Rialtas na hÉireann
Government of Ireland

Residential Construction Cost Study Report

May 2023

A Shared Government and Construction Sector Group Initiative
www.gov.ie

Table of Contents

Minister’s Foreword

Our national strategy, Housing for All, commits that the housing system needs to be placed on a long-term economically sustainable footing. Thankfully, supply - key to addressing Ireland’s housing needs - is increasing and Housing for All is having a real impact. More homes are being built and bought than in a generation.

In 2022 we saw the most number of homes delivered since 2008 (up 45.2% on 2021) and we’ve recently seen record completion and commencement figures for a first quarter since the current data series began. The Government is making record State investment available for housing, with €4.5 billion committed in 2023.

To ensure we build on this kind of momentum into the longer term, it is important that we deliver the right homes, in the right places, at the right price.

In some cases, a gap exists between the construction cost and the market price of housing. This gap is making the delivery of homes economically unviable in certain key areas. While Government have introduced immediate initiatives to help bridge the viability gap and activate supply we do need a more long-term approach. Costs associated with residential construction remain high. These need to be tackled to enable a functioning housing market, particularly for apartment construction.

Action 19.1 of Housing for All Update committed to conduct an analysis of each component of the cost of construction of house and apartment development, informed by cost comparisons with comparable EU countries. This study, is a shared Construction Sector Group and Government initiative, facilitated by the Department of Housing, Local Government and Heritage. It supports actions to implement reductions in residential construction cost and increased standardisation.

In residential development, actual construction costs account for approximately 50% of total development costs. This study is focused on the actual construction costs only and acknowledges work already done, and further work to be done, in examining the other 50% of development costs. This review of total development costs is identified as an action from the study.

The actions in the report complement a range of other initiatives in Housing for All to help achieve economic sustainability including the development of Modern Methods of Construction and the establishment of ‘ConstructInnovate’ the new construction technology centre hosted by University of Galway.

The study also identifies proposed cost reduction actions related to the specification (standardisation, typologies and finishes) and scope of works (fixtures and fittings, appliances etc.) and size. A collaborative approach with industry to develop standardised approaches for housing design and construction to inform the design of policy initiatives, and be used as best practice by industry, is proposed to deliver the actions and to realise the cost reduction opportunities identified by the report.

The findings and follow up actions from the Residential Construction Cost Study will inform future policy and initiatives to deliver quality and cost effective design approaches. The subsequent follow up actions have been prioritised within Government. My Department in collaboration with other Government Departments, and Industry, will act on these opportunities.

I wish to thank the Construction Sector Group’s nominated Steering Group, comprising representatives of the Society of Chartered Surveyors of Ireland, the Royal Institute of Architects of Ireland, the Construction Industry Federation, the Local Government Management Agency, and the wide range of industry, local government and public sector participants in the study’s workshops for their time and expertise. I look forward to continuing collaboration with industry and Government stakeholders throughout the development and implementation of these actions.

By building on this report with its actions combined with the other initiatives in Housing for All, Government continues to work to place housing delivery on a long-term economically sustainable footing, helping to ensure affordable and high-quality housing for all.

Darragh O’Brien TD

Minister for Housing, Local Government and Heritage

Glossary of Abbreviations

BER	Berlin
BHM	Birmingham
BoQs	Bill of Quantities
CEEC	European Council of Construction Economics
CIF	Construction Industry Federation
CPH	Copenhagen
CS	Case Study
CSG	Construction Sector Group
CSO	Central Statistics Office
DHLGH	Department of Housing, Local Government and Heritage
DK	Denmark
DKK	Danish Kroner
DUB	Dublin
FF&E	Furniture, Fixtures and Equipment
GER	Germany
GFA	Gross Floor Area
HA	Housing Agency
HfA	Housing for All
IRE	Ireland
LGMA	Local Government Management Agency
MMC	Modern Methods of Construction
NFA	Net Floor Area
NL	Netherlands
PBSA	Purpose Built Student Accommodation

RIAI	Royal Institute of Architects of Ireland
SCSI	Society of Chartered Surveyors of Ireland
UK	United Kingdom
UTR	Utrecht
STG	UK Sterling

Glossary of Terminology

2B4P/3B5P	These shorthand descriptions provide the number of bedrooms in the dwelling (e.g. 2B is two bedrooms) as well as the intended occupancy (e.g. 4P is four persons).
Actual Project	A project or building which has been designed, is being implemented and/or is constructed.
Benchmarking	Comparison of performance (e.g. costs, design) against market competitors or peers.
Bill of Quantities	Quantified description of the drawings and specification used for the purpose of generating the cost of construction works
Building Elements	The main components, which make up a building are typically grouped into elements.
Construction Costs	Construction costs are the direct costs for the construction.
Cost-per-sqm	The construction cost for each square metre of building gross floor area (GFA).
Cost-per-unit	The construction cost for each apartment, house or bedspace.
Development Costs	Total cost of development; i.e. construction and soft costs combined.
European Cost Consultants	Cost consultants in the four comparator locations who participated in the study. They each completed the 'travelling-box' exercise, provided data on local cost ranges based on their own cost databases, and provided observations to assist the cost and design comparison exercises.
Grey Box Finish	A concept more common in commercial buildings, for the purposes of this study, a grey box finish is a dwelling where finishes such as floor finishes, suspended ceilings, wall painting

