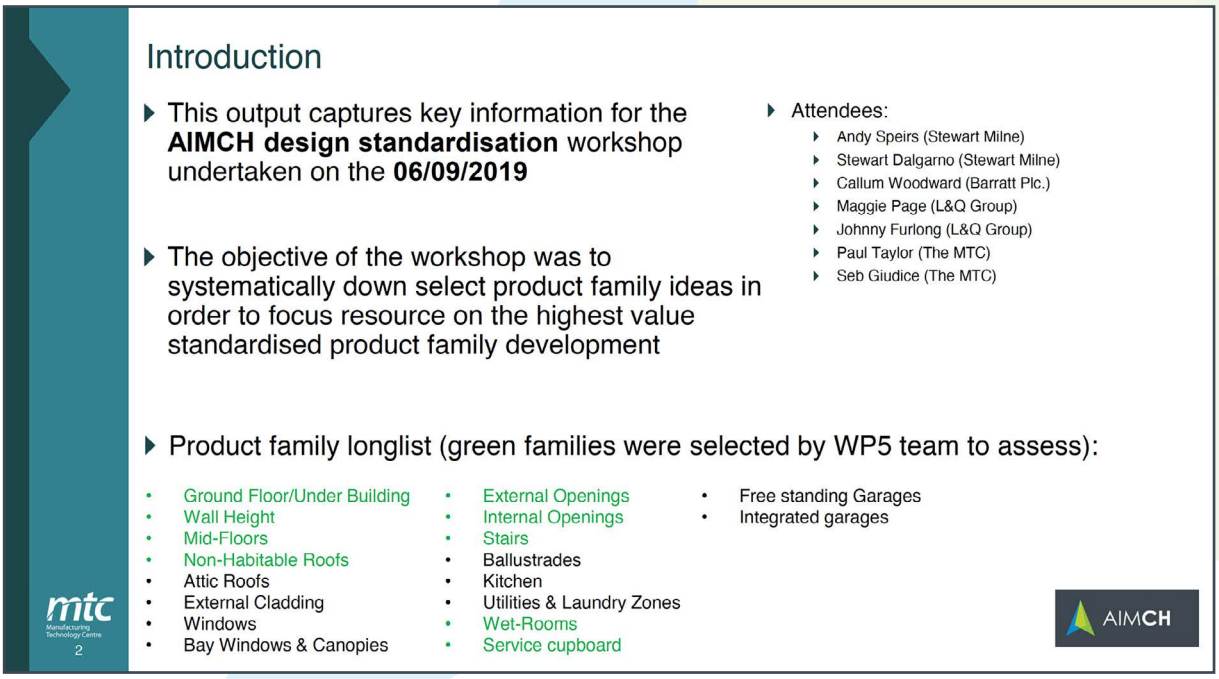
All partners had wide ranging views, believes and perceptions, which made it difficult to establish a common approach and methodology for selecting things to be considered further. Through initial scoping meetings and the sharing of house range documentation, design and specifications, it became clear that whilst sounding simple, the task of filtering standardisation ideas was challenging. Some partners and/or individuals had fixed views and some were more open, but none of the partners, had a means to rank selection to derive the most promising standardisation opportunities.

The MTC provided a non-partisan facilitation solution, using previous methodologies and tactics derived within the automotive industry. These had to be re-configured to suit the housing sector and terminology simplified to align with the developer's language to make relevant and meaningful.

This led to several workshops, hosted by MTC, where developer information was shared and discussed in a collaborative way. This was very novel. The fact that three developers were sharing intellectual property relating to design information on their house types, specifications and building design considerations, a unique and innovative approach. Overtime all partners became comfortable with the approach and saw value in working with others to drive collective standardisation.

These workshops led to the creation of a long list of 18 standardisation topics (long list). All topics had merit and potential but is was clear a means to filter these was needed, so partners could focus their limited resources on the items of greatest benefit.

AIMCH – Long List of Housing Standardisation Topics



Through further review the long list was consolidated down to 9 primary standardisation opportunities (short list) for further detailed down selection (shown in green above). This led to the following down selection process set out below:

1. Set selection criteria definitions
2. Assemble list of product families to be standardised
3. Scoring of the product families
4. Shortlisting of critical product family concepts

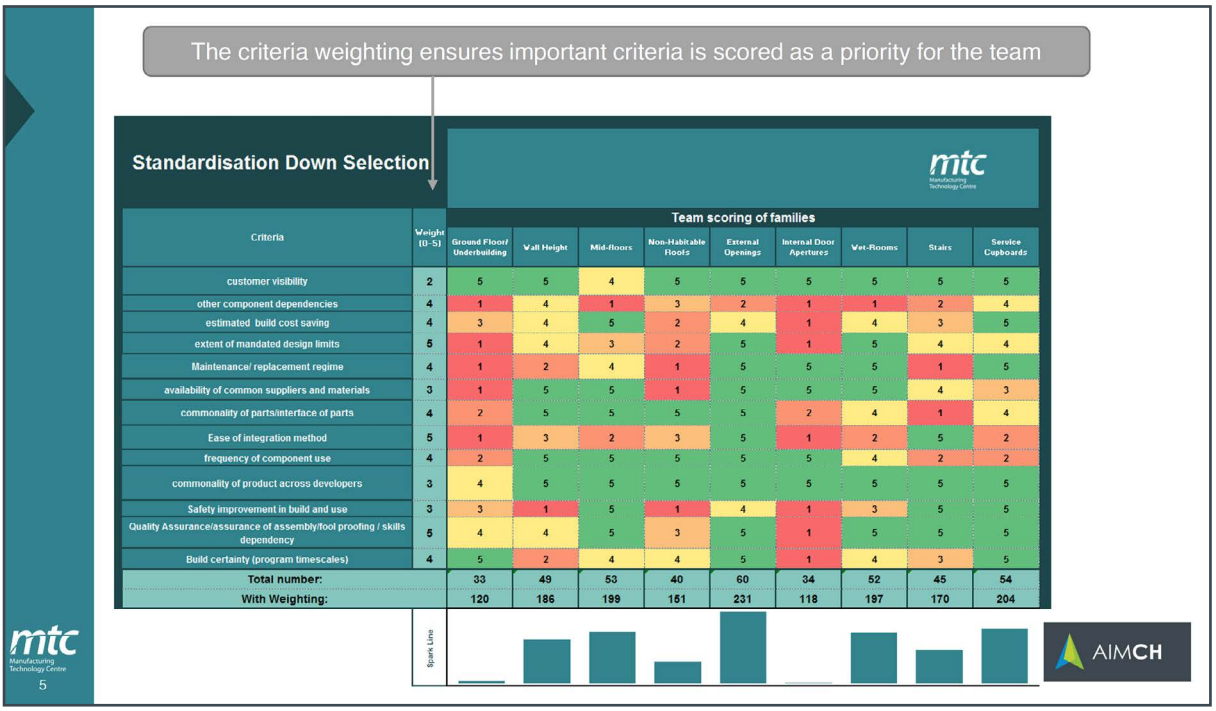
Setting the selection criteria was important. This derived 13 key selection criteria, including commercial benefit, consumer impact, ease of implementation and build certainty. Linked to this was a scoring scale (1 – 5) for each criterion. Each criterion was given an upper and lower limit and definition of impact. A matrix was developed.

Minimum/Maximum Criteria Descriptions: Criteria to be weighted on a sliding scale from 1→ 5

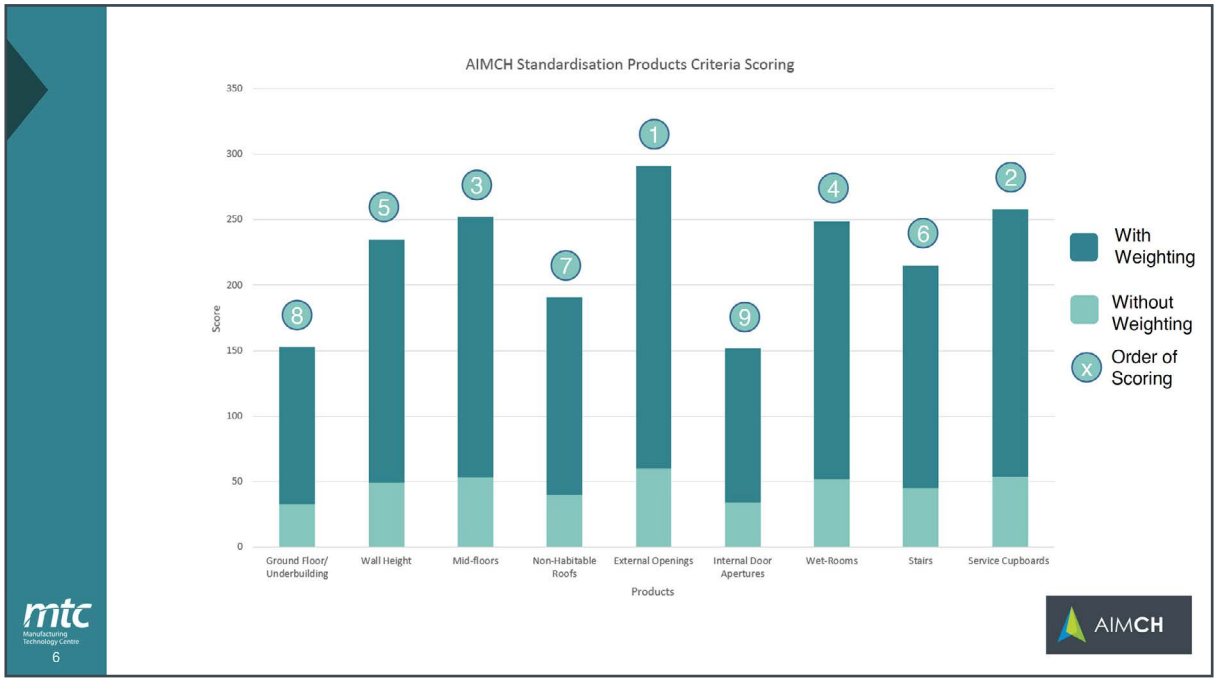
Criteria	Criteria Descriptions	
	1 (Sliding Scale)	5
customer visibility	Product is visible to customer and customer will be negatively impacted by standardising of product	Product is practically invisible to customer; any design for standardisation changes will not affect customer
other component dependencies	Product design is heavily dependant on interfacing products; difficult to standardise	Product design is independent of interfacing products; no barriers to standardisation
estimated build cost saving	Standardising the product will provide no financial gain/incur greater costs to the business	standardising the product will result in substaintial cost savings
extent of mandated design limits	many design limits are in place which restirct the extent of possible design changes	the product has little/no constraints from mandated design limits
Maintenance/ replacement regime	The product will not be repaired/replaced during the enitre lifespan of the house	The product is expected to need repair/replacment and/or service
availability of common suppliers and materials	the standradised design requires unique materials to other products which can only be sourced from a single supplier	the standardised design uses materials used by other products which can be sourced from multiple different suppliers
commonality of parts/interface of parts	It would not be possible to standardise the interface or include any parts common to toher products	the product could be easily standardised to include both common interfaces and parts
Ease of integration method	Introducing the standardised design would require substantial changes to the business, such as new software, machines and supplier network	the proposed standardised design could be introduced with minimal effort
frequency of component use	the product is used 1 in every 10 houses	This product is used at least twice in every house
commonality of product across developers	most developers have their own unique design for this product which is deemed as a USP	most developers do not consider this product to be a partuclar USP of their business
Safety improvement in build and use	the standardised design would incur more risk associated with the production or assembly	a substantial increase in safety could be achieved by the standardised design
Quality Assurance/assurance of assembly/fool proofing / skills dependency	in build quality is not improved by the standardised design	the standardised design will be manufactured with build in quality in mind, removing quality issues and non conformity
Build certainty (program timescales)	the standardised product would be at risk of delayed delivery	the standardised design could be guaranteed to be delivered on time more consistently than the original range of products

AIMCH - Standardisation Down Selection Criteria Matrix

Once the criterion was set, a weighting was applied to each criterion. This criteria weighting ensured important criteria is scored as a priority by the AIMCH developer partners. Once this was completed a scorecard was assembled and the partners collectively scored each of the 9 scandalisation opportunities and ranked them, considerate of their score and weighting.



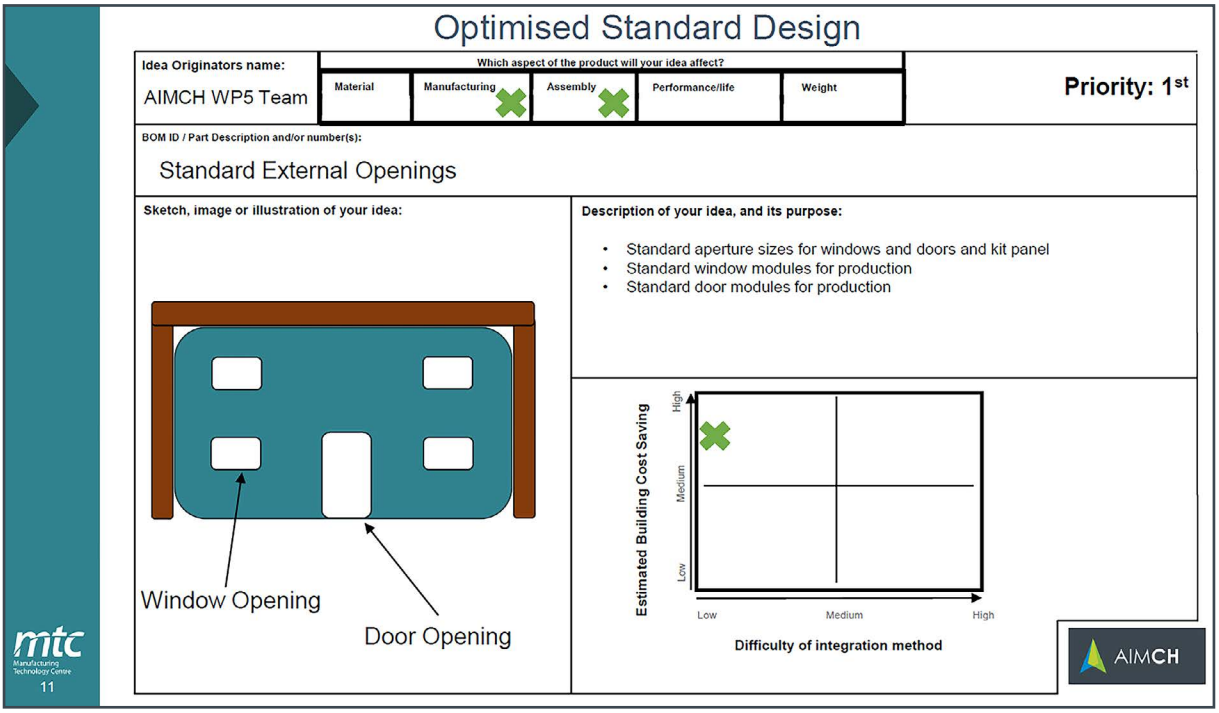
AIMCH – Standardisation Down Selection Scorecard



AIMCH – Standardisation Down Selection Ranking

Once the 9 opportunities (short list) had been scored and ranked, they required further filtering, to derive final areas of focus, in which to undertake detailed standardisation studies and derive a suite of product families. It was evident that this was increasing becoming subjective, and a means to objectively assess, the remaining 9 shortlisted opportunities was needed to derive meaningful final selection, underpinned by a strong rationale.

A final selection process was developed. This included a simple template, which can be collectively populated to record considerations and capture rationale, as well as early thought ideas of product families and likely implementation benefits. The template developed considering things like, area of impact, description of product family idea, sketch of thoughts and a 2 x 2 matrix, to position the selection relevant to difficult to integrate standardisation versus cost saving impact of standardisation. The template sought solutions which offered high commercial return to the developer but low impact on end home user/buyer or brand impact.



AIMCH – Standardisation Final Selection Template (Example)

The conclusion to the final down selection process resulted in 5 key areas of Design Standardisation. These being:

1. External Apertures – Windows & Doors
2. Service Cupboards – Electrical/Utilities Areas and Hot Water Storage Spaces
3. Storey Heights – Considered with the DFMA Guide
4. Wet rooms – Bathrooms, En-suites and WC's
5. Staircases & landings – excluding handrails/newels

These were then developed in much greater detail through Detailed Standardisation Studies and Product Family Recommendations. The building storey height standardisation would be investigated in more detail through the development of the DFMA Guide to Timber MMC Panelised Systems. (Design for Manufacture and Assembly)

The remaining standardisation opportunities provide further opportunity. However, these are not being progressed within the scope of AIMCH, due the projects resource and time limitations.

Standardisation Studies

A significant part of this work package was the completion of detailed standardisation studies. These were undertaken by the AIMCH developer partners using there current housing portfolio ranges. The developers worked innovatively together to share information on housing designs, specifications, supply chains and brand parameters. The total number of homes analysed, was 99 homes across the AIMCH developer partners, as noted below:

1. Barratt Developments – 29 homes
2. L&Q Counties – 34 homes
3. Stewart Milne Homes – 36 homes

The Studies involved detailed evaluations of the standardised opportunities identified within the down selection process described above. Each developer focused on studying at least one area, collating information from the developers and undertaking analysis, the detail of each study is explained later. The studies also investigated the influencing factors and constraints, around the issues of achieving coalescence of standardised outcomes. Often this is limited by external factors out with the developers controls such as differing building regulations requirements around the devolved nations or planning approvals.

The use of standardised housing designs is common place within the housing market, and this was reflected in the analysis of the three AIMCH developers housing portfolios. The AIMCH developers were at varying levels of housing portfolio design maturity. An established private developer like Barratt Developments, had very mature housing portfolio's designed and refined over many years of housing delivery and market feedback. L&Q Counties region being relatively new to the market and in the earlier stages of establishing a range of homes, based on first live developments. Stewart Milne Homes as a medium sized developer had a mature portfolio and brought a higher degree of OSM manufacturing integration. The cross section of expertise was highly beneficial in recognising the differing developer challenges in embracing, leveraging and implementation design standardisation.