	and tiling, fitted joinery (e.g. built-in wardrobes), fitted kitchen cabinets/appliances, and light fittings, are not included at point of sale or letting as a rental unit.[1]
Gross Floor Area	Internal floor area, measured and denoted in square metres (sqm), of a dwelling plus proportion of common or landlord areas, or in the context of the building, the internal floor area of the whole building.
Gross External Floor Area	Floor area, measured and denoted in square metres (sqm), of a dwelling, including the area of the external wall thickness, plus proportion of common or landlord areas
Gross Internal Floor Area	Floor Area, measured and denoted in square metres (sqm), of a dwelling, measured between the internal faces (finished surface) of perimeter walls that enclose the dwelling. This includes partitions, structural elements, cupboards, ducts, flights of stairs and voids above stairs.
MMC (see above)	MMC (Modern Methods of Construction) was developed by UK Research and Industry bodies and is commonly used in the UK and Ireland since 2006 to describe a range of manufacturing and innovative alternatives to traditional construction (e.g. panellised façade systems, sandwich panels)
Net Floor Area	Internal floor area, measured and denoted in square metres (sqm), of a dwelling, excluding common or landlord areas (e.g. corridors, staircores, amenity spaces)
Purpose Built Student Acc.	Residential units specifically built for third level students
Residual Difference	This is the cost difference remaining after the differences due to scope, specification and unit sizing are accounted for. The residual difference includes respective market conditions,

[1] Sanitary appliances and in some cases, linings are required for BC(A)R certification.

	labour costs, and planning and building regulatory requirements in each location.
Scheme House	A house, which is part of larger residential development ranging in size from 1-2B to 5-6B. Sub-categories of a scheme house can be terraced, semi-detached, detached.
Scope	The range of items that are included in construction costs, such as foundations, structure, walls, brickwork, roof finish, services, fitted kitchens, ensuites, tiling, floor finishes.
Soft Costs	Indirect costs associated with the delivery of a construction project. These include; site acquisition costs, professional fees, levies / contributions, cost of financing the project, developer's margin, VAT, legal and marketing costs.
Specification	The specific characteristics and performance of the items in the scope.eg.
Travelling Box	The same dwelling built to a typical Irish (Dublin) specification costed in selected locations as if it was built in the comparator locations with costs compared elementally (prelims, substructure, super-structure, building services, fittings and finishes).
Unit Sizing	The Gross Floor Area (GFA) used for each building type in each location in this study.

Executive Summary

1

1.0 Executive Summary

1.1 Introduction

Housing for All committed to conduct an analysis of each component of the cost of construction of house and apartment development, informed by cost comparisons with comparable EU countries. The study is a shared Construction Sector Group (CSG) and Government initiative, facilitated by the Department of Housing, Local Government and Heritage (DHLGH). The scope of the study is to analyse actual residential construction costs for housing, apartments and student accommodation. The study aims to support reduction in residential construction costs and increased standardisation. Research by industry identifies that construction costs account for approximately 50% of overall development costs.

The CSG nominated a Steering Group in March 2022 to provide oversight to the study, comprising representatives on the Royal Institute of Architects of Ireland (RIAI), the Society of Chartered Surveyors of Ireland (SCSI), the Local Government Management Agency (LGMA) and the Construction Industry Federation (CIF). A representative of the CSG chaired the Steering Group. Following a public procurement process, a construction economics consultant, Mitchell McDermott, was appointed in July 2022.

The CSG Steering Group and DHLGH selected four case-study projects as the basis for the exercise, representative of actual residential projects being delivered in Ireland at the time. These are a 3-bed Semi-Detached 'Scheme House', a Suburban Apartment Building, an Urban Apartment Building and a Purpose-Built Student Accommodation (PBSA) Building. Whilst findings from this study may be applied across tenures, the study does not analyse the difference across tenures e.g. build to rent, social housing.

There are a number of related studies currently underway between the DHLGH and the Housing Agency, which will also assist in establishing a strategic direction across the private, social and affordable housing sectors. Taken cumulatively with this study, these will form a more comprehensive roadmap. These related studies are described in the recommendations section.

In line with the scope set out in Housing or All, this study is focused on the construction costs. Specifically, the study is focused on construction costs of the direct building works and associated preliminaries only. Soft costs are not within the scope of this study, but are being considered under other Housing for All studies, including those referenced in the last section of the Executive Summary below.

The study carries out a comparative study across four North European comparator countries - Denmark (DK), Germany (GER), Netherlands (NL) and United Kingdom (UK) and focuses on specific cities within each country – Copenhagen (CPH), Berlin (BER), Utrecht (UTR) and Birmingham (BHM) respectively. In Ireland (IRE), Dublin (DUB) is the nominated city for comparison. The study examines costs and differences in design and construction on each of the four case study projects, using the 'travelling box' methodology (i.e. the same dwelling built to an Irish specification costed in selected locations). It also examines typical European housing types in the four comparator locations and associated cost ranges. A synthesis of the cost and design comparisons and cost modelling exercise and feedback from the workshops, are presented as a summary of findings which identify potential cost reduction opportunities and inform the recommendations and a set of actions to realise these opportunities.

1.2 General Findings

The general findings from the study are noted below by building type and other findings arising mainly from the stakeholder engagement during the study (to maximise stakeholder engagement workshops were held at the end of the study's first three stages). Due to the similarities in the findings for Case Study #2 (Suburban Apartment) and Case Study #3 (Urban Apartment), these are combined. These general findings are summarised at the end of each case study chapter and in the stakeholder engagement chapter. Case Study #1 is based on a comparison between IRE (DUB) and the UK (BHM) only, for reasons explained in the case study chapter. Case Studies #2, #3 and #4 are based on a comparison between DUB and the four comparator locations.

1.2.1 Case Study (CS) #1 - Scheme House

- **Travelling box exercise found lower scheme house costs in BHM**
  The 'travelling box' exercise found that construction costs using Irish specifications on a cost-per-sqm rate for the same scheme house were approximately 15% lower in BHM than in DUB.

- **Cost ranges for actual scheme houses are lower in BHM**
  Lower construction costs were also evident in BHM for an actual scheme house when built using the typical specifications for BHM. The cost-per-sqm rate was 6-10% lower in BHM than DUB and the cost-per-unit basis was 21-29% lower in BHM than DUB. This is due to a number of factors set out below.

- **Cost and design comparison found differences in size and specification in BHM**
  Cost comparison indicates that UK can achieve a lower construction cost due to local market conditions[2] and labour costs. This applies to both the travelling box and actual scheme houses.

  Design comparison indicates differences in scope, unit sizing and specification, which lead to a lower cost in BHM than DUB for actual scheme houses. On scope, typically no ensuites or fitted wardrobes are included in the 3-bedroom semi-detached scheme house in BHM. On unit sizing, the benchmark sampling for this study indicates that houses being delivered in BHM[3] are up to 15% (93 sqm vs 110 sqm) smaller than DUB.

- **Cost modelling found potential cost reduction opportunities on unit sizing**
  By adopting some of the design comparison findings, the modelled cost-per-unit is reconciled within 21% of BHM average construction cost.

  Opportunities on the scheme house are primarily linked to size. Potential opportunities for cost reduction also exist in scope and specification to a lesser extent.

1.2.2 Case Studies (CS) #2 & #3 – Suburban and Urban Apartments

- **'Travelling box' exercise found similar apartment construction costs in all locations**
  The 'travelling box' exercise found that overall construction costs using Irish specifications on a cost-per-sqm rate for the same apartment building are broadly

[2] This refers to scale, supply and demand of goods and services, imported goods, population base, regulatory framework of the construction sector which is unique or local to a particular location.

[3] This unit size comparison is in the private-for-sale market.

in line (+/- 4% for CS #2 and up to +9% for CS #3) with construction costs in the four European comparator locations.

- **Cost ranges for actual apartment buildings are lower in CPH, BER and UTR.** Lower construction costs were evident in CPH, BER and UTR than DUB (and BHM) for actual apartment buildings when built using the typical specifications for those locations on a cost-per-sqm rate (up to 30% differences identified).
- **Cost and design comparison found differences in scope, size and specifications in CPH, BER and UTR**
  On the design comparison, cost differences were identified related to differences in scope, unit sizing and specification. It is common in CPH, BER and UTR to sell or rent apartments with exposed concrete slab (bare ceilings), no floor finish, no fitted wardrobes, no light fittings and sometimes minimal or no fitted kitchen. In addition, it is common for apartments to have a single bathroom shared between two or three bedrooms and no ensuites. Stakeholders providing feedback during the study's Stage 2 Workshop noted that some of these scope and specification choices are market driven, and some may require further assessment in relation to achieving technical performance requirements including sound, hygiene and fire.

  When typical construction practices in two locations are compared, it is difficult, and not always possible to quantify cost impacts of all differences in individual regulations, standards or norms. Not all standards and regulations are prescriptive. For example, CPH, BER and UTR requirements for apartment sizes are more performance-based than prescriptive and a significant range of apartment sizes is evident in these locations.
- **Cost modelling found potential cost reduction opportunities on scope and specification**
  By modelling the items identified in the comparison findings on the case study projects' Irish baseline unit cost, the cost-per-unit is reconciled to within 18% of the lowest comparison which was CPH.

  Potential cost reduction opportunities on apartments are primarily linked to scope and standardisation.

Increased use of standardisation in construction systems and specification of components such as windows is evident in the CPH, BER and UTR for apartments. Manufactured panel systems (a type of Modern Methods of Construction (MMC)) are more common in CPH, BER and UTR than labour-intensive site-based activities (such as block- or brick-laying). CPH, BER and UTR also deliver a higher proportion of apartments with associated efficiencies. Stakeholders in Stage 2 Workshop noted that diversity in the design and appearance of housing can increase construction costs. Diversity also makes it more challenging to increase standardisation, including materials selection.

If the European approaches were adopted, it is estimated the construction cost of a two-bed apartment has the potential to be reduced by up to 14%. This consists of 3% savings by small reductions in specification, 6% savings could be achieved by reducing scope (e.g. omitting ensuites and extent of finishes) and standard scope could be deferred (e.g. kitchen, joinery and flooring), saving a further 5%. The scope deferral whilst still a cost would be borne by the end-user in line with their budget and timing.