The studies were most illuminating in that it often highlighted the lack of standardisation that exists within a developer, between developer and as an industry. It also highlighted how the evolution of housing portfolios overtime have created high levels of variability. The studies concluded with recommendations on standardised product families and governance measures. The concept being a kit of standardised common parts or sub-assemblies, that can be individually or collaboratively procured and integrated into housing designs. In doing so, this approach to standardisation, can yield significant commercial, business and housing delivery benefits, without detracting from brand values and consumer appeal, whilst also complying with UK regulatory variations.

External Openings Standardisation Study – Windows and Doors

This study was undertaken by Barratt Developments, using all three AIMCH developers standard housing information. The study sets out the parameters used to assess the current state of variability within opening widths and heights of external apertures.

Window and door fenestrations and styles are driven by local planning, brand aesthetics and regulatory requirements. The study excluded the review of the actual components themselves and focused on the dimensional setting out of aperture sizes. All AIMCH developers work to a brick setting out standard for external openings, with a preference for a check reveal. The coursing of brickwork is well established norm within the housing industry, based on 75mm vertically and 225mm horizontally. Half brick sizing is common place and an efficient way optimise the raw brickwork material, to negate waste.

The study assessed the external regulatory influencing factors that need to be considered, such as the differing building regulations in England & Wales and Scotland and the NHBC technical standards. In addition, the input for the AIMCH developers, window and door manufacturing supply chains were sought, on dimensional optimisation and coordination from an industry supply chain perspective.

Detailed window analysis was undertaken of the aperture sizes adopted within the AIMCH developer housing portfolios. The findings are shown on the charts below, and highlight areas of similarity and variability, and the potential for coalescence around common dimensional brickwork sizes.

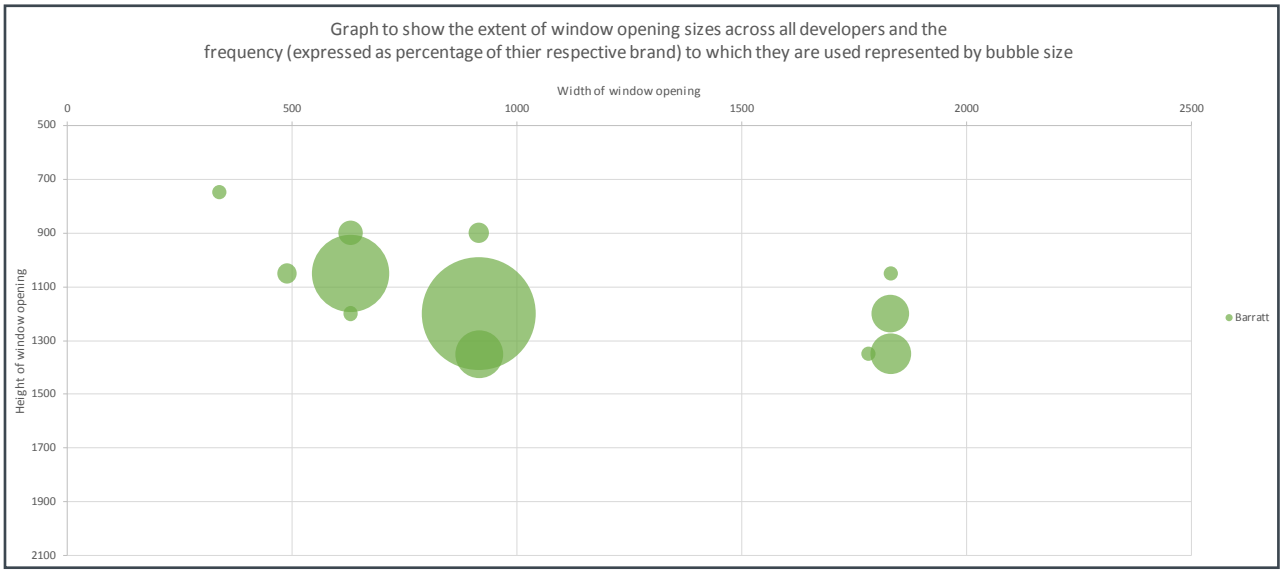


Figure 02: Barratt: Core Range

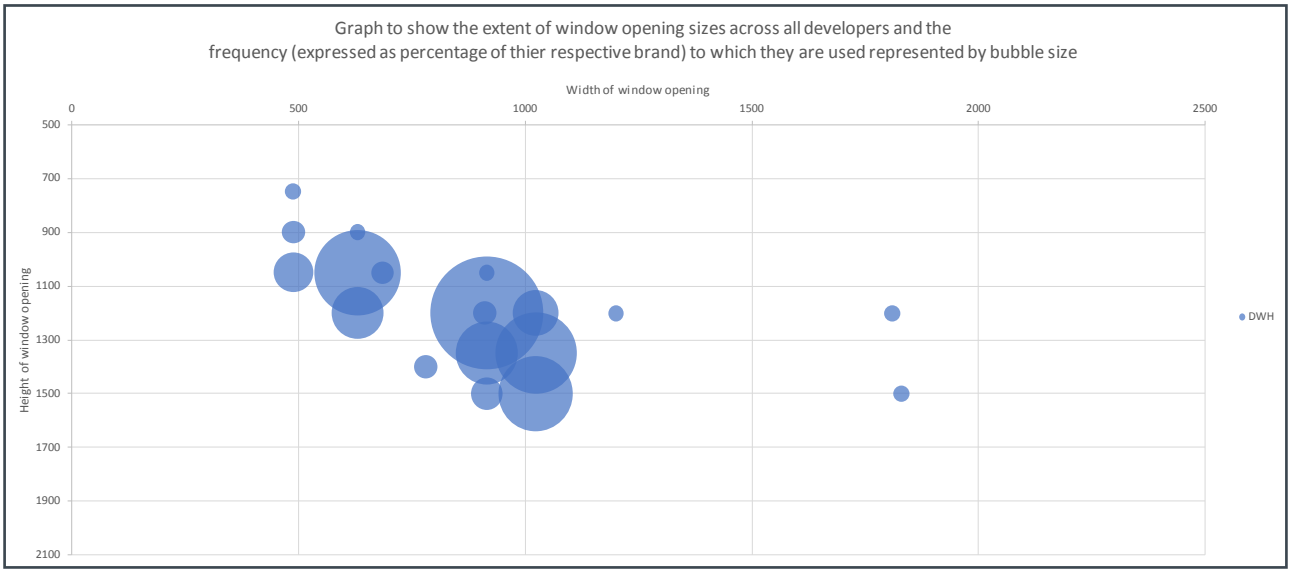


Figure 03: DWH: Core Range

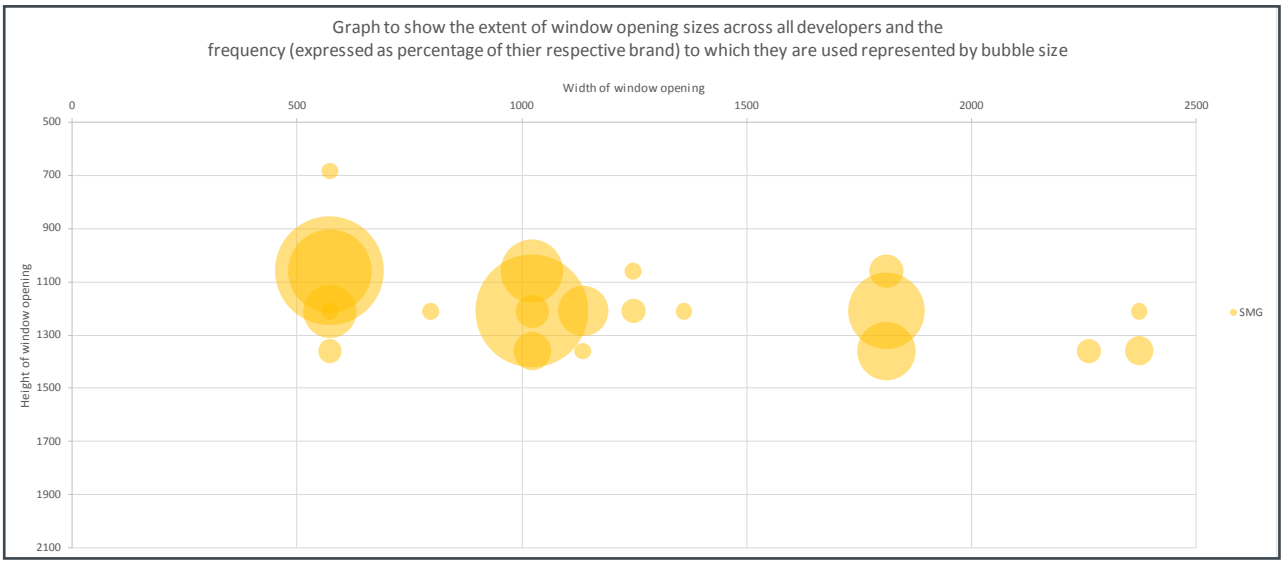


Figure 04: Stewart Milne: Woodlands Range

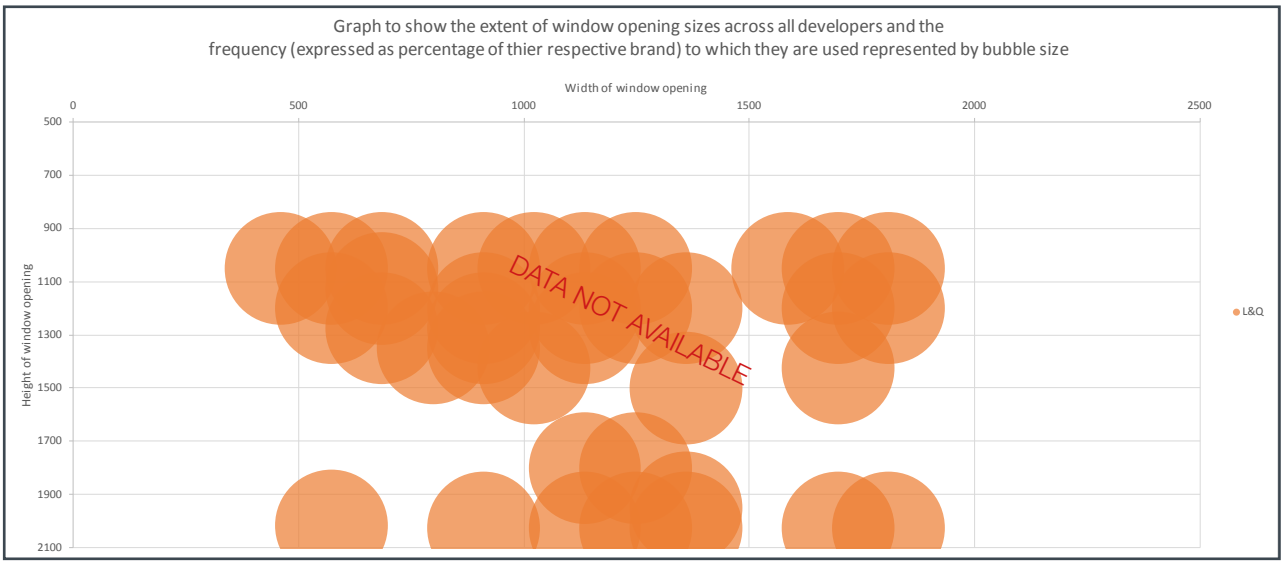


Figure 05: L & Q: Counties Range

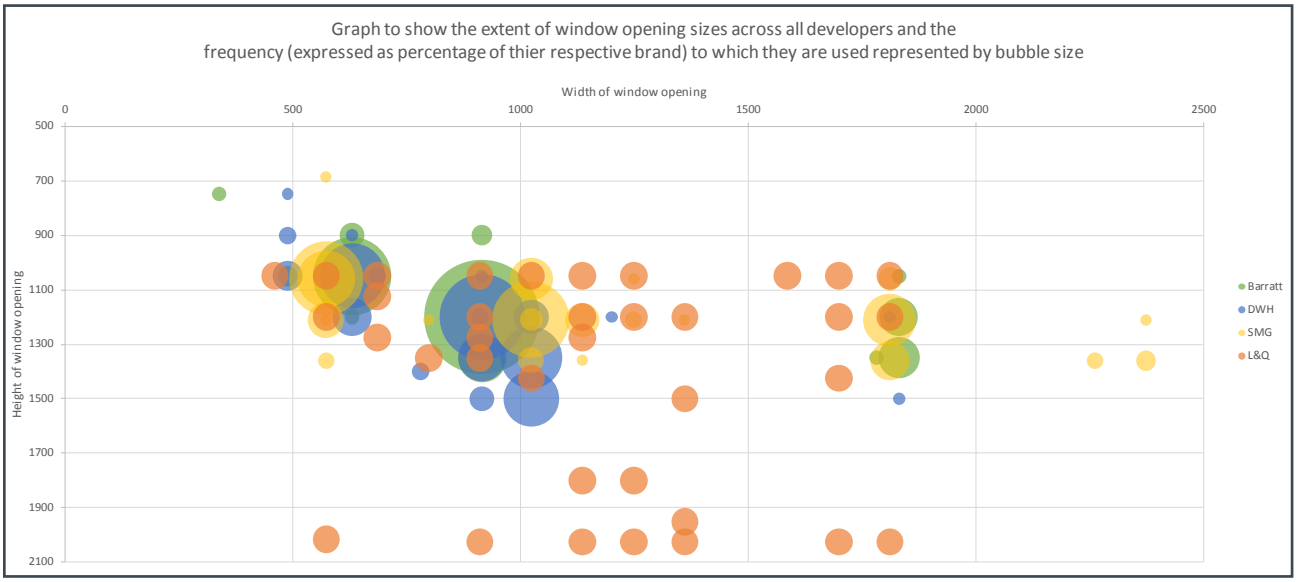


Figure 06: Overlay of all developers

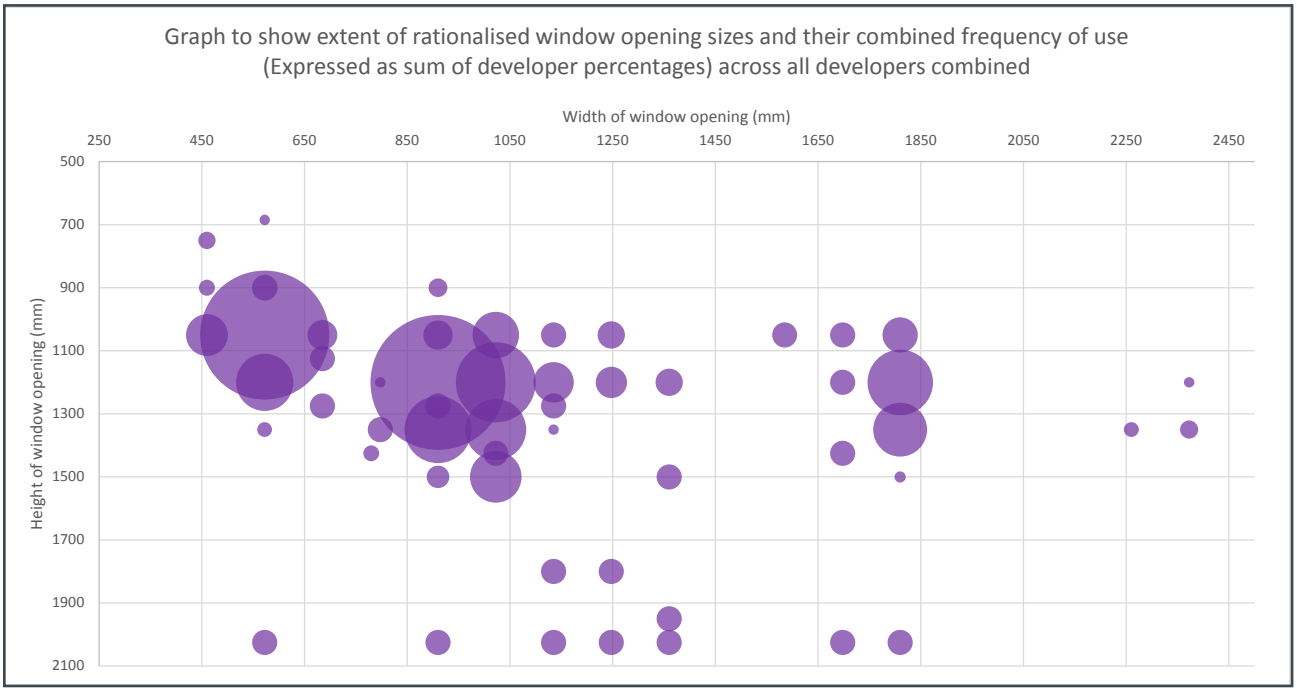


Figure 09: Rationalised openings frequency

Following the dimensional analysis further work was undertaken to evaluate the potential for rationalisation. This included the review of linear and vertically orientated fenestrations. Taller vertically configured openings have additional regulatory challenges associated with glazing specification, fall protection and internal room design/layout. Work was undertaken to investigate differing opening configurations, such as top/side hung casement and tilt and turn operating mechanisms. In addition, through supply chain engagement, window limitations were evaluated such as optimised production dimensions, raw material optimisation, handling and packing, with a view to reducing waste and driving commercial gains.

Recommendations

The work concluded by recommending the dimensions most readily suitable for standardisation, across the AIMCH developer partners and possibly the wider housing industry. This led to a 3 tier standardised system approach. Tier 1 (Green) being the Top 10 most used dimensions, representing at least 71% of window openings needed in a conventional commonly derived house design. The Top 10 all fall within a common suite of parameters that provide reasonable coverage and compliance across the UK. Tier 2 (Amber) sizes impact to a lesser extend but offer a wide range of standardised sizes, to suit a wider range of paraments. Tier 3 (Red) are outlier sizes, which attract technical and commercial implications, and should be used accordingly, safe in the knowledge that this will, not yield the same level of standardisation benefits.

The report goes on to evaluate external door openings, in a similar approach to the window analysis. The analysis investigated front and rear pass doors, french doors and garage up/over doors. Similar findings emerged. A key finding was the potential to derive a common single front/rear door brick opening size of 1023 x 2100, using a 914mm door leaf, that could be unilaterally adopted across the sector and external door supply chain.

In addition, through supply chain engagement, further benefits could be realised through optimised window production, raw material optimisation, handling and protection, with a view to reducing cost, waste and driving further commercial gains. This work is likely to be taken forward with the AIMCH supplier sandpit selection process during 2021.

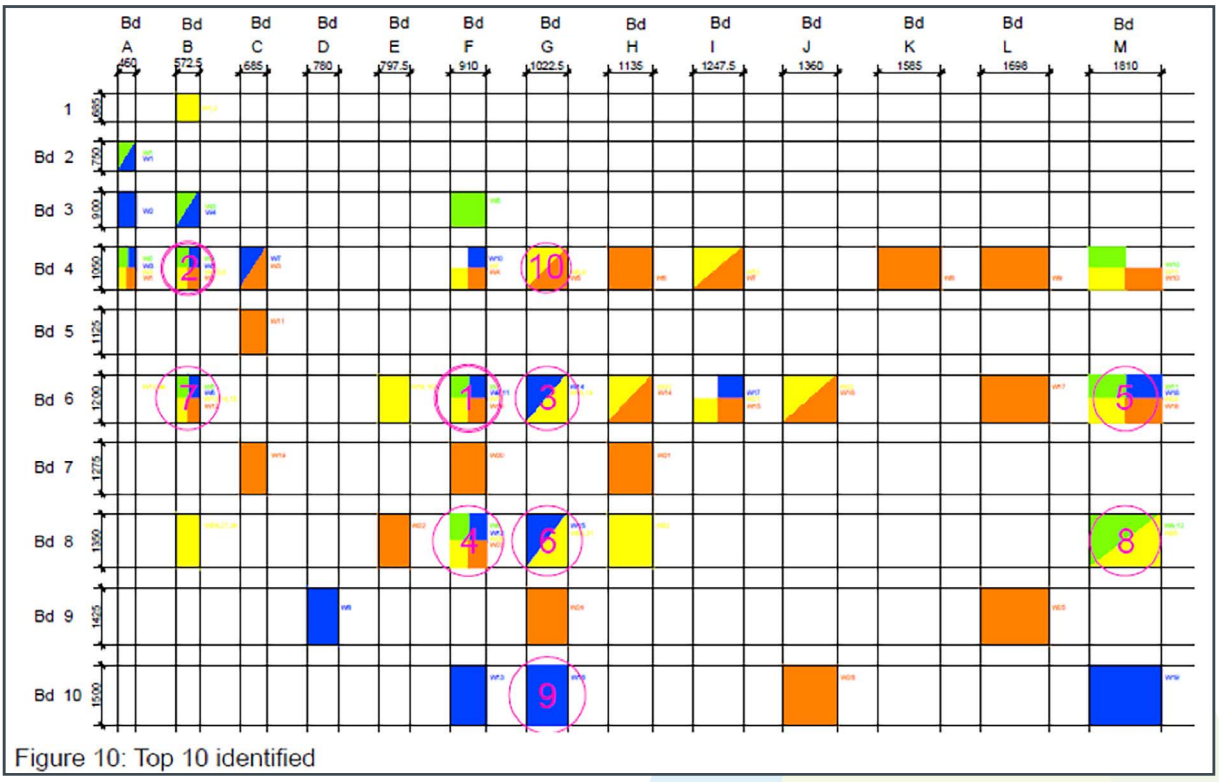


Figure 10: Top 10 identified

AIMCH Window Dimensional Analysis – Three Tier Traffic Light System Recommendations

Staircase Standardisation Study

This study was undertaken by Barratt Developments, using all three AIMCH developers standard housing information. The study sets out the parameters used to assess the current state of variability within opening widths, depths and height clearances of stairwells.

Stairwell openings are driven by internal layouts, floor to floor heights, clearance values and handrail/ newel preferences, as well as regulatory requirements. The study included the review of the actual stair components themselves, by investigating the potential for a common set of sub-assemblies, to make up the overall staircase design. In addition, the study focused on the dimensional setting out of stairwell opening sizes.

All AIMCH developers work to varying floor to floor heights, due to differing joist depts, floor make ups and internal ceiling heights. This is a challenge, however there is strong potential to coalesce around a common floor to floor height, including a small tolerance provision to allow flexibility in joist depth. A common issue is the variation in joist depth, ranging from 195 – 241mm, sometimes deeper for large spans, impacting on the ability to derive a common industry norm floor to floor dimension.

The study assessed the external regulatory influencing factors that need to be considered, such as the differing building regulations in England & Wales and Scotland and the NHBC technical standards. In addition, the input for the AIMCH developers, stair manufacturing supply chains were sought, on dimensional optimisation and coordination from an industry supply chain perspective.

Detailed analysis was undertaken of the aperture sizes, floor to floor heights and differing staircase configurations adopted within the AIMCH developer housing portfolios. The findings are shown on the charts below, and highlight areas of similarity and variability, and the potential for coalescence around common opening sizes and staircase sub-assembly parts.

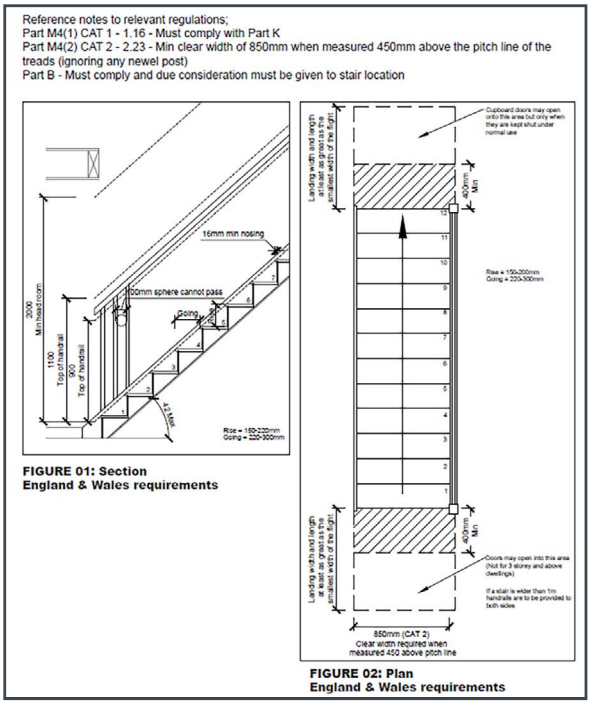


FIGURE 01: Section
England & Wales requirements

FIGURE 02: Plan
England & Wales requirements

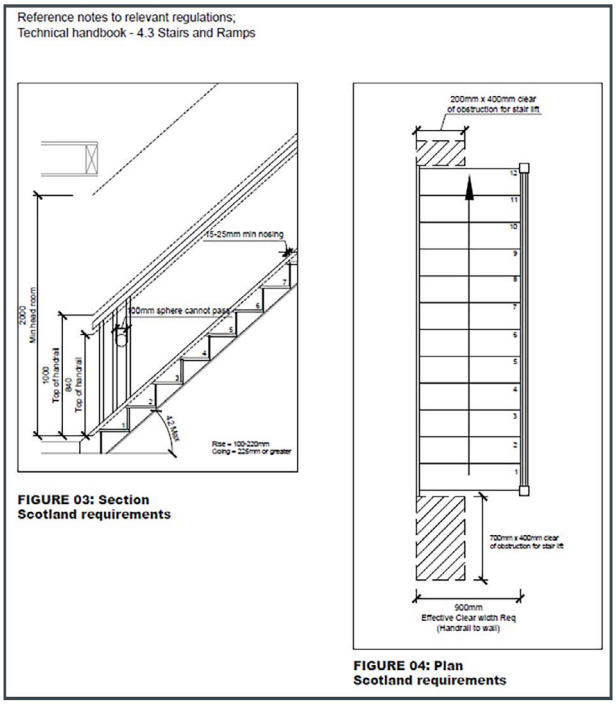


FIGURE 03: Section
Scotland requirements

FIGURE 04: Plan
Scotland requirements

AIMCH Stairwell Regulatory Design Differences – E&W and Scotland

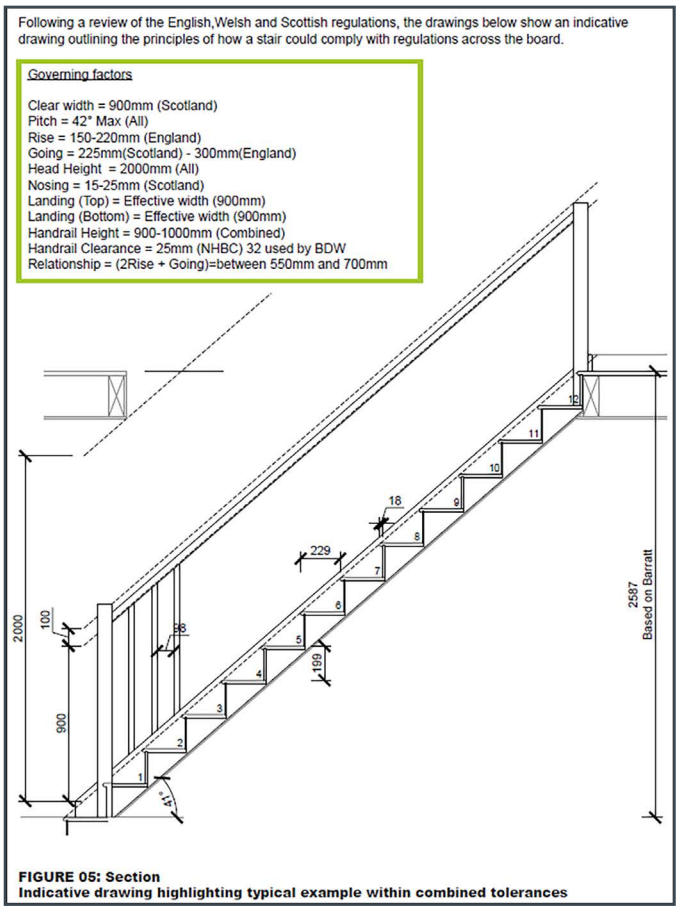


FIGURE 05: Section
Indicative drawing highlighting typical example within combined tolerances

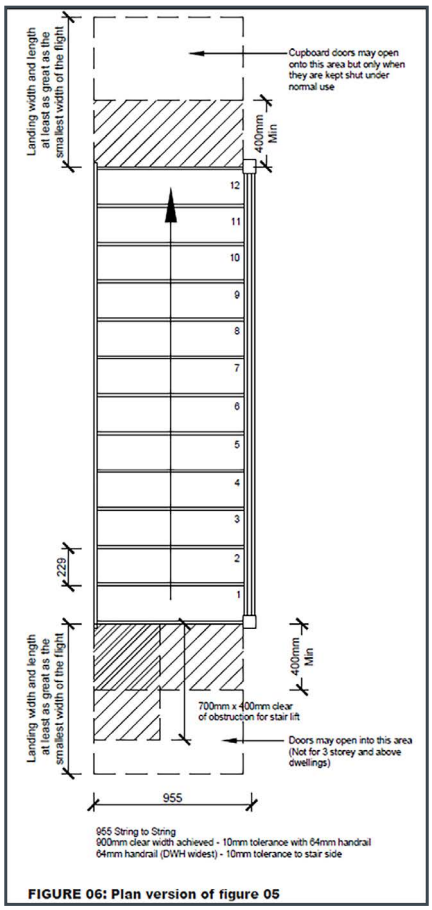


FIGURE 06: Plan version of figure 05

AIMCH Possible Stairwell Design for UK Wide Regulatory Compliance

A key conclusion from the research study, was the critical requirement to have a common floor to floor height. A study was undertaken of the differing joist manufacturers product depths and their alignment with panelised MMC systems such as timber frame, steel frame or SIPS. This was also coordinated with the availability of common plasterboard sheeting sizes used in housing. The unilateral sheet size being 2400 high. The table below shows the level of variation across the joist manufacturing supply chain. Timber engineered I-Joists are the most commonly supplied joist system in the housing sector.

I–JOISTS – Typical Sizes (other Manufacturers are available)																		
Manufacturer	Depth																	
TIMBER WEB	195	200	206	220	225	235	240	241	245	254	300	302	350	356	360	400	406	450	500
James Jones (JJI)	●			●		●			●		●		●			●		●	
Stairccraft (TFSI)				●			●				●								
Metsa Finnjoist (FJI)		●		●			●				●				●	●			
Steico		●		●			●				●				●	●		●	●
Masonite				●			●				●		●			●			
TJI								●				●		●			●		
BCI (Oakworth)								●				●		●			●		
LP Solidstart					●			●				●		●			●		
METAL WEB	195	202		219	225					254		304			373		417	421	
Wolf Easi Joist				●						●		●					●		
MiTek PosiJoist		●			●					●		●			●			●	
Merronbrook Easi Joist	●			●						●		●					●		

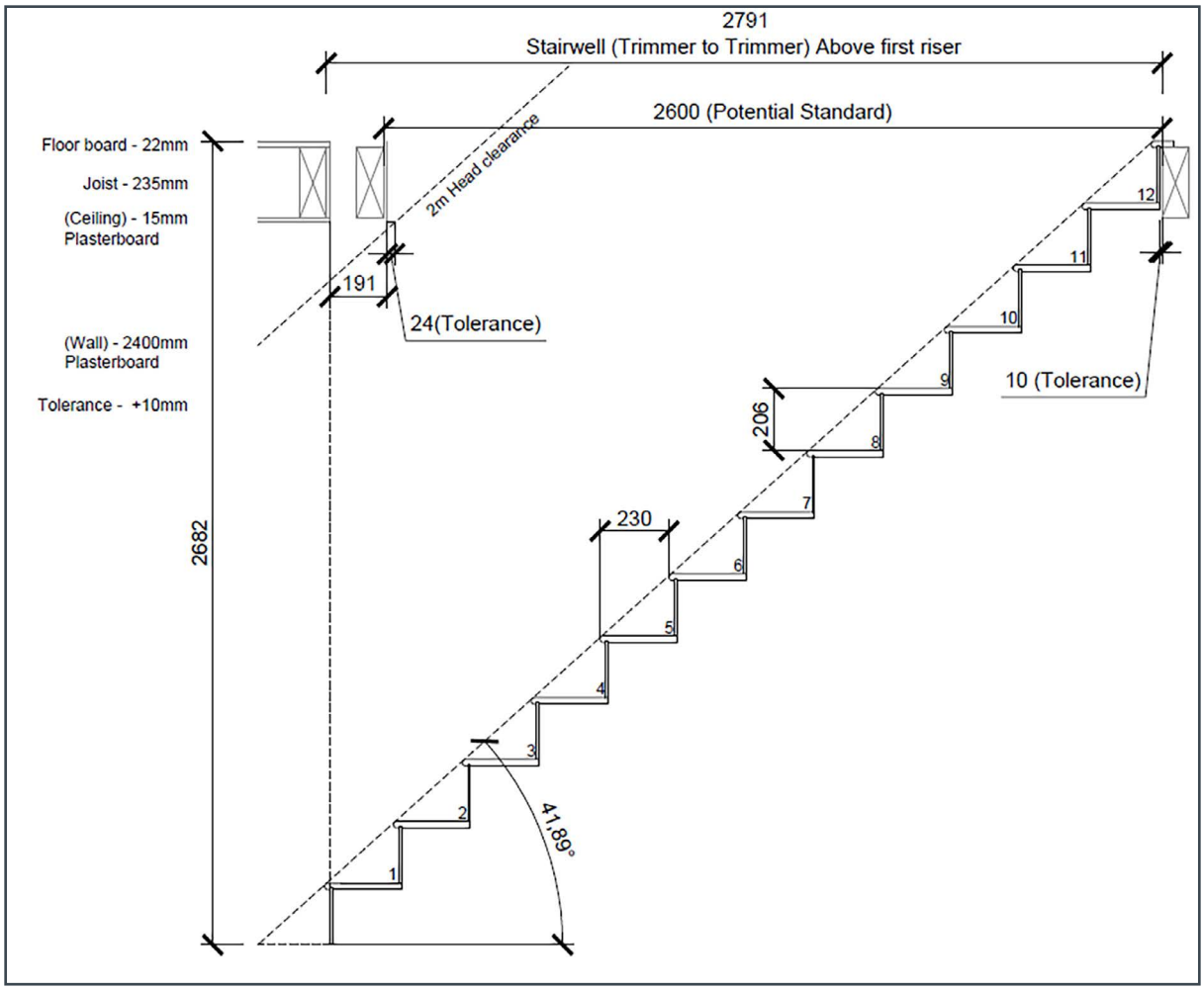
AIMCH Floor Joist Variability Study

From the table above it can be seen that there is a coalescence of I-Joist floor depths ranging from 235 – 241mm, available from a wide range of producers. Using this preferred floor joist range, common plasterboard sheet size and ceiling and floor finishes, a preferred common floor to floor dimension was derived of 2682mm, compatible with any panelised MMC building system.