1.2.3 Case Study (CS) #4 – PBSA

- **Travelling box exercise found higher PBSA costs in European locations**
  The 'travelling box' exercise found that overall construction costs using Irish specifications on a cost-per-sqm rate for the same PBSA building are higher (up to 11%) in the four European comparator locations albeit with the costs distributed differently between the building elements**.**
- **Cost ranges for actual PBSA buildings are lower in CPH, BER and UTR**
  Lower construction costs were evident in CPH, BER and UTR for actual PBSA buildings when built using the typical specifications for those locations on a cost-per-sqm rate (10% to 32% differences identified)**.**
- **Cost and design comparison found differences in scope, size and specification in CPH, BER and UTR**
  On the design comparison, the study found that DUB typically builds a different typology to CPH, BER and UTR. These European locations design and build more studio / 1-bedroom units as opposed to the 6 to 8 beds per cluster arrangement common in DUB (and BHM).

When typical construction practices in two locations are compared, it is difficult, and not always possible to quantify cost impacts of all differences in individual regulations, standards or norms. Not all standards and regulations are prescriptive.

Increased use of standardisation in construction systems and specification of components such as windows is evident in PBSA in CPH, BER and UTR. Manufactured panel systems (a type of MMC) are more common in CPH, BER and UTR than labour-intensive site-based activities (such as block- or brick-laying).

- **Cost modelling found potential cost reduction opportunities on scope and specification**
  By adopting some of the findings and modelling them against the case study project, the cost-per-unit is reconciled to within 11% of the lowest comparator location (BER).

  The value of having a design standard for PBSA with typology options (clusters, ensuites/ shared bathrooms, studios) and applications (on-campus/ off-campus) was discussed at the Stage 2 Stakeholder Workshop. There is currently no national design standard for PBSA.

  Potential cost reduction opportunities for PBSA were identified as design standards and unit sizing, as well as scope and specification.

1.2.4 Other Findings

- **Building Services costs are higher in DUB**
  Building services costs were found to be higher in DUB than other locations across all dwelling types. Amongst one of the main areas of difference, district heating, i.e. CPH, as opposed to site-based heat generation, which is adopted in Ireland.

- **Other Dwelling Types Required**
  Stakeholders at the Stage 2 and Stage 3 Workshops noted the importance of considering other dwelling typologies to achieve a medium level of density, which may have potential cost reduction opportunities.

- **Design Standard for PBSA Beneficial**
  It was noted by stakeholders in the Stage 2 Workshop that further standardised guidance would be of benefit. National design guidance for student accommodation would inform design approaches. A range of design options for students would be preferable, incl. small studios and clustered bed-spaces, both with and without ensuites. Shared rooms was also suggested as an option.
- **Opportunity for Standardisation**
  Potential benefits of increased standardisation were cited by stakeholders in the workshops. Support is needed for more offsite construction systems and components, such as Modern Methods of Construction (MMC). It was noted that any guidance on standardisation of plans and/or components should be accompanied by performance and economic best practice guidance.
- **Application of Planning Guidance**
  Feedback noted that the variation in the application of planning design requirements for the appearance of housing can increase costs. This also makes it more challenging to increase standardisation, including materials selection.
- **Further Studies Required**
  Areas for further studies which were raised included the areas of soft costs, cost impact of construction programme and cost impact of different forms of contract.

1.3 Recommendations

The study sets out recommendations below based on the findings, and are followed by a set of actions to be implemented following this study.

General

1. Take account of the general findings in development of future policy and incentivisation measures. Refer to Action 1.
2. Review standardisation of housing design and construction, to include the size ranges of houses specifically. Standardisation of plans and/or components should be indicative only and accompanied by performance and economic best practice guidance. This work should be coordinated with work ongoing by The Housing Agency on examination of innovation/efficiencies in design regarding affordable housing types, form and density, which includes a

review of case examples both nationally and in other EU Member States (concluding in Q2 2023); Refer to Actions 2.

3. Review technical specifications relating to building elements, such as external walls, windows and building services. Continue to support the development of city-wide district heating in urban areas. Refer to Actions 2 and 6.
4. Disseminate the findings of the study to ensure that the construction cost implications of decision-making at all stages in a project, including early design development and planning, are considered, taking account of observations made by stakeholders in the stage workshops. Refer to Action 3.
5. Develop a design standard for PBSA, taking account of observations made by stakeholders in the stage workshops. Refer to Action 4.

Research

1. Utilise cost information from this study and other studies to analyse overall development costs. This work should be coordinated with work ongoing in related areas having regard to other studies in this area. Refer to Action 7.
2. Undertake a market research study on market expectation and cultural factors e.g. whether there is a market for apartments in Ireland (for sale or rental) without fitted kitchens and wardrobes, and/or one bathroom and no ensuite, and/or whether bare ceilings with electrical services visible would be considered acceptable to potential buyers / renters. Consider undertaking a study on the technical aspects and market appetite, and raise awareness for the 'grey box' approach on apartments (i.e. flooring, kitchens, integrated appliances, wardrobes, suspended ceilings provided by owner / tenant), including handover and compliance procedures. Review certain standards around apartment fittings and finishes.
3. Undertake a similar cost study at regular intervals, utilising the methodology developed in this study, including new comparator locations and housing types to expand the data available and to track trends occurring internationally.

4. Undertake a study of the cost of the social and physical infrastructure that is needed to service new development and the resulting correlation between density and cost per unit.
5. Conduct a study on design innovation and cost efficiency for medium and high density housing typologies taking account of forthcoming Sustainable and Compact Settlement Guidance by Planning Division on settlement forms/density standards.
6. Support research into productivity in construction study, in conjunction with a selection of construction partner and technical experts. Align with other existing/ongoing work in this area such as DETE MMC data dashboard.