	Structural Height/plasterboard height	Joist Depth	Chipboard	GF Ceiling Plaster	(Y Distance) Floor to Floor Height	Riser Height (150mm min-220mm max)	No. of Risers	(X Distance) front of first riser to front of last riser	Angle x Distance (to create full triangle)	Going distance 225mm - 300mm	Going No.	Angle (max 42)	(2R + G) = 550 to 700mm
MAX	2410	245	22	15	2692	207.0769231	13	2760	2990	230	12	42.00	644.15
MIN	2410	195	22	15	2642	203.2307692	13	2760	2990	230	12	41.46	636.46
ADVISED	2410	235	22	15	2682	206.3076923	13	2760	2990	230	12	41.89	642.62

Figure 07 Table showing standard floor to floor constructions

AIMCH Range of Floor to Floor Heights (using 195 – 245mm joist range)



2682mm: Finished floor to finished floor consisting of the following build up;

2400mm: Plaster board - Wall
15mm: Plaster board - Ceiling
235mm: Floor Joist
22mm: Floor board
10mm: Fitting tolerance (To allow for wall plasterboard fitting)

AIMCH Preferred Floor to Floor Height

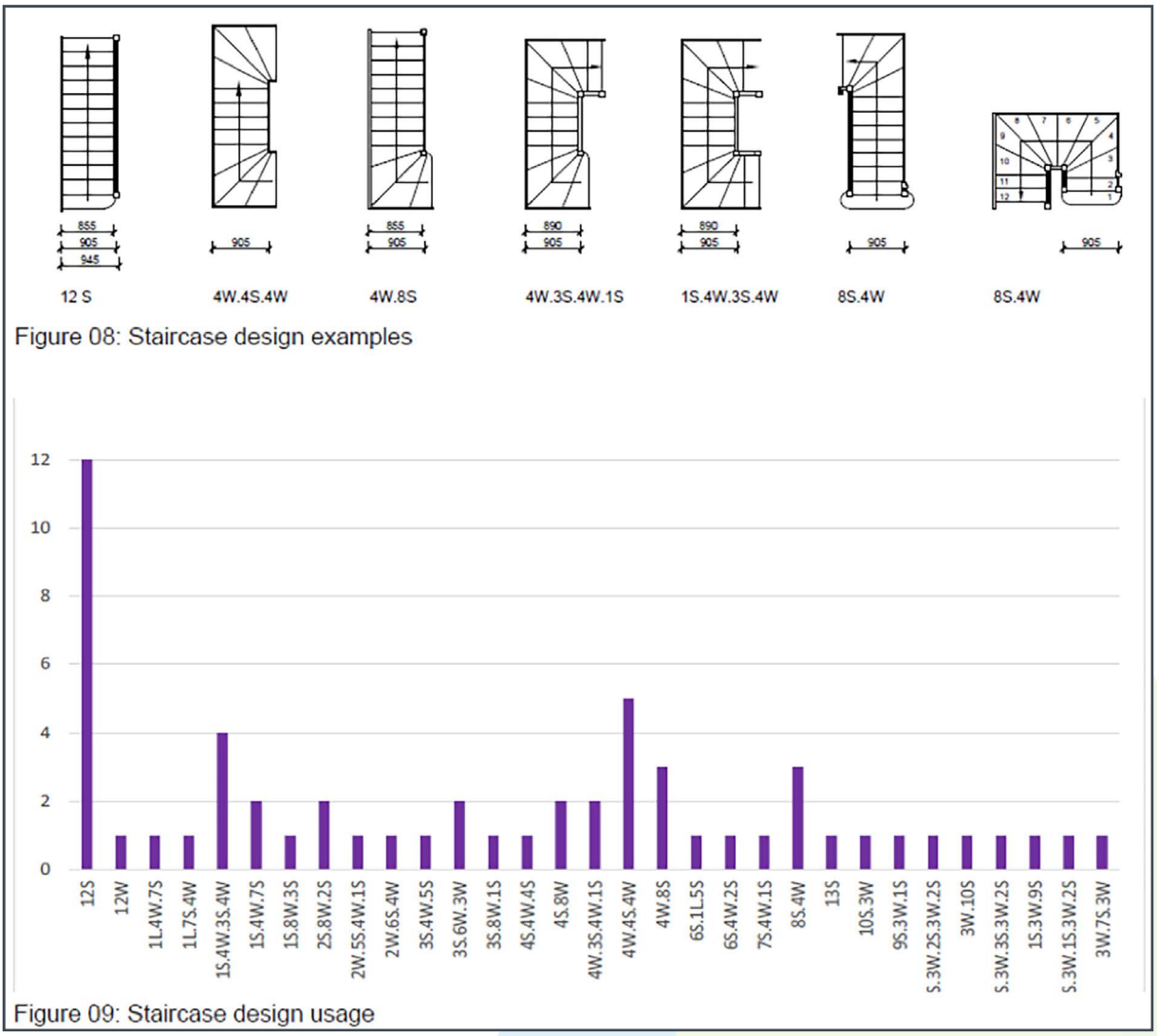
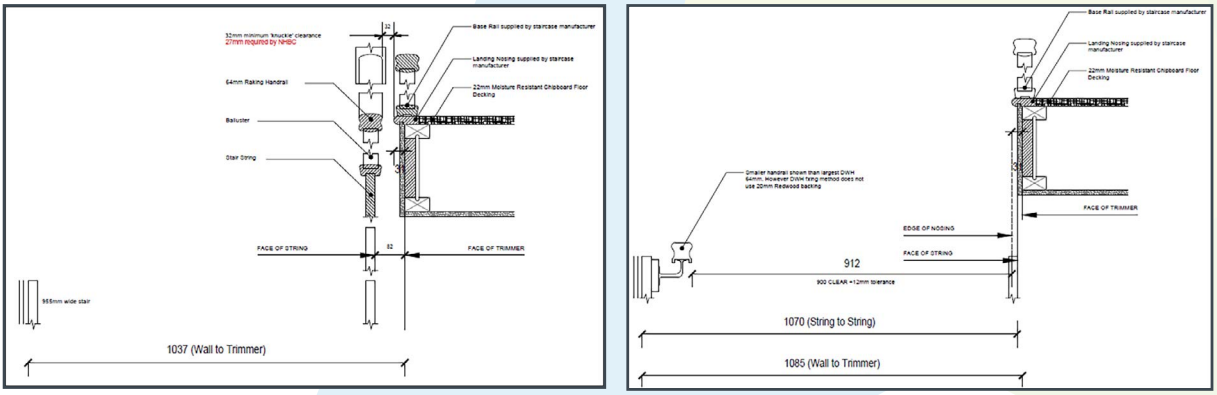


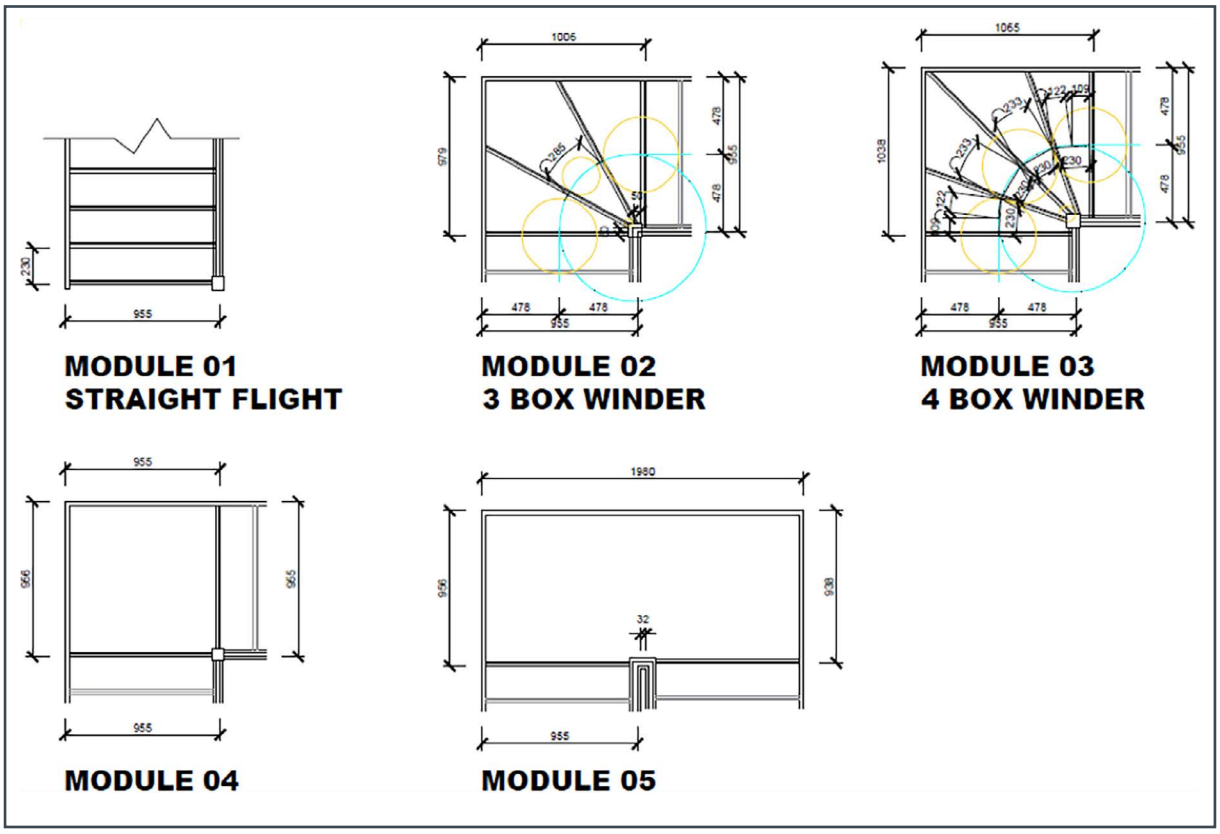
Figure 08: Staircase design examples

Figure 09: Staircase design usage

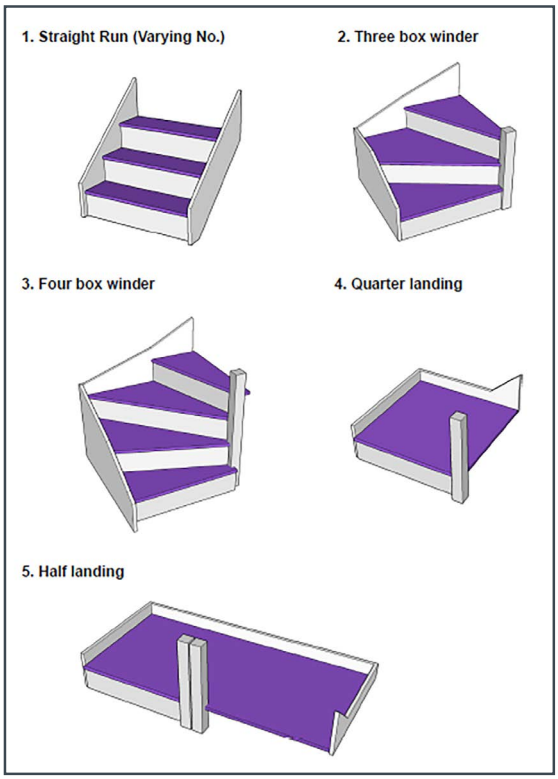
AIMCH Common Staircase Design Configurations and Usage Assessment

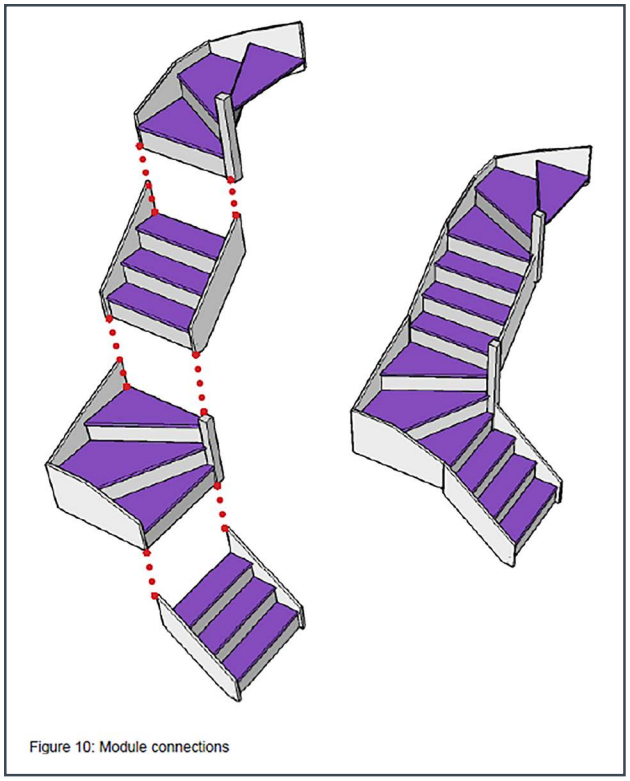


AIMCH Preferred Stair Width Options



AIMCH Modular Staircase & Landing Recommendations





AIMCH Modular Staircase & Landing Recommendations

Recommendations

The work concluded by recommending the opening and floor to floor height dimensions, most readily suitable for standardisation, across the AIMCH developer partners and possibly the wider housing industry.

The study highlighted the potential for a set of modular common stair parts within a staircase design. These could be fabricated as sub-assembly's (product families), to derive a kit of parts solution, that has potential for unilateral adoption across the staircase supply chain and by developers. This in conjunction with a standardised approach to floor to floor height, has potential to yield significant commercial, business and housing delivery benefits.

In addition, through supply chain engagement, further benefits could be realised through optimised stair production, raw material optimisation, handling and protection, with a view to reducing cost, waste and driving further commercial gains. This work is likely to be taken forward with the AIMCH supplier sandpit selection process during 2021.

Wet Room Standardisation Study

This study was undertaken by L&Q Counties, using all three AIMCH developers standard housing information. The study sets out the parameters used to assess the current state of variability within bathroom, en-suites and WC room accommodation.

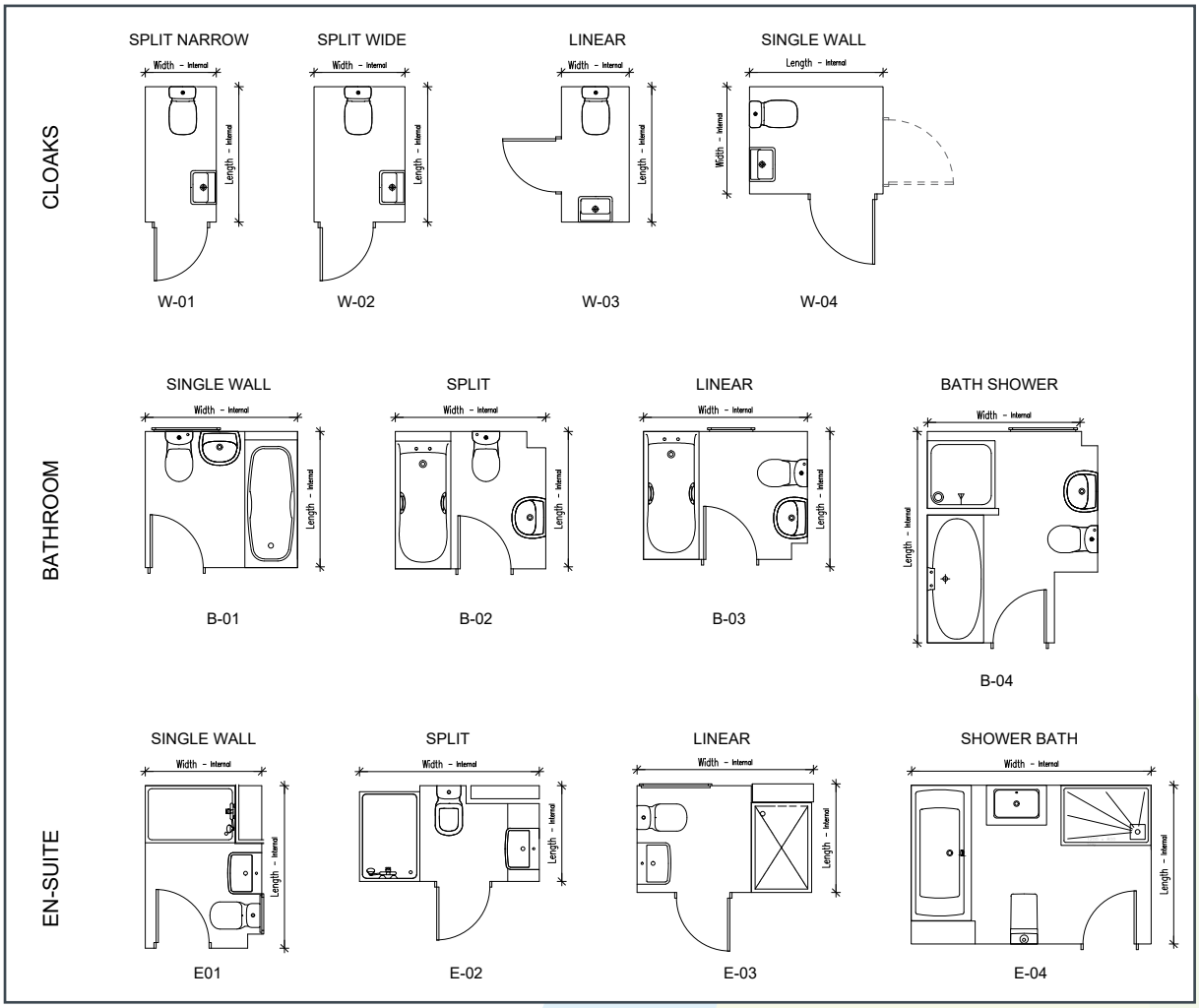
Wet room layouts are driven by internal layouts, spatial requirements, sanitary ware, fitted furniture, developer specifications/finishes and brand preferences, as well as regulatory requirements. The study reviewed the actual wet room layouts, configurations and sizes components, and concluded by investigating the potential for a common set of wet room layouts, that could become prefabricated sub-assemblies, such as volumetric pods for integration with a panellised MMC superstructure, within future housing design and delivery. The study focused on the dimensional setting out, layout configurations and spatial design to allow flexibility in fit out and door orientation.

All the AIMCH developers have a high degree of variation in wet room dimensions, layouts and configurations driven by internal room design and overall house size/efficiency. This is a significant challenge to overcome, however there is strong potential to coalesce around a common range for wet room layouts, configurations and sizes. When considering the future modular construction approach, there will be knock on effects that need to be considered and overcome. For example, additional floor area to cater for one, two and three side pod locations and floor levels to cater for pod base designs, as well as service connections and fire integrity of the main superstructure.

These will require engagement with a supplier to drive cost effective solutions to mitigate these downsides and achieve a cost optimal/neutral outcome. Not with standing the future potential for a hybrid MMC construction system, there is benefit in adopting standard wet rooms for current MMC building practises, whilst building a housing design platform/range that could be converted to volumetric pods sometime in the future.

The study assessed the external regulatory influencing factors that need to be considered, such as the differing building regulations in England & Wales and Scotland and the NHBC technical standards. In addition, the input for the AIMCH developers, technical staff and sanitary suppliers was sought.