1.4 Actions

A number of actions are generated from the findings and recommendations of this study. These are set out in Table 1 below. A collaborative approach with industry to develop standardised approaches for housing design and construction which can inform the design of policy initiatives and be used as best practice by industry is proposed to realise the cost reduction opportunities identified by the study.

Table 1: Table of Actions arising from the study

Action Number	Action Description	Proposed Approach	Commencement Date	Completion Date
General				
1	Have regard for, and take into account the findings of this study when developing future policy measures.	Cross-Government	Q2 2023	Ongoing
2	Develop standardised approaches to the design of housing for wider application to inform policy and encourage simplified layouts. These approaches are to include the development of: a.) standardised dwelling types b.) standardised specifications, including for building services (i.e. plumbing, heating and ventilation systems and	DHLGH in collaboration with Industry[4] and Housing Delivery bodies with MMC Leadership and Integration Group and construction research support	Q2 2023	Q4 2024

[4] Industry includes professional bodies, housing delivery bodies and homebuilders for example to include Royal Institute of Architects of Ireland (RIAI), Construction Industry Federation and Irish Home Builders Association (CIF/IHBA), Society of Chartered Surveyors of Ireland (SCSI) and Engineers Ireland (EI), Association of Consulting Engineers of Ireland, Chartered Institute of Building Services Engineers, MMC Manufacturers.

	electrics) and standardised components. The aim is to raise awareness of standardised housing design with compliant and simplified layouts and examples of standardised details, building on the Design Manual for Quality Housing but for a wider application than social housing.			
3	Deliver a training and awareness programme, in relation to the cost impact of materials and finishes commonly used in the residential construction sector in order to inform high-quality, cost-effective design and to assist in the planning and development process.	DHLGH, LGMA, LAs, and Professional Bodies	Q4 2023	Q2 2024
4	The development of standardised design specifications for student accommodation in Ireland.	DFHERIS	Q4 2023	Q4 2024

5	As part of the commitment in Housing for All to achieve a significant increase in the use of MMC, pursue the development of standardisation across various building components and detailing in innovative construction, including open-source construction details, to include promotion of Design for Manufacture and Assembly (DFMA) design approaches. Incorporate the various steps required for delivery as part of the forthcoming roadmap for MMC in public procurement of residential construction.	DHLGH in collaboration with Industry[5] and Housing Delivery bodies supported and coordinated by the MMC Leadership and Integration Group and construction research.	As per HfA Actions.	As per HfA Actions.
6	Carry out a review of external wall build-ups, assess and test alternatives for suitability, including external leaf, for Irish climatic conditions,	Construction research body supported by DHLGH	Q4 2023	Q4 2024

[5] Industry includes professional bodies, housing delivery bodies and homebuilders for example to include Royal Institute of Architects of Ireland (RIAI), Construction Industry Federation and Irish Home Builders Association (CIF/IHBA), Society of Chartered Surveyors of Ireland (SCSI) and Engineers Ireland (EI), Association of Consulting Engineers of Ireland, Chartered Institute of Building Services Engineers, MMC Manufacturers.

	for new houses and apartment buildings.			
Research				
7	Building on this and previous studies, incorporate construction costs and 'soft' costs (e.g. fees, land) into an overall development cost.	DHLGH	Q2 2023	Q2 2024

Introduction

2

2.0 Introduction

2.1 Policy Context

Housing for All was published in 2021 with the overarching aim that 'everyone in the State should have access to sustainable, good quality housing to purchase or rent at an affordable price, built to a high standard, and located close to essential services, offering a high quality of life.'

Reducing construction costs is a key part of supporting the delivery of Ireland's Housing for All plan. Reducing construction costs is critical to increasing supply. These have risen considerably over recent years through a combination of the increased cost of regulatory compliance and general increases in labour and materials costs.

The housing system needs to be placed on a long-term economically sustainable footing. Alongside other measures, costs associated with residential construction, which remain high, need to be tackled to enable a functioning housing market, particularly for apartment construction. The Government and relevant State agencies will advance methods to reduce residential construction costs, particularly the cost of apartment construction, by increasing the focus of existing and planned construction-related initiatives on the residential construction sector, and by ensuring a coordinated, whole-of-government approach to residential construction.

This will include the introduction and full implementation of a pipeline of cost reducing innovations and productivity measures, in line with its established remit to improve productivity and efficiency, and to control price inflation.

Housing for All's Action 19.1 supports wider planning, environmental and social objectives, to deliver inclusive, sustainable, safe and low-impact communities. The twin National Planning Framework objectives of tackling climate change (NSO 8 Transition to a Low Carbon and Climate Resilient Society) and delivering more compact growth (NSO 1 Compact Growth) require action to ensure that we see developments at scale in our cities, particularly close to public transport nodes and existing infrastructure. There is therefore a strong public policy imperative to develop housing in our cities. In addition, there is a growing demand for urban living, with people wanting to live close to work and urban amenities, but despite the policy support and the evident demand, the supply of apartments for sale at a price people can afford has not been forthcoming.

With the above challenges in mind, this study compliments work being carried out by DHLGH and others under Housing for All on other development cost areas, such as site acquisition and land value, planning, and utilities.