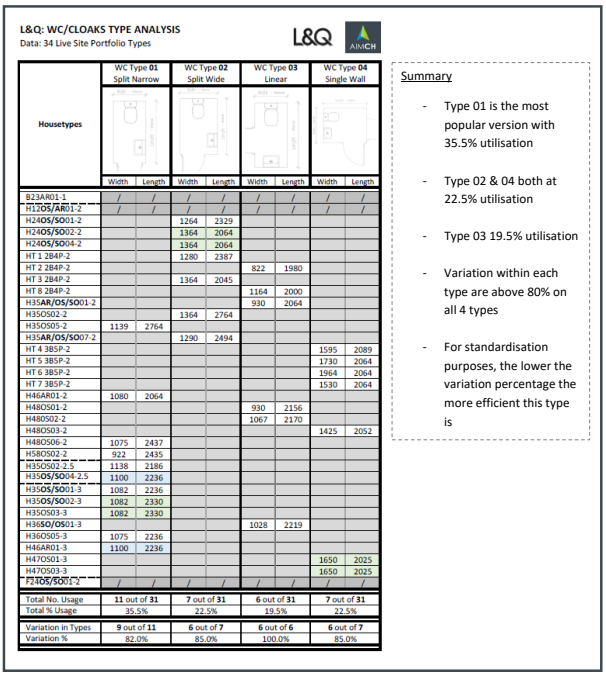
Detailed analysis was undertaken of the wet room sizes, layouts and differing internal fit out specifications and components, adopted within the AIMCH developer housing portfolios. The findings are shown on the charts below.



AIMCH Wet Room Types & Common Configurations

The above provides a generic overview of the common layouts emerging from the study. Following this more detailing studies were undertaken of each developers' layouts and then a harmonisation approach was taken to evaluate the potential derive standardised layouts for bathrooms, en-suites and cloak rooms.

An example of the assessment undertaken for GF cloakroom variation is shown below. This was undertaken for all layouts by developer. These are excluded from this report to reduce repetition and document size.



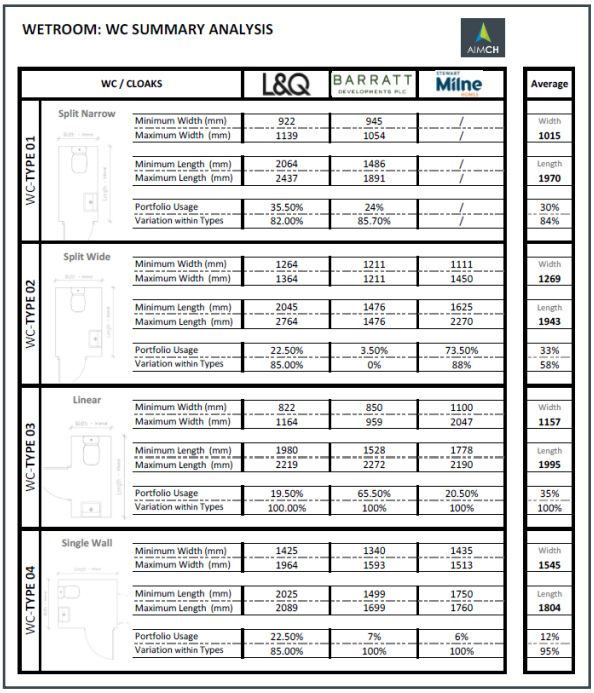
L&Q: WC/CLOAKS TYPE ANALYSIS
Data: 34 Live Site Portfolio Types

Housetypes	WC Type 01 Split Narrow		WC Type 02 Split Wide		WC Type 03 Linear		WC Type 04 Single Wall	
	Width	Length	Width	Length	Width	Length	Width	Length
B23AR01-1	/	/	/	/	/	/	/	/
H12OS/AR01-2	/	/	/	/	/	/	/	/
H24OS/SO01-2			1264	2329				
H24OS/SO02-2			1364	2064				
H24OS/SO04-2			1364	2064				
HT 1 2B4P-2			1280	2387				
HT 2 2B4P-2					822	1980		
HT 3 2B4P-2			1364	2045				
HT 8 2B4P-2					1164	2000		
H35AR/OS/SO01-2					930	2064		
H35OS02-2			1364	2764				
H35OS05-2	1139	2764						
H35AR/OS/SO07-2			1290	2494				
HT 4 3B5P-2							1595	2089
HT 5 3B5P-2							1730	2064
HT 6 3B5P-2							1964	2064
HT 7 3B5P-2							1530	2064
H46AR01-2	1080	2064						
H48OS01-2					930	2156		
H48OS02-2					1067	2170		
H48OS03-2							1425	2052
H48OS06-2	1075	2437						
H58OS02-2	922	2435						
H35OS02-2.5	1138	2186						
H35OS/SO04-2.5	1100	2236						
H35OS/SO01-3	1082	2236						
H35OS/SO02-3	1082	2330						
H35OS03-3	1082	2330						
H36SO/OS01-3					1028	2219		
H36OS05-3	1075	2236						
H46AR01-3	1100	2236						
H47OS01-3							1650	2025
H47OS03-3							1650	2025
H24OS/SO01-2	/	/	/	/	/	/	/	/
Total No. Usage	11 out of 31		7 out of 31		6 out of 31		7 out of 31	
Total % Usage	35.5%		22.5%		19.5%		22.5%	
Variation in Types	9 out of 11		6 out of 7		6 out of 6		6 out of 7	
Variation %	82.0%		85.0%		100.0%		85.0%	

Summary

- Type 01 is the most popular version with 35.5% utilisation
- Type 02 & 04 both at 22.5% utilisation
- Type 03 19.5% utilisation
- Variation within each type are above 80% on all 4 types
- For standardisation purposes, the lower the variation percentage the more efficient this type is

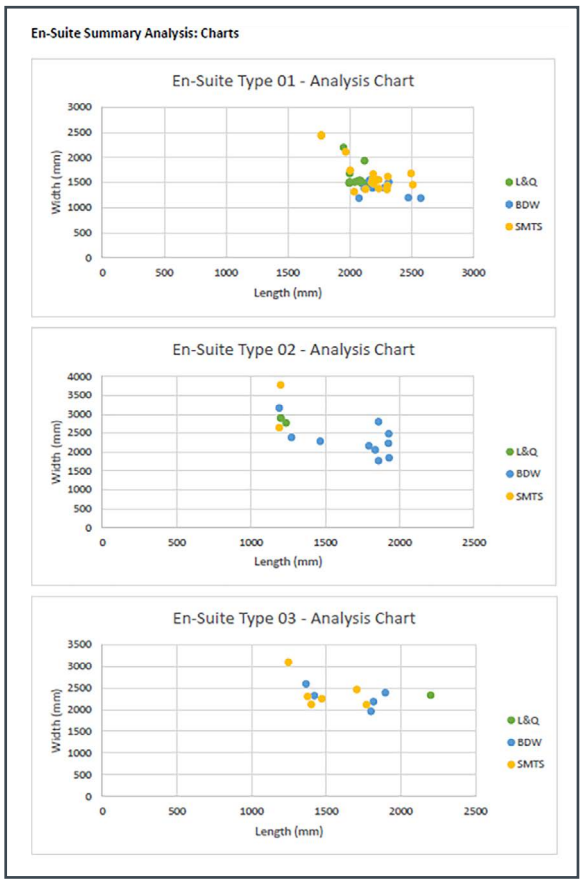
AIMCH Example of WC Room Study (L&Q)



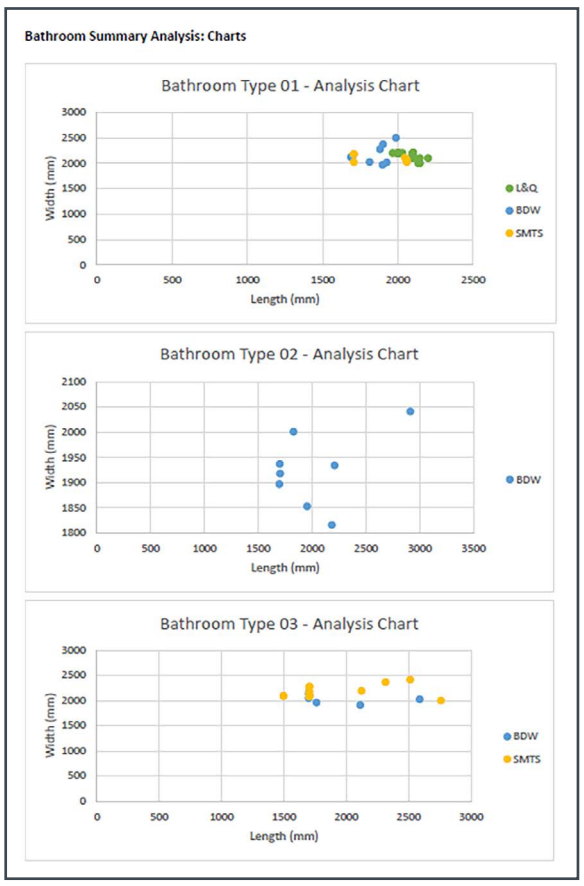
WETROOM: WC SUMMARY ANALYSIS

WC / CLOAKS		L&Q	BARRATT	Milne	Average
WC-TYPE 01 Split Narrow	Minimum Width (mm)	922	945	/	Width 1015
	Maximum Width (mm)	1139	1054	/	
	Minimum Length (mm)	2064	1486	/	Length 1970
	Maximum Length (mm)	2437	1891	/	
	Portfolio Usage	35.50%	24%	/	30%
	Variation within Types	82.00%	85.70%	/	84%
WC-TYPE 02 Split Wide	Minimum Width (mm)	1264	1211	1111	Width 1269
	Maximum Width (mm)	1364	1211	1450	
	Minimum Length (mm)	2045	1476	1625	Length 1943
	Maximum Length (mm)	2764	1476	2270	
	Portfolio Usage	22.50%	3.50%	73.50%	33%
	Variation within Types	85.00%	0%	88%	58%
WC-TYPE 03 Linear	Minimum Width (mm)	822	850	1100	Width 1157
	Maximum Width (mm)	1164	959	2047	
	Minimum Length (mm)	1980	1528	1778	Length 1995
	Maximum Length (mm)	2219	2272	2190	
	Portfolio Usage	19.50%	65.50%	20.50%	35%
	Variation within Types	100.00%	100%	100%	100%
WC-TYPE 04 Single Wall	Minimum Width (mm)	1425	1340	1435	Width 1545
	Maximum Width (mm)	1964	1593	1513	
	Minimum Length (mm)	2025	1499	1750	Length 1804
	Maximum Length (mm)	2089	1699	1760	
	Portfolio Usage	22.50%	7%	6%	12%
	Variation within Types	85.00%	100%	100%	95%

AIMCH Summary of WC Room Study (All AIMCH Developers)



AIMCH Summary of En-suite Room Study



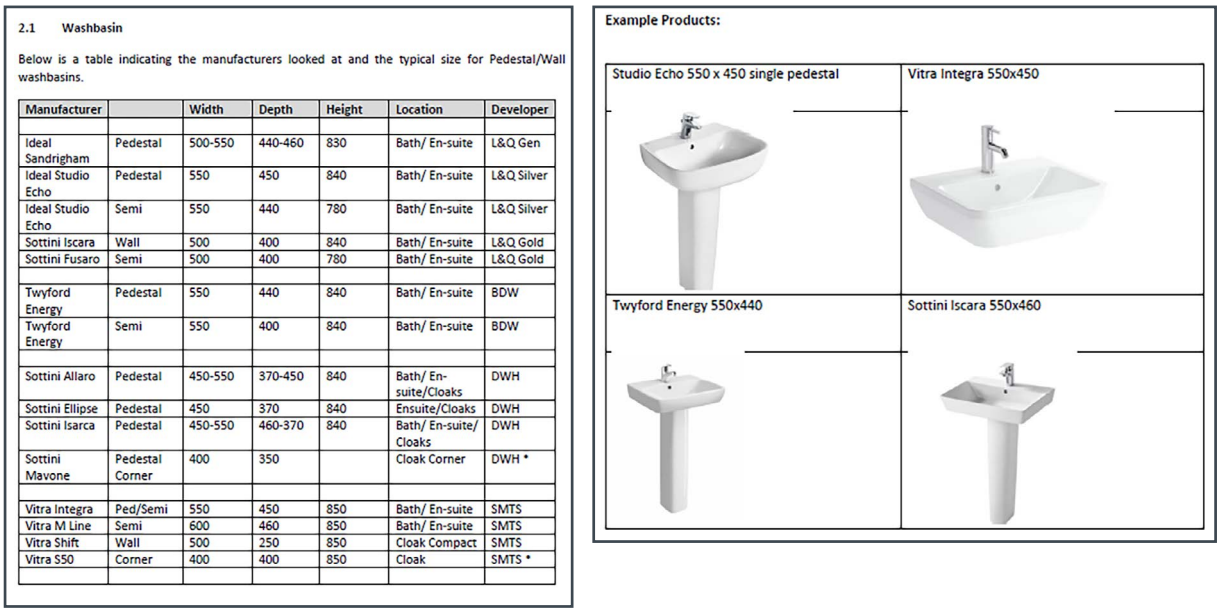
AIMCH Summary of Bathroom Study

The above summary gives us a good indication on the minimum and maximum, width and length within each wet room type and the internal variation within each type. Achieving an average width and length will aid development of layout standardisation. All layouts indicate a high percentage of variation, within a common framework of layouts for each type. This supports the case to standardise.

Following the study of the layout and sizes of the differing wet room layouts, detailed internal analysis was undertaken, investigating the internal sanitary ware and specifications. All wet rooms have the following main components within their layout and design:

- Washbasin
- Bath
- WC
- Shower Trays

The AIMCH developers provided information from there supply chains on these components to allow a detailed assessment to be undertaken, primary focused on setting out sizes and dimensions. The concept being to determine a spatial zone or set of parameters, where interchangeable components can be used, that suit the AIMCH developers preferred supply chains, specifications and brand requirements. An example of this mapping work is shown below:



2.1 Washbasin

Below is a table indicating the manufacturers looked at and the typical size for Pedestal/Wall washbasins.

Manufacturer		Width	Depth	Height	Location	Developer
Ideal Sandrigham	Pedestal	500-550	440-460	830	Bath/ En-suite	L&Q Gen
Ideal Studio Echo	Pedestal	550	450	840	Bath/ En-suite	L&Q Silver
Ideal Studio Echo	Semi	550	440	780	Bath/ En-suite	L&Q Silver
Sottini Iscara	Wall	500	400	840	Bath/ En-suite	L&Q Gold
Sottini Fusaro	Semi	500	400	780	Bath/ En-suite	L&Q Gold
Twyford Energy	Pedestal	550	440	840	Bath/ En-suite	BDW
Twyford Energy	Semi	550	400	840	Bath/ En-suite	BDW
Sottini Allaro	Pedestal	450-550	370-450	840	Bath/ En-suite/Cloaks	DWH
Sottini Ellipse	Pedestal	450	370	840	Ensuite/Cloaks	DWH
Sottini Isarca	Pedestal	450-550	460-370	840	Bath/ En-suite/ Cloaks	DWH
Sottini Mavone	Pedestal Corner	400	350		Cloak Corner	DWH *
Vitra Integra	Ped/Semi	550	450	850	Bath/ En-suite	SMTS
Vitra M Line	Semi	600	460	850	Bath/ En-suite	SMTS
Vitra Shift	Wall	500	250	850	Cloak Compact	SMTS
Vitra S50	Corner	400	400	850	Cloak	SMTS *

Example Products:

Studio Echo 550 x 450 single pedestal

Vitra Integra 550x450

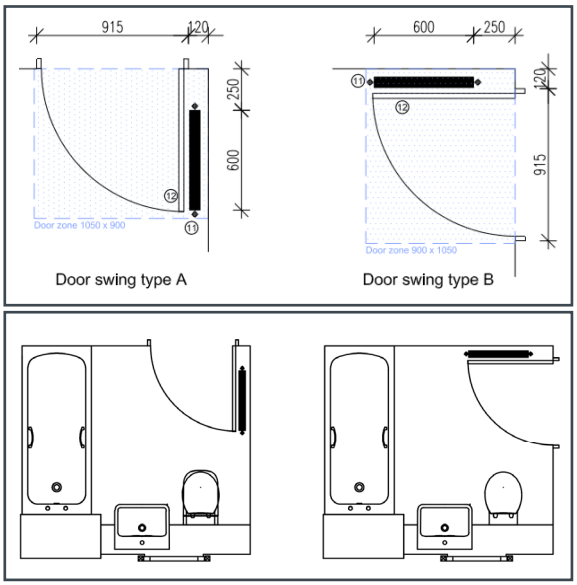
Twyford Energy 550x440

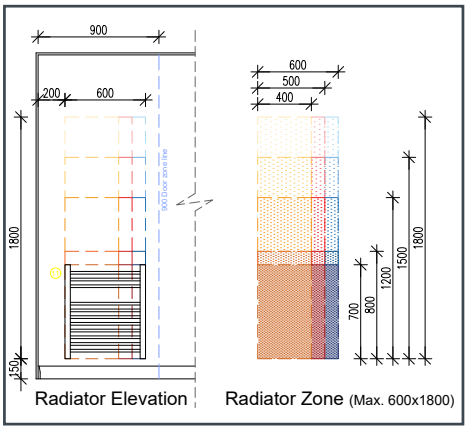
Sottini Iscara 550x460

AIMCH Wet Room Component Analysis - Example

Further analysis was undertaken to derive product usability zones, within the design of each wet room configuration. The study looked at the following zones to ensure the scope for standardisation worked within different design and layout scenarios. An example of this work is shown here:

- Bathroom door zone
- Radiator zone
- WC and WHB and Bath zone
- Shower zone
- Bathroom/En-suite window zones
- Accessibility spaces, building regulations Part M compliance zones
- Services areas and routes





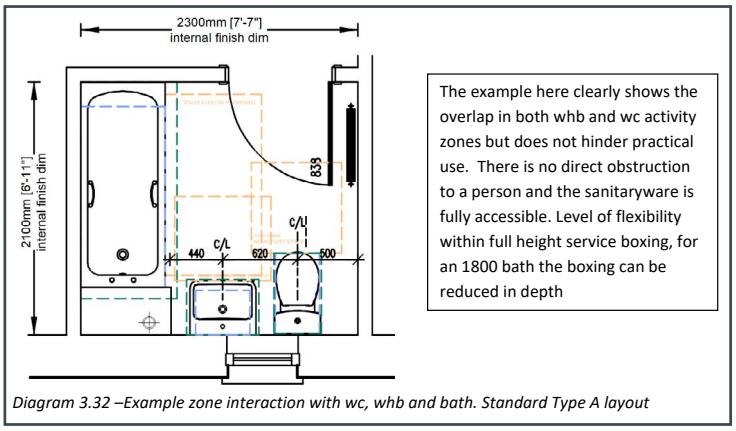


Diagram 3.32 –Example zone interaction with wc, whb and bath. Standard Type A layout

AIMCH Wet Room Product Usability Zones – Door Way & Towel Rail Example

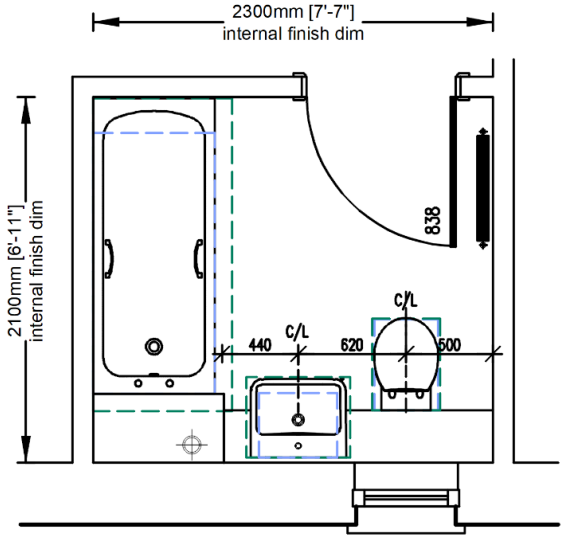
The work culminated in a suite of wet room layouts and configurations. The studies identified 4 common bathroom layouts, 4 common ensuite configurations and 3 common cloakrooms. Cloakroom are less likely to be commercially viable as prefabricated sub-assembly pods, due to the simplicity and cost effectiveness of current conventional construction methods. However, it is considered that bathroom and ensuite pods, have commercial promise, albeit viability and technical challenges remain. These industrialised sub assembly solutions could be adopted in an industrialised housing design in the future. An example of one of the standardised wet room product families derived from this research, for a bathroom is shown below.