2.2 Study Outline & Aim

The Residential Construction Cost Study seeks to support both the reduction in residential construction costs and increased standardisation. To identify potential cost reduction opportunities, costs applicable to comparable EU economies are compared and reviewed through international benchmarking on a range of typical housing types. Findings and potential cost reduction opportunities can be subsequently disseminated for consideration by relevant bodies and industry, and can then also be used as a reference for similar future construction cost studies. The study is a shared Construction Sector Group (CSG) and Government initiative, facilitated by the Department of Housing, Local Government and Heritage (DHLGH) and is set out under 19.1 of HfA 2022 Update:

'Conduct an analysis of each component of cost of construction (including cost of compliance) of house and apartment development, informed by cost comparisons with comparable EU locations. Agree a set of follow-up actions to be implemented arising from the exercise.'

The CSG and Government, facilitated by the DHLGH, have undertaken the study with Mitchell McDermott Construction Cost consultants.

The CSG nominated a Steering Group to provide oversight to the study, comprising representatives on the Royal Institute of Architects of Ireland (RIAI), the Society of Chartered Surveyors of Ireland (SCSI), the Local Government Management Agency (LGMA) and the Construction Industry Federation (CIF). A representative of the CSG chaired the Steering Group.

Engagement with industry, professional bodies and public sector representatives was key to the study. The study included three stakeholder workshops towards the end of each successive work stage, providing progress updates, capturing the views of stakeholders and their input into the direction of the study. A record of these workshops is set out in Chapter 8 and further details are in Appendix H.

The Project Working Group comprised senior staff of Mitchell McDermott and project managers from DHLGH's Residential Construction Cost and Innovation Unit.

2.3 Study Objectives

- To illustrate how smart residential design could deliver housing, planning, social and environmental policy objectives in a cost-efficient manner with a view to reducing cost, with a particular focus on higher-density development.
- To review, by way of international benchmarking, how residential construction costs in Ireland compare to comparable EU economies.
- To develop models, identify and test areas for potential cost reduction opportunities on a range of case study projects, and any associated barriers, representative of residential construction projects currently being delivered.
- To identify potential areas of construction cost reduction opportunities on a range of typical house types.
- To disseminate findings to the construction sector.
- To provide a reference for similar future construction cost studies.

2.4 Study Scope

The study scope is to comprise actual residential construction costs for new build housing, apartment schemes and student accommodation. The findings may be applicable to any tenure. The cost study includes a cost estimating exercise based on, or adapted from actual residential schemes in IRE, and comparison with comparable European locations through a benchmarking exercise covering, costs and cost-effective design.

Development costs, which comprise construction and soft costs, are detailed in the Table 2 below. As identified in the SCSI 2021 report, The Real Costs of New Apartment Delivery, construction costs make up approximately 50% of total development costs in residential schemes.

Table 2: Construction and Soft Costs

Construction Costs	Soft Costs
Direct building works including plant, labour and material	Site acquisition cost
Site development works (roads, paths, services) within site boundary	Professional design fees
External works (i.e. driveways, fencing, gardens, landscaping)	Value Added Tax
Car parking (i.e. basement, at grade parking)	Legal & Marketing costs
On-site overheads (i.e. preliminaries)	Capital contributions, utility works outside the footprint of the building
Off-site overheads (i.e. management and administration costs) and builder's margin[6]	Development levies
	Finance
	Developer's Margin

This study focuses on construction costs only. Soft costs are outside the study scope. The study is further refined to focus on the **direct building works costs and associated preliminaries** of each case study project. As such, the following items are excluded from the costs presented in this study:

- Site development works (roads, paths, services), including site abnormals (e.g. poor ground conditions, contamination proximity to other structures)
- External works
- Car parking

[6] Included in construction costs in this study.

Site characteristics and potentially local planning requirements influence for example site development works and parking requirements. Costs from one site to the next can be heavily influenced by site abnormalities. In addition, it is noted from a review of previous comparative studies that costs are not necessarily available on such items in other European locations[7].

This study covers different types of residential buildings but **is focused on the costs associated with the direct building works and associated preliminaries only.**

It is not the study's intention to compare different building types' construction costs. The cost for a house differs from an apartment as they are fundamentally different in terms of complexity, construction materials and applicable building regulations and are appropriate to different locations.

The cost data is project-specific. It is not intended to provide cost information for benchmarking purposes.

2.5 Case Study Projects

DHLGH with the Steering Group set out specific criteria for notional residential schemes in the study brief to facilitate case study project selection. These were intended to be representative of projects currently being delivered in Ireland. These were in terms of housing scale, location and type, and with a sufficient level of detail to facilitate the overall study. The case studies had to align to the four notional residential schemes, or encompass a range of broad scheme criteria. The final selection of notional schemes was intended to allow for a detailed level of inquiry within the study timeframe, with transferable findings to other housing typologies of similar construction or scale.

Central Statistics Office (CSO) data indicates that New Dwelling Completions in 2022 across all tenures amounted to 29,851 units. Of these, scheme houses comprised 15,163 (51%) and apartments comprised 9,166 (31%). In 2022, the average scheme house GFA was 118sqm[8] and apartment Net Floor Area (NFA) was

[7] This is noted for example in The Housing Agency's 2018 report.

[8] 118sqm was the average for all scheme houses. The Building Control Management System (BCMS) Commencement Notice data for 2022 indicates that 46% of houses commenced were 3Bs and 39% were 4Bs. Based on this data, 85% of houses were either 3B or 4B houses.