5.2 Bathroom

There are 3 proposals for Bathroom design that lend themselves to standardisation. This gathered from current partners data and looked at the most practical designs.

Type A – Single Wall layout.
Type B - Split layout.
Type C – Linear Layout.

The Type A – Single wall layout is recommended for standardisation as it is widely used in the majority of layouts by partners and meets most future-proofing needs.



NOTE: The bathroom layout recommended includes a window position centre of wc. This allows for a mirror/cabinet to be utilised above the whb. Window positions may be dictated by planning or housetype design but for standardisation fixing a window would be preferred.

Diagram 5.21 –**TYPE A Bathroom (2300x2100mm)** AD M4(2) Compliant.

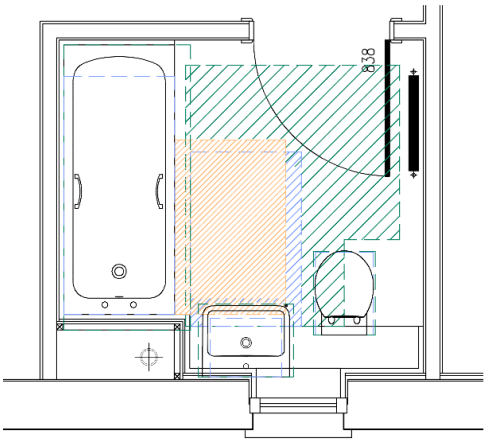
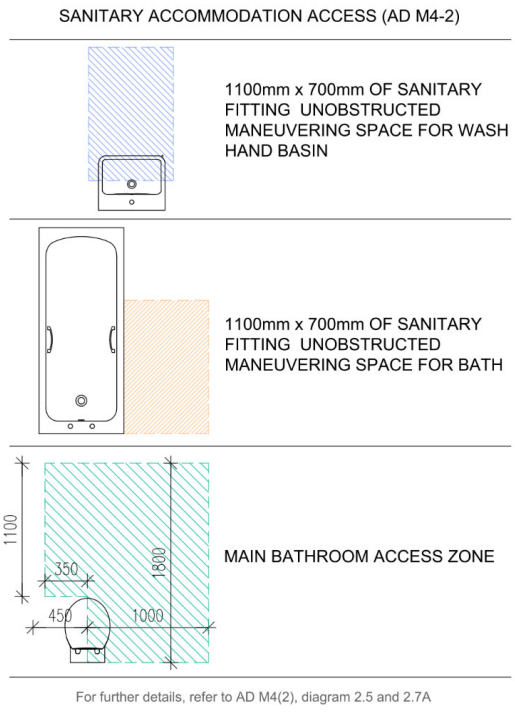


Diagram 5.22 – BATHROOM TYPE A
AD M4(2) Compliance zones



Recommendations

The work concluded by recommending the wet room designs, most readily suitable for standardisation, across the AIMCH developer partners and possibly the wider housing industry.

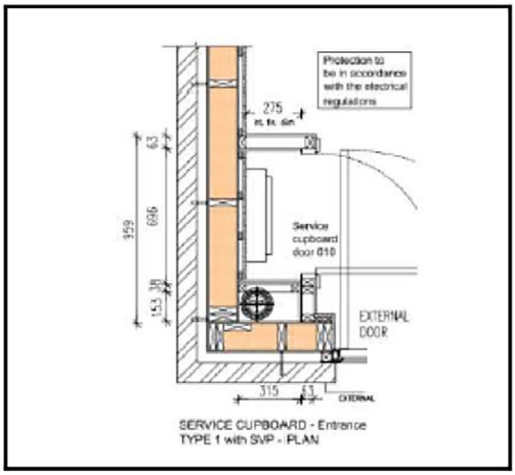
The study highlighted the potential for a set of modular parts (pods) within a wet room design. These could be fabricated as sub-assembly's (product families), to derive a kit of parts solution, that feasibily could be adopted by AIMCH developers. This has potential to yield commercial, business and housing delivery benefits, subject to volumes and technical hurdles being overcome.

In the longer term, through further supply chain engagement, further benefits could be realised through optimised pod production and volume procurement, with a view to reducing cost and driving further commercial gains to achieve a viability tipping point that could drive mainstream update in the housing marketplace. This work will be taken forward within the AIMCH supplier sandpit selection process during 2021.

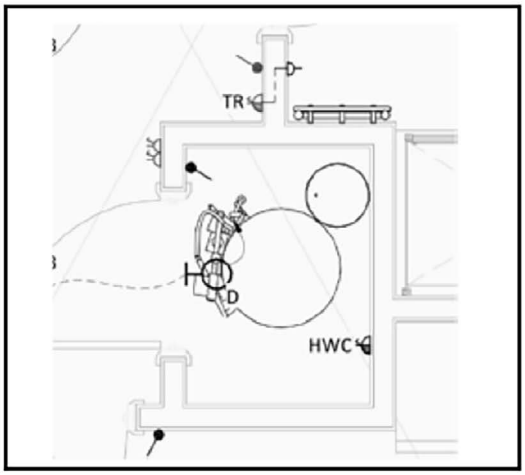
Service Cupboard Standardisation Study

For the purposes of brevity, the detail of the standardisation studies undertaken for service cupboards has been removed from this report. The detailed standardisation report is available and contained within the IUK WP5 evidence pack associated with deliverables and milestone points.

The areas of focus for this study was service cupboards, often located under stars or entrance hallways and hot water storage cupboards, where plumbing and storage vessels are located. A similar approach was undertaken to previous the studies. The studies concluded with recommendations on standardised cupboard spaces and fittings, as well as the potential for pre-fabricated services boards. These could be made offsite and installed as a collective solution, rather than site installed individual standalone service systems i.e. electrics, data, meters, isolators, alarms, broadband.

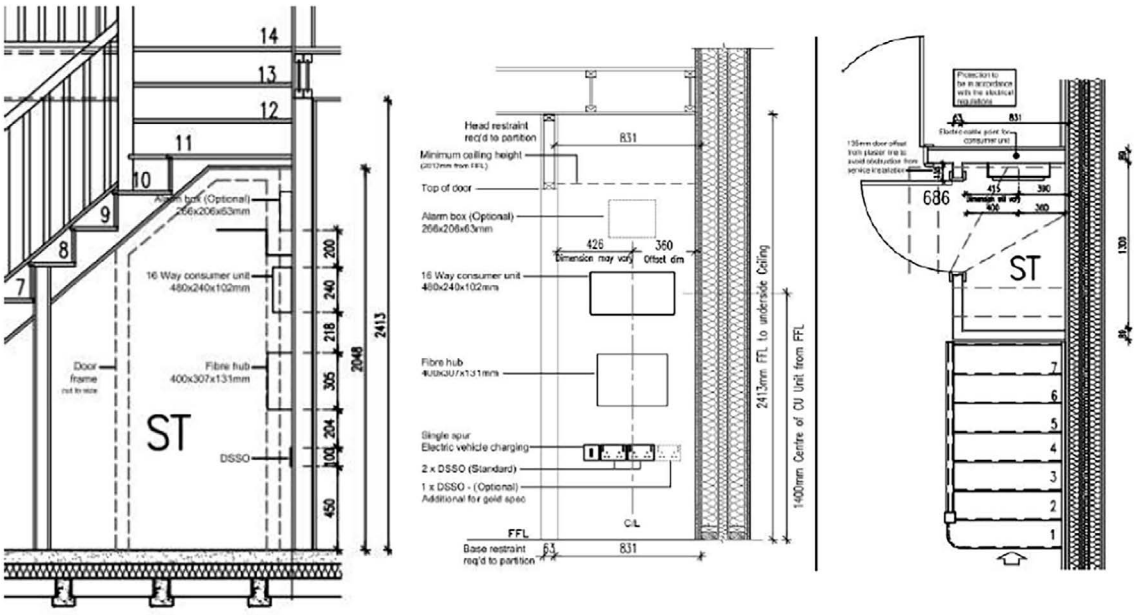


UTILITIES



HOT WATER CYLINDER

Diagram 1.21 Example- Under stairs service cupboard. Straight Flight Staircase.



Next Steps

The information provided from the down selection methodology, detailed standardisation studies and product family recommendations will be used by the AIMCH developers to review current and future housing portfolios.

In addition, within the remaining WP5 deliverables/milestones activities this information will be used to create and inform an AIMCH pattern book of housing designs. This work will pull together the outputs created within WP5, of Product Families, DFMA guide and BIM housing manual. These housing designs will be commercially evaluated within WP8, through detailed desk top commercial analyse the cost effectiveness of this approach and the standardisation solutions created.

To support the desk top commercial evaluations this information will feed into WP6 AIMCH supplier sandpit selection process. This is an innovative call to the supply chain market, seeking suppliers keen to engage and exploit the standardisation considerations evolved from this work package. It is anticipated that suppliers will welcome the opportunity to engage and the potential that could be offered. The sandpit selection process will facilitate further collaboration with preferred suppliers to refine solutions to the next level of detail, overcoming any technical challenges and developing a viability point, attractive to the AIMCH developer partners.

It is hoped that once promising solutions are technically robust and commercially attractive, these will be trialled on live developments/plots with the AIMCH developer partners. Outcomes from trials will be commercially evaluated within WP8 and findings reported.

Standardisation of sub-assemblies and the creation of product families, within housing design, as a mainstream industrialised process, is a significant shift for the AIMCH developers and wider industry. This will take many years to embrace, embed and deliver to the scale, capability and benefits shown by the automotive sector.

However, these innovative collaborative studies, believed to be the first of their kind, show real promise in the potential to embrace standardisation as a positive attribute and not as a perceived negative thing.

AIMCH partners are already seeing business opportunities where this work can be exploited within their businesses. In the case of Stewart Milne Homes, the recommendations have been utilised in the creation on a new housing range for deployment within the business in the next 12-36 months. Similarly, L&Q have adopted the information for the standardisation of their medium-high rise apartments developments, where there is strong potential for offsite manufactured modular bathroom pods, to be commercially viable at scale and beneficial to construction on site.

CSIC, AIMCH research and dissemination partner will use the research and recommendations derived create an information paper. This will be available for free download from the AIMC website www.aimch.co.uk. The website will also have a dedicated web page explaining the down selection process, standardisation studies and product family recommendations, for wider sector benefit, awareness and impact.

summary & conclusions

This sizable work package tackles a subject often discussed but difficult to tangibly realise. The down selection process with MTC leveraging their automotive and manufacturing knowledge, provided a clear way to assess and select standardisation opportunities. The detailed standardisation studies delivered by the AIMCH developer partners in collaboration, is though to the first of their kind, marking a step change in attitude, towards industrialised thinking and working together to solve the challenges of standardisation and deployment of product family solutions.

The standardisation recommendation derived, forms a robust basis to engage the supply chain and to collaboratively drive further benefits, while overcoming remaining any technical and commercial challenges. AIMCH partners are already seeing business opportunities where this work can be exploited within their businesses. Through the creation and exploitation of industrialised housing designs of the future, that embrace standardisation and MMC, yet deliver high quality, functional and appealing homes, AIMCH is fuelling a path to delivering more homes, at an affordable cost.

Stewart Dalgarno

WP11 Lead – Embodied Carbon Assessment of Timber MMC wall Systems.

Appendix 1 - AIMCH Developer Partner Standardisation Studies and Product Family Reports

Note: Information provided in IUK evidence pack Zip folder, as standalone detailed documents

AIMCH_WP5_External Openings Review

Contents

1. Background
2. Report parameters
3. Influencing factors
4. Existing information analysis
5. Windows analysis
6. Window conclusion
7. Door analysis
8. Door conclusion
9. Appendix

1. Background

External openings was one of the 7 areas identified as having the highest potential value for standardisation and product family development. This was achieved by analysing numerous areas of standardisation within typical house types using a weighted matrix with criteria defined by the group to determine elements or areas with the best potential for standardisation. Standardisation of external openings was deemed to have a relatively low difficulty of integration, but high potential build cost saving and little to no impact upon customer perception.

2. Report parameters

To create a sample size suitable enough to draw conclusions, data from three developers and four brands has been used;

Barratt Developments PLC - Barratt Homes 2016 Range (Core range only)
Barratt Developments PLC- David Wilson Homes -7 Range (Core range only)
Stewart Milne Group - Woodlands Range
London & Quadrant - Counties sites

It is understood that developers will all have their own practices with regards to construction types, detailing, external materials etc. For the purposes of this report it has been agreed that all openings will be based on a metric brick external leaf with 10mm mortar joints. Any additional detailing bespoke to a system or external finish would be excluded for the purposes of clarity.

Whilst the initial research will account for all external openings, the focus of this reports is on windows and single leaf doors where standardisation will be most effective. For example openings such as dormer windows, bay windows and pods/light box openings will not be reviewed in detail, as these areas in general are more bespoke and often brand specific.

External openings are subject to a multitude of buildings regulations from ventilation requirements to providing means of escape. Until an opening is located within a building many aspects of these requirements cannot be given due consideration. For example a ventilation requirement for a window will change depending upon the size of the room in which it is located and the number of windows within that given space.

As such, this report will not be able to feasibly give consideration to placement of all openings and their specific scenarios, but looks to provide general guidance where applicable to inform decisions. For example by providing guidance on where robust glazing or protection is likely to be required in line with building regulations Part K.

In the same vein specific styles or fenestrations of windows are not referred to. Different styles of window whether mock sash or casement for example can impact both on regulatory requirements i.e for means of escape but also help to create a sense of brand identity amongst developers. It would therefore not be feasible to standardise this aspect. Similarly it is understood that planning restrictions can commonly negate standardisation.

For avoidance of doubt regulations referred to will be will be in reference to private residential dwellings and not communal or non-residential buildings.

Report 1 – External Openings (BDW)

AIMCH_WP5_Staircase

Contents

1. Background
2. Report parameters
3. Regulation review and standardisation
4. Influencing factors
5. Existing data analysis
6. Proposals
7. Appendix

1. Background

Staircases were identified as one of the 7 areas having the highest potential value for standardisation and product family development. This was achieved by analysing numerous areas of standardisation within typical house types using a weighted matrix with criteria defined by the group to determine elements or areas with the best potential for standardisation. Standardisation of staircases was deemed to have a relatively low difficulty of integration but with a high potential impact upon efficiency and little to no impact upon customer perception.

2. Report parameters

To create a sample size suitable enough to draw conclusions, data from three developers and four brands was used;

Barratt Developments PLC - Barratt Homes 2016 Range (Core range only)
Barratt Developments PLC- David Wilson Homes -7 Range (Core range only)
Stewart Milne Group - Woodlands Range
London & Quadrant - Counties sites

3. Regulation review and standardisation

There are multiple factors that can have an affect upon the output of this section of work package 5. The following identifies some of the key areas that have been given consideration. Please note this list is not exhaustive and relates only to a hypothetical and theoretical scenarios only and does not account for any external or surrounding context. For example, this report does not account for scenarios such as if the stair is to be used within a fire protected lobby or if for example a developer utilises the underside of stairs for storage.

3.1 Regulatory requirements

Building regulations (England & Wales)
- Part B
- Part K
- Part M

Building regulations (Scotland)
- Technical handbook 2019

NHBC Standards 2020

Specific areas of relevance will be referred to where appropriate but surrounding context knowledge will be assumed in order to keep this report concise.

01

Report 2 – Staircases (BDW)

L&Q

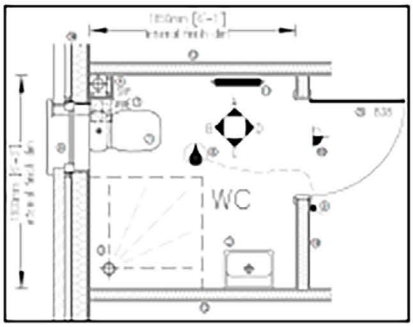
AIMCH

Report by: **L&Q**

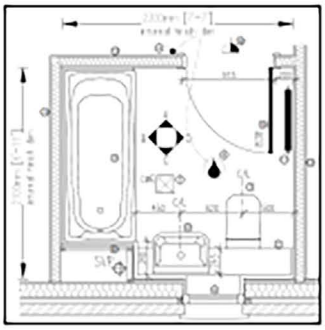
Project: **AIMCH – WP5**

Date: **September 2020**

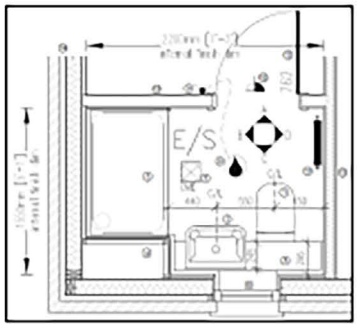
Wet Room Layout Standardisation



CLOAKS



BATHROOM



EN-SUITE

Rev B

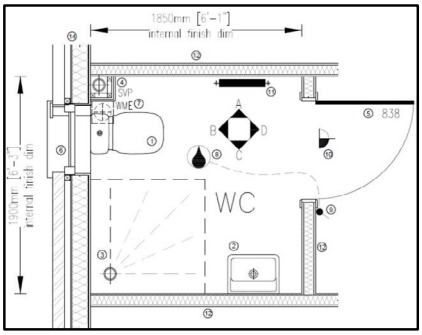
Report 3 – Wet Rooms (L&Q)

Report by: **L&Q**

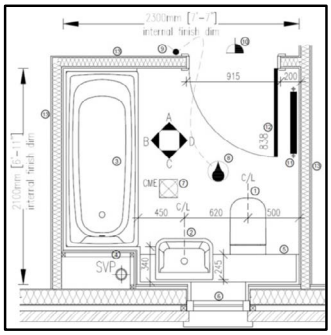
Project: **AIMCH – WP5**

Date: **September 2020**

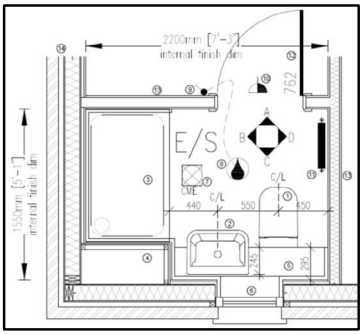
Wet Room Layout Standardisation



CLOAKS

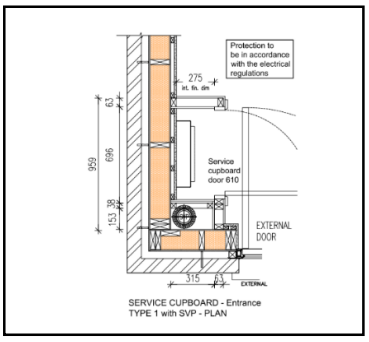


BATHROOM

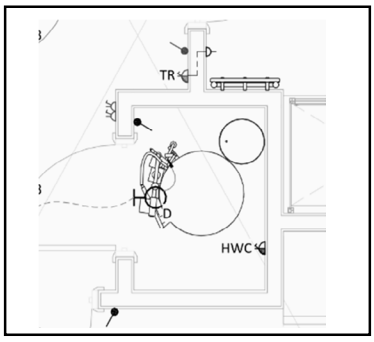


EN-SUITE

Service Cupboards Standardisation



UTILITIES

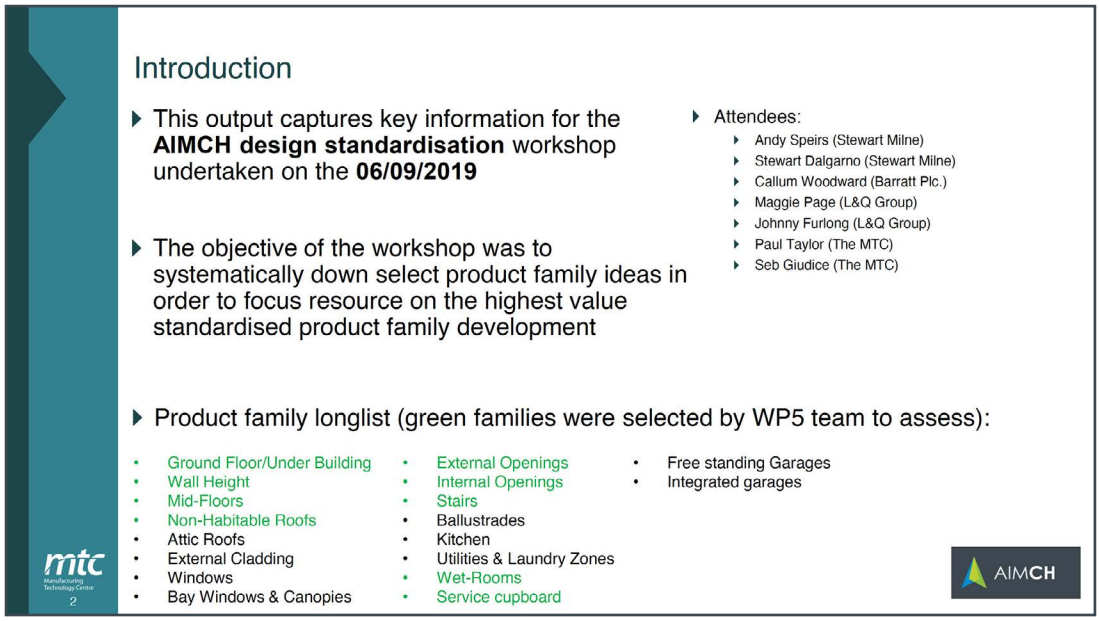


HOT WATER CYLINDER

Appendix 2 - Presentations

Housing Standardisation - Mobilisation Workshop 6/9/19 @ MTC

Output – A methodology for the assessment of housing standardisation opportunities, a means to score and rank these, to allow focus of detailed effort/resources, on areas of greatest standardisation benefit.



Contents

- **Criteria Definitions**

  Definitions of the criteria the WP5 AIMCH team used to compare product families. Also in this section is criteria weighting

- **Standardisation Down Selection**

  Output of the down selection, showing a priority list of product families to be standardised

- **Graph of standardised scoring**

  Graphical representation of the scoring for the product families

- **Descriptions of standardised products**

  1 Page capture forms of the concept standardised product that was used for scoring

mtc Manufacturing Technology Centre

3

AIMCH

Minimum/Maximum Criteria Descriptions: Criteria to be weighted on a sliding scale from 1→ 5

mtc Manufacturing Technology Centre

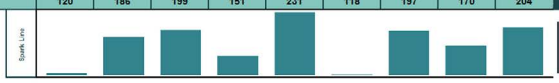
Criteria	Criteria Descriptions	
	1 (Sliding Scale)	5
customer visibility	Product is visible to customer and customer will be negatively impacted by standardising of product	Product is practically invisible to customer; any design for standardisation changes will not affect customer
other component dependencies	Product design is heavily dependant on interfacing products; difficult to standardise	Product design is independent of interfacing products; no barriers to standardisation
estimated build cost saving	Standardising the product will provide no financial gain/incur greater costs to the business	standardising the product will result in substaintial cost savings
extent of mandated design limits	many design limits are in place which restirct the extent of possible design changes	the product has little/no constraints from mandated design limits
Maintenance/ replacement regime	The product will not be repaired/replaced during the enitre lifespan of the house	The product is expected to need repair/replacment and/or service
availability of common suppliers and materials	the standradised design requires unique materials to other products which can only be sourced from a single supplier	the standardised design uses materials used by other products which can be sourced from multiple different suppliers
commonality of parts/interface of parts	It would not be possible to standardise the interface or include any parts common to toher products	the product could be easily standardised to include both common interfaces and parts
Ease of integration method	Introducing the standardised design would require substantial changes to the business, such as new software, machines and supplier network	the proposed standardised design could be introduced with minimal effort
frequency of component use	the product is used 1 in every 10 houses	This product is used at least twice in every house
commonality of product across developers	most developers have their own unique design for this product which is deemed as a USP	most developers do not consider this product to be a partuclar USP of their business
Safety improvement in build and use	the standardised design would incur more risk associated with the production or assembly	a substantial increase in safety could be achieved by the standardised design
Quality Assurance/assurance of assembly/fool proofing / skills dependency	in build quality is not improved by the standardised design	the standardised design will be manufactured with build in quality in mind, removing quality issues and non conformity
Build certainty (program timescales)	the standardised product would be at risk of delayed delivery	the standardised design could be guaranteed to be delivered on time more consistently than the original range of products

The criteria weighting ensures important criteria is scored as a priority for the team

Standardisation Down Selection

mtc Manufacturing Technology Centre

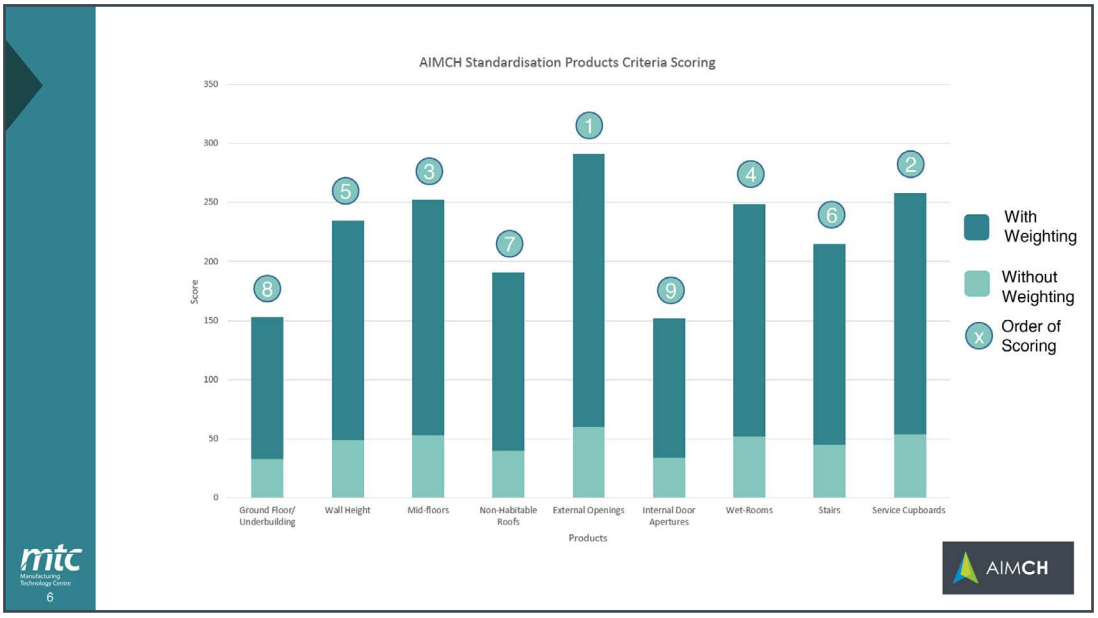
Criteria	Weight (0-5)	Team scoring of families								
		Ground Floor/ Underbuilding	Wall Height	Mid-floorz	Non-Habitable Roofs	External Openings	Internal Door Apertures	Wet-Rooms	Stairz	Service Cupboards
customer visibility	2	5	5	4	5	5	5	5	5	5
other component dependencies	4	1	4	1	3	2	1	1	2	4
estimated build cost saving	4	3	4	5	2	4	1	4	3	5
extent of mandated design limits	5	1	4	3	2	5	1	5	4	4
Maintenance/ replacement regime	4	1	2	4	1	5	5	5	1	5
availability of common suppliers and materials	3	1	5	5	1	5	5	5	4	3
commonality of parts/interface of parts	4	2	5	5	5	5	2	4	1	4
Ease of integration method	5	1	3	2	3	5	1	2	5	2
frequency of component use	4	2	5	5	5	5	5	4	2	2
commonality of product across developers	3	4	5	5	5	5	5	5	5	5
Safety improvement in build and use	3	3	1	5	1	4	1	3	5	5
Quality Assurance/assurance of assembly/fool proofing / skills dependency	5	4	4	5	3	5	1	5	5	5
Build certainty (program timescales)	4	5	2	4	4	5	1	4	3	5
Total number:		33	49	53	40	60	34	52	45	54
With Weighting:		120	186	199	151	231	118	197	170	204

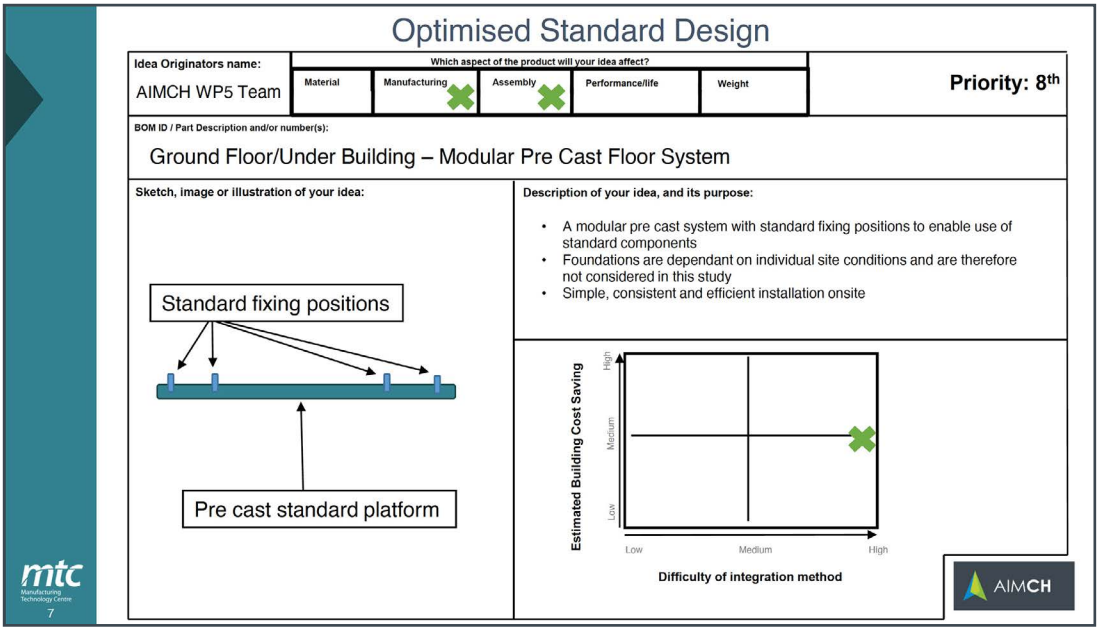


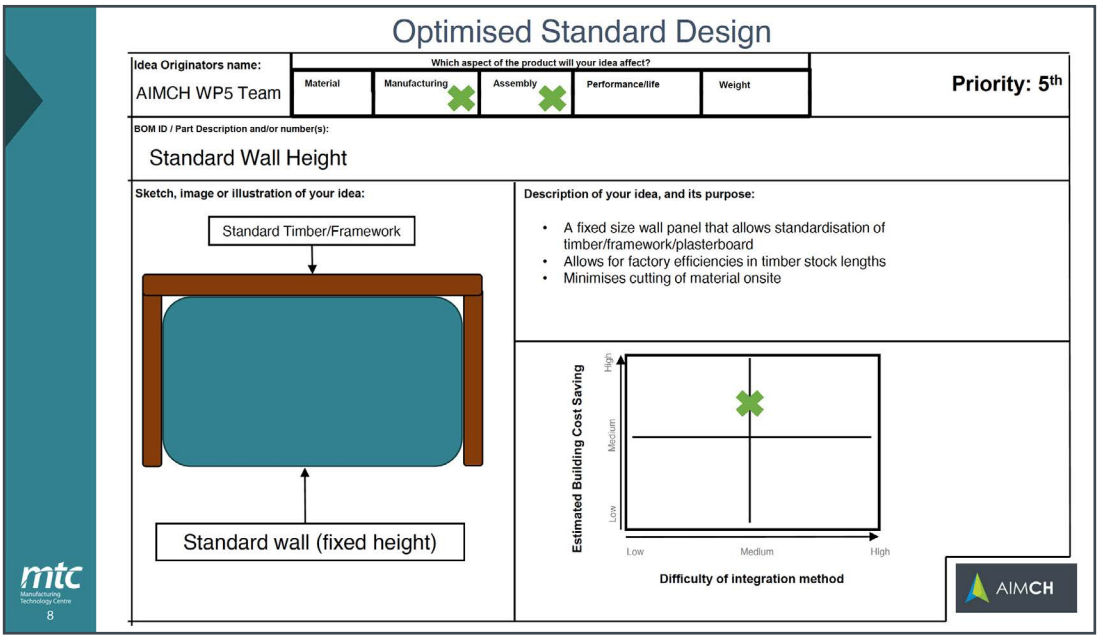
mtc Manufacturing Technology Centre

5

AIMCH


AIMCH Standardisation Products Criteria Scoring
Score
350
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
Ground Floor/ Underbuilding
Wall Height
Mid-floors
Non-Habitable Roofs
External Openings
Internal Door Apertures
Wet-Rooms
Stairs
Service Cupboards
Products
With Weighting
Without Weighting
Order of Scoring
mtc
Manufacturing Technology Centre
6
AIMCH


Optimised Standard Design
Idea Originators name:
AIMCH WP5 Team
Which aspect of the product will your idea affect?
Material
Manufacturing
Assembly
Performance/life
Weight
Priority: 8th
BOM ID / Part Description and/or number(s):
Ground Floor/Under Building – Modular Pre Cast Floor System
Sketch, image or illustration of your idea:
Standard fixing positions
Pre cast standard platform
Description of your idea, and its purpose:
A modular pre cast system with standard fixing positions to enable use of standard components
Foundations are dependant on individual site conditions and are therefore not considered in this study
Simple, consistent and efficient installation onsite
Estimated Building Cost Saving
High
Medium
Low
Low
Medium
High
Difficulty of integration method
mtc
Manufacturing Technology Centre
7
AIMCH


Optimised Standard Design
Idea Originators name:
AIMCH WP5 Team
Which aspect of the product will your idea affect?
Material
Manufacturing
Assembly
Performance/life
Weight
Priority: 5th
BOM ID / Part Description and/or number(s):
Standard Wall Height
Sketch, image or illustration of your idea:
Standard Timber/Framework
Standard wall (fixed height)
Description of your idea, and its purpose:
A fixed size wall panel that allows standardisation of timber/framework/plasterboard
Allows for factory efficiencies in timber stock lengths
Minimises cutting of material onsite
Estimated Building Cost Saving
High
Medium
Low
Low
Medium
High
Difficulty of integration method
mtc
Manufacturing Technology Centre
8
AIMCH

Optimised Standard Design

Idea Originators name: AIMCH WP5 Team

Which aspect of the product will your idea affect?