75sqm. As such, the selection of Case Studies #1, #2 and #3 can be considered broadly representative of a large proportion of actual housing delivery in Ireland at this time. The inclusion of Case Study #4, Purpose Built Student Accommodation (PBSA), is due to high associated construction costs and the actions in Housing for All to increase delivery of this housing type. This is a relatively narrow case study selection for a deep and detailed comparative study at a fixed point in time.

In response to the notional schemes identified, case study projects were proposed which largely comply with the notional schemes set out. The selected projects are located in Ireland and are in compliance with Building Regulations that applied at time of site commencement.

Further details on the notional schemes and the case studies are provided in Appendix A.

Review of Existing Literature

3

3.0 Review of Existing Literature

3.1 Overview

This chapter undertakes a review of recent literature available on Irish and international construction costs, including reports and cost indices, as well as literature and guidance on spatial and technical standards in the selected locations. The degree of detail and basis for the costs varies or is not referenced in certain instances. Publication dates vary and the cost information in the reference literature reflects this. The scope of inclusions and exclusions also varies e.g. site curtilage / site works are included in some figures but excluded in others. It is not intended that the costs in the literature review are compared with costs presented in this study. Reference literature details are provided in Appendix B.

3.2 Irish Construction Costs

Construction costs in IRE are published by various bodies including the SCSI, and various private construction cost consultants. These costs tend to be DUB focussed or national averages and typically are presented as a range.

In 2018, the DHLGH published a “Review of Delivery Costs and Viability for Affordable Residential Developments”. In the area of construction costs, this report found there was a skills shortage in key construction trades for the short to medium term, which impacts on delivery capacity and on wage inflation. However, it also found that ‘the industry itself must face the challenge to innovate in order to increase output while at the same time becoming less dependent on a large labour input, e.g. through increased utilisation of prefabrication methods’.

In 2020, the SCSI published its updated report on the “Real Cost of New Housing Delivery" and noted that the construction cost of a three bed semi-detached house was €178,902 (based on 114 sqm including site curtilage and site development costs) which made up 48% of total development costs (€371,311). The SCSI report concluded with some recommendations for policymakers to address the housing crisis.

Similarly, in 2021, the SCSI published the updated report on apartment delivery cost, which covers total cost of development. From its analysis, the construction cost for a suburban two-bedroom apartment (Category 2) ranges from €191,000 to €253,000.

Urban apartment equivalent (Category 3) is in the range of €219,000 to €262,000. These figures include a portion for site works. The 2021 report also found that there were cost savings achieved largely due to the introduction of new apartment design guidelines in 2018. It found, additionally, that construction costs of medium rise blocks made up 47% of total costs, up from 43% since 2017, while soft costs made up 42% and land 11%. It also made recommendations across the full range of development costs to address viability including the use of Modern Methods of Construction (MMC).

Linesight, an international construction consultancy, noted in their "Europe 2022" report that the typical construction costs for the relevant residential buildings are as follows:

a. Suburban apartments range from €200,200 to 236,600 (€2,200 to €2,600 per sqm and excluding substructure)
b. Urban apartments range from €209,300 to 273,000 (€2,300 to €3,000 per sqm and excluding substructure)
c. PBSA is noted with a range of €87,000 to €108,000 (€2,900 to €3,600 per sqm)

3.3 International Construction Costs

The Housing Agency (2018) report, Comparison of Residential Construction Costs in Ireland to other European Countries, addressed a similar topic to this study but with a different approach. The study used location indices to establish differentials between IRE and four comparison countries, namely, UK, France, Germany and Netherlands. The 2018 report covered construction costs only (similar to this study) and noted that IRE was very similar to UK, France and Germany. Residential construction cost in IRE was noted as 1.2% below the UK index but 1.3% and 2.9% above the France and Germany indices respectively. The Netherlands index was noted as 18% below the IRE residential construction cost. This was based on national averages as opposed to regions or cities. The 2018 report also identified challenges with international benchmarking, due to different legislation, construction systems, and building types.

Annual international cost reports published by global construction consultants identify cities and / or countries. Turner & Townsend and Arcadis, among others, publish annual reports which cover some cities examined in this study. The T&T International Construction Market Survey (2022) cited apartment construction costs in BHM to be very similar, i.e. within 3%, of DUB costs. The same report noted Amsterdam to be circa 17% less than DUB, whilst CPH and BER are not documented. International Consultant Arcadis provides a global index across all major cities in their International Construction Costs report 2022. This captures general construction costs and does not identify particular building types. It notes construction costs in DUB to be marginally less than CPH and 15 to 20% higher than BHM and BER respectively. The European Council of Construction Economics (CEEC) produces an annual cost model for a typical office building to compare construction costs between EU member states. The cost model is updated annually and is based on national averages. The most recent report (2021) noted IRE and UK to be similar. DK was highlighted as being 29% higher than IRE while NL and GER were 5% and 7% less than DUB respectively. This is summarised in Table 3 below.