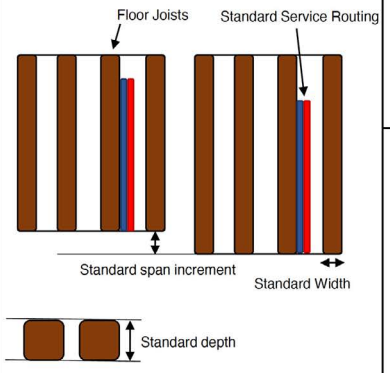
Material	Manufacturing	Assembly	Performance/life	Weight
	✖	✖		

Priority: 3rd

BOM ID / Part Description and/or number(s):

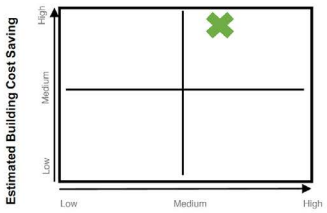
Standard Mid Floors

Sketch, image or illustration of your idea:



Description of your idea, and its purpose:

- Standard Joist Depth
- Standard Width
- Standard Increments of joist length (span)
- Standard routing of services/service zones



AIMCH

mtc Manufacturing Technology Centre 9

Optimised Standard Design

Idea Originators name: AIMCH WP5 Team

Which aspect of the product will your idea affect?

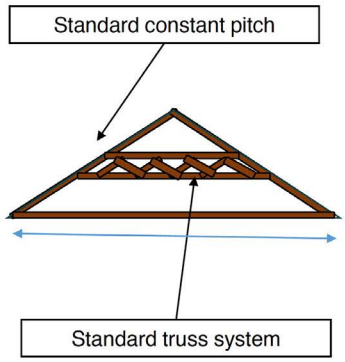
Material	Manufacturing	Assembly	Performance/life	Weight
	✖	✖		

Priority: 7th

BOM ID / Part Description and/or number(s):

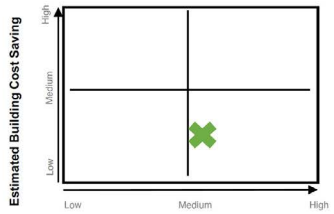
Non Habitable Roof

Sketch, image or illustration of your idea:



Description of your idea, and its purpose:

- Standard constant pitch
- Standard Truss system
- Standard span of roof system
- Standard eaves overhang (allows use of standard fascia board and soffit components)
- Allows for factory efficiency in manufacture



AIMCH

mtc Manufacturing Technology Centre 10

Optimised Standard Design

Idea Originators name: AIMCH WP5 Team

Which aspect of the product will your idea affect?

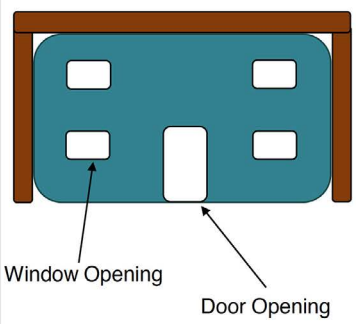
Material	Manufacturing	Assembly	Performance/life	Weight
	✖	✖		

Priority: 1st

BOM ID / Part Description and/or number(s):

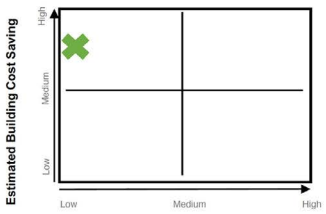
Standard External Openings

Sketch, image or illustration of your idea:



Description of your idea, and its purpose:

- Standard aperture sizes for windows and doors and kit panel
- Standard window modules for production
- Standard door modules for production



AIMCH

mtc Manufacturing Technology Centre 11

Optimised Standard Design

Idea Originators name: AIMCH WP5 Team

Which aspect of the product will your idea affect?

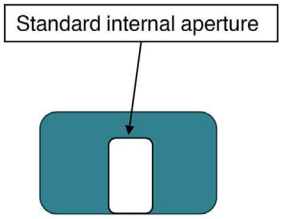
Material	Manufacturing	Assembly	Performance/life	Weight
	✖	✖		

Priority: 9th

BOM ID / Part Description and/or number(s):

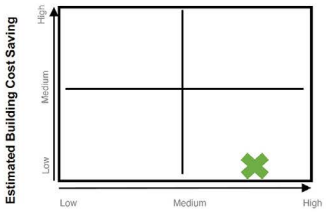
Standard Internal Door size

Sketch, image or illustration of your idea:



Description of your idea, and its purpose:

- Standard aperture sizes for internal doors
- Standard size door sets
- Flexibility for different wall thicknesses



mtc Manufacturing Technology Centre 12

AIMCH

Optimised Standard Design

Idea Originators name: AIMCH WP5 Team

Which aspect of the product will your idea affect?

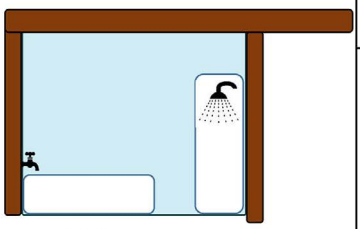
Material	Manufacturing	Assembly	Performance/life	Weight
	✖	✖		

Priority: 4th

BOM ID / Part Description and/or number(s):

Wet Room Pod

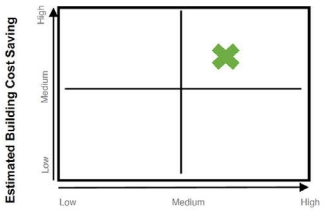
Sketch, image or illustration of your idea:



Bath,
shower, wc

Description of your idea, and its purpose:

- Wet room modular pod (Bath, WC, shower etc.)
- Standard size
- Easy maintenance routine
- Standard interface for parts (e.g. shower, toilet)



mtc Manufacturing Technology Centre 13

AIMCH

Optimised Standard Design

Idea Originators name: AIMCH WP5 Team

Which aspect of the product will your idea affect?

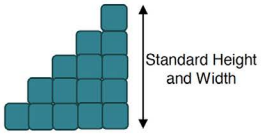
Material	Manufacturing	Assembly	Performance/life	Weight
	✖	✖		

Priority: 6th

BOM ID / Part Description and/or number(s):

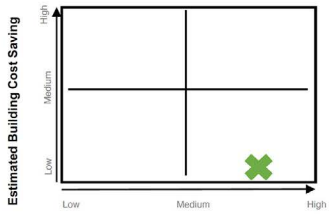
Standard Stairs

Sketch, image or illustration of your idea:



Description of your idea, and its purpose:

- Allows for Standard dimension over the stair flight (overall stair width
- Standard half and full winder configurations
- Would allow for standard factory components
- Standard floor to floor size
- Allows consistent/standard method of installation onsite



mtc Manufacturing Technology Centre

AIMCH

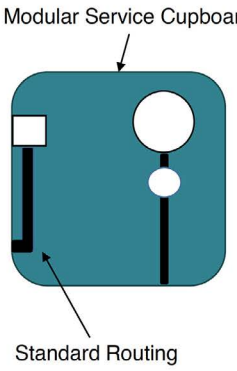
Optimised Standard Design

Idea Originators name:	Which aspect of the product will your idea affect?					
AIMCH WP5 Team	Material	Manufacturing ✖	Assembly ✖	Performance/life	Weight	**Priority: 2nd**

BOM ID / Part Description and/or number(s):

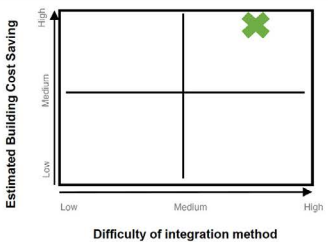
Service Cupboards

Sketch, image or illustration of your idea:



Description of your idea, and its purpose:

- Modular Service Cupboard
- Option to pre assemble standard components
- Improvement for quality, onsite installation and testing



mtc Manufacturing Technology Centre 15

AIMCH

Conclusions

- Criteria was **reviewed**, **weighted**, **assessed** and used for **down selection** scoring
- The team were given a long list of 15 components, discounting 6 components as not being applicable for AIMCH WP5
- Therefore 9 product families were compared and scored relative to each other
- The standardised concepts were captured in this output
- The WP5 team have agreed to take 7 components (to be agreed) forward to develop into a standardised product

mtc Manufacturing Technology Centre 16

AIMCH

Housing Standardisation - Final Summary Presentation – Presented QRM6 – 19/11/20

WP5 Design Standardization QRM7 Progress : Design Standardization Studies

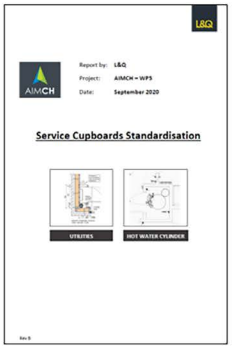
- Deliverable (D5.2) 4 x Standardization Reports – Completed (each 20-30 pages)
- Current state assessment – Significant level of variation that exists
- Future state assessment - Standard product family recommendations
- Consolidate and format into IUK Milestone Documentation (M5.2) – end of Nov 20, due 24/12/20

- Contents to be AIMCH branded and formatted, suitable for AIMCH website CASE STUDY download – Jan 2021

Report 1 – External Openings

Report 2 - Staircases

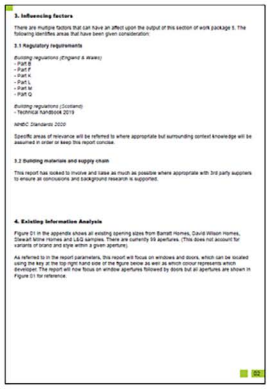
Report 3 – Wet Rooms



Report 4 - Service Areas

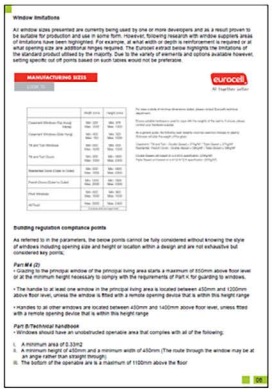
1 @AIMCH2 aimch aimch.co.uk INDUSTRIAL STRATEGY UK Research and Innovation

WP5 Design Standardization QRM7 Progress : Product Families – External Openings

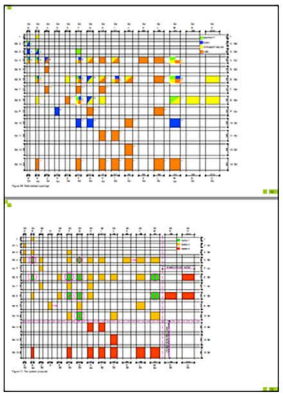


Influencing Factors

Detailed Analysis & Mapping



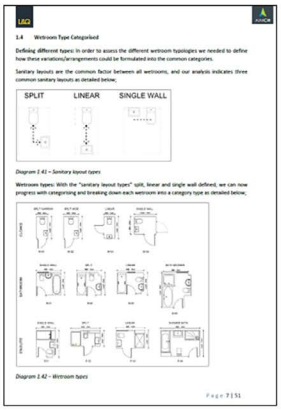
Supplier Engagement



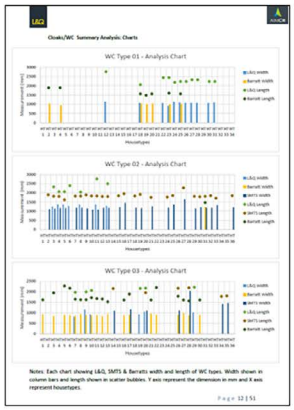
Standardized openings proposals

2 @AIMCH2 aimch aimch.co.uk INDUSTRIAL STRATEGY UK Research and Innovation

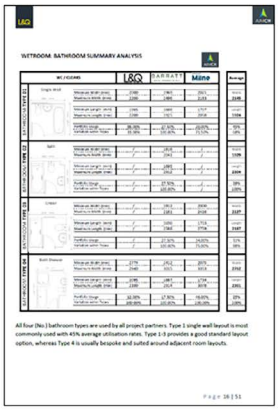
WP5 Design Standardization QRM7 Progress : Product Families – Wet Rooms



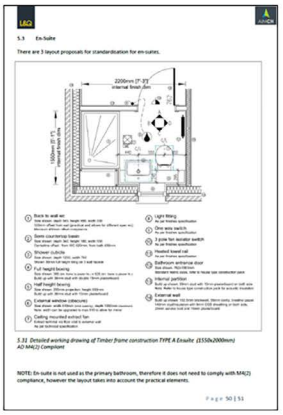
Common Themes



Detail Analysis - Developer house types



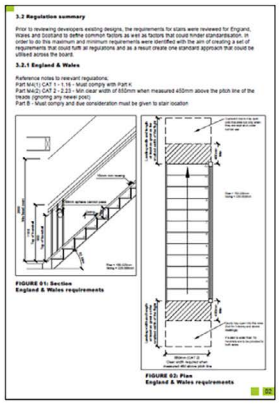
Consolidation & Commonality



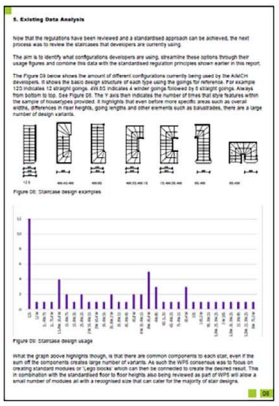
Standardized Solution

3 @AIMCH2 aimch aimch.co.uk INDUSTRIAL STRATEGY UK Research and Innovation

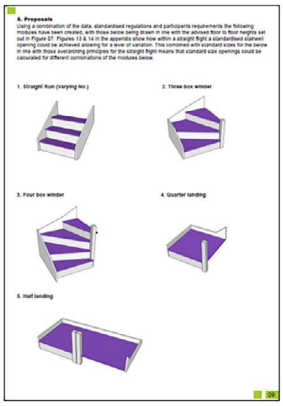
WP5 Design Standardization QRM7 Progress : Product Families - Stairs



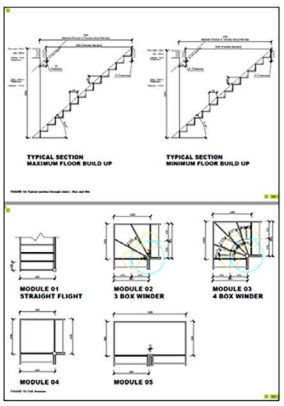
Regulatory review & needs



Detailed Analysis

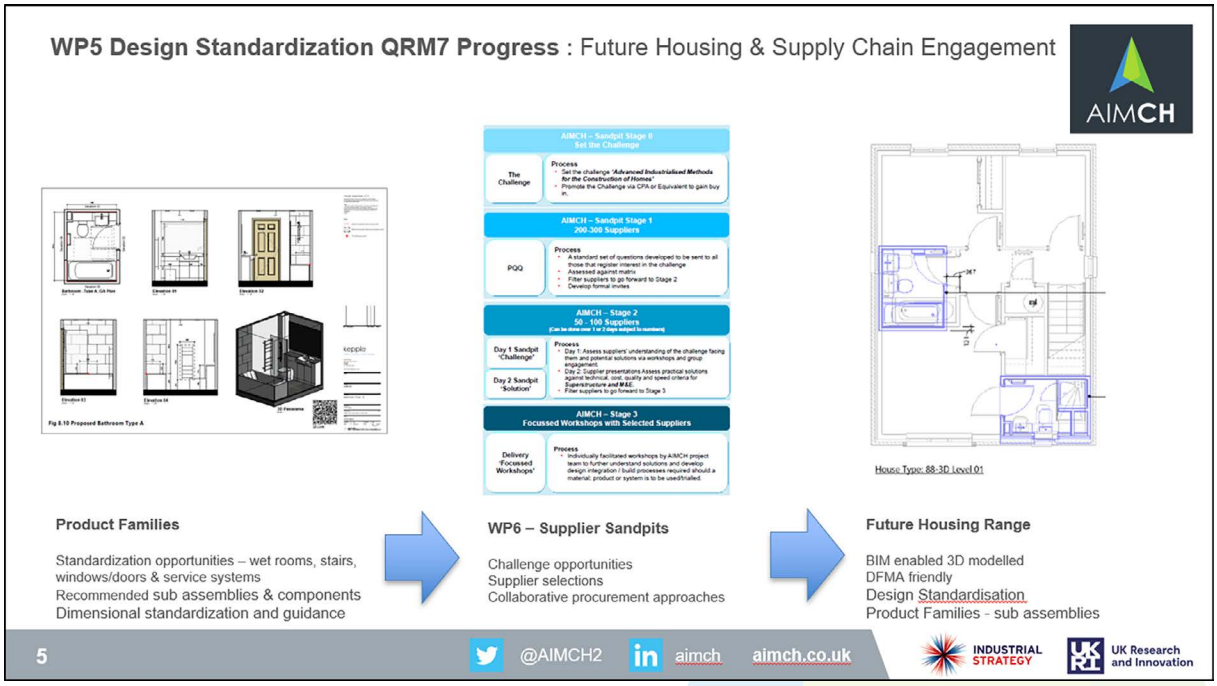


Standardized sub-assembly proposals



Standardized configurations

4 @AIMCH2 aimch aimch.co.uk INDUSTRIAL STRATEGY UK Research and Innovation



This report is part of the AIMCH project which is developing all areas of modern methods of construction in housebuilding. For more information on the full scope and outputs of the project visit aimch.co.uk and follow us on LinkedIn and Twitter.

AIMCH

TRANSFORMING
HOW WE BUILD HOMES

mtc Manufacturing Technology Centre

L&Q

Construction Scotland Innovation Centre

Forster Group

Stewart Milne Group

Barratt Developments PLC Building Excellence Since 1958

Industrial Strategy

UK Research and Innovation

@AIMCH2

aimch

aimch@cs-ic.org

www.aimch.co.uk