Table 3: Indexed International Construction Cost Comparison (various)

	Housing Agency (2018)	T&T (2022)	Arcadis (2022)	CEEC Cost Model (2021)
Cost Coverage	National Average	Cities/Regions	Cities/Regions	National Average
Building Type	Residential	Apartment	General	Office Building
IRE	100	100	100	100
UK	101.2	97.3	86.2	95.2
NL	82	82.7[9]	69[10]	95
DK	n/a	n/a	106.9	129
GER	97.1	n/a	79.3	93.3

[9] Costs based on Amsterdam

[10] Costs based on Amsterdam

These represent a mix of government commissioned studies and annual reports published by international construction consultancies. These studies vary in terms of their approach but for the most part, rely on location factors or cost-per-sqm of floor area, and range from national averages to specific regions or cities. The reports do recognise, to varying degrees, **some of the challenges when comparing construction costs** on an international level. The challenges identified include:

- Difficulties obtaining 'like for like' comparisons
- Varying definitions of building floor areas
- Costs which are typically analysed on a cost-per-sqm of floor area
- Large regional cost differences within countries
- Variations of construction details and materials between certain jurisdictions
- Differences of localised industry practices and approaches
- Currency fluctuations

In Germany, a construction cost reduction commission was established in 2014 with the main task to carry out an '…analysis of the development of construction costs, identification of cost drivers in new construction and modernisation of residential buildings.' The report[11] identified 71 recommendations for federal and local governments to consider. Standardisation of work, uniformity of state building codes and re-densification were some of the highlighted recommendations.

3.4 Spatial Standards

Varying levels of detail are set out in each jurisdiction for spatial standards. In IRE and the UK, a prescriptive set of documents define minimum or target Net Floor Areas (NFA) for various housing types. In IRE, the Design Standards for New Apartments (2018) sets out minimum NFAs for apartments, as well as minimum living, bedroom and storage areas to satisfy normal living requirements. The Quality Housing for Sustainable Communities Guidelines (2007) sets out target minimum NFAs for houses and apartments, also referenced in the Design Manual for Quality

[11] Neitzel, M. (2019) Boosting the (affordable) housing supply – Measures to reduce construction and development cost

Housing (2022). In the UK, the Nationally Described Space Standards (NDSS) specifies similar prescriptive requirements for NFAs across all housing types.

Standards in DK, NL and GER are typically based on the functional requirements in the building types in this study. Local requirements have been located which describe performance criteria for certain rooms or spaces within dwellings, but they do not prescribe minimum Net Floor Areas (NFAs).

Irish Institutional Property (IIP) published a paper in 2020, Ireland Apartment Sizes Among Largest in Europe, which compared minimum apartment sizes for new developments in nine locations across various European countries. Locations applicable to the scope of this study are noted in Table 4 below.

Table 4: IIP Minimum NFAs Comparison. 2020

Dwelling Type	DUB* (Ireland)	London (UK)	CPH (Denmark)	Amsterdam (Netherlands)	BER (Germany)
1B2P Apartment	45 sqm	50 sqm	41 sqm	40 sqm	45 sqm
2B4P Apartment	73 sqm	70 sqm	69.7 sqm	65 sqm	75 sqm
3B5P Apartment	90 sqm	86 sqm	86.1 sqm	70 sqm	90 sqm

*BTR minimum sizes used.

The research for the 2020 report was compiled by Hines Ireland, an international property developer, and cites that regulation of apartment design is '…highly nuanced across geographies and standards are complex…'

Based on project delivery in the market, the SCSI (2021) report notes the 73 sqm NFA for a 2B4P apartment is difficult to achieve whilst meeting the various design standards (e.g. bedroom dimensions, dual aspect) and a 78.5 sqm NFA is used in the study.

3.5 Technical Standards

Limited literature exists which compares design standards and practices / norms across different European locations. The Housing Agency 2020 report, 'Social, affordable, and Co-operative housing in Europe' presents a design comparison across European countries, including DK, NL and GER. Among other findings, it identified that the fit-out of apartments in GER is commonly left to the residents and that flexibility is incorporated into designs to allow for further changes in use / layout.

Buildings constructed in BHM, CPH, UTR and BER are all subject to Building Codes and regulations for Fire Safety, Accessibility, Energy Performance and fitness for use, as well as Health & Safety legislation.

Nearly Zero Energy Buildings (NZEB) is an EU requirement under the Energy Performance of Buildings Directive and applies across all member states. The UK adopted an energy performance standard similar to NZEB for residential buildings in 2022. Refer to Appendix G for Energy Performance Requirements. Construction materials are also subject to EU Construction Products Regulations.

Methodology

4

4.0 Methodology

4.1 Introduction

This section details the methodology adopted to achieve this study's objectives; formulated from the brief set out for the study, but also from drawing on the literature review which identified a number of challenges for international comparison on construction costs. This methodology chapter aims to address these as far as practical.

4.2 Identification of Comparison Locations

The study brief set out that construction costs in Ireland should be compared against comparable EU economies, similar also in terms of climate, culture, level of housing, economic activity and cost of living. Consequently, northern European countries were identified in the brief. In addition, regulatory contexts are similar - as detailed in the literature review. Countries identified as suitable for this study in the Housing for All Plan included Denmark, Netherlands and Austria.

The final selection of comparator countries are:

United Kingdom (UK), Denmark (DK), Netherlands (NL), Germany (GER)

As identified in the Housing Agency report (2018), significant regional cost differences can exist within national boundaries. For example, Greater Dublin construction costs differ to other parts of the country. In response to this, nominated cities / regions within each comparison country were chosen for cost comparison. This is intended to refine cost comparisons and reduce the risk of national averages skewing the findings.

The following nominated cities are used in the study:

Birmingham (BHM), Copenhagen (CPH), Utrecht (UTR), Berlin (BER)

Dublin (DUB) is identified here as Ireland's nominated city for comparison purposes. This is due to the large volume of available construction cost data across housing typologies in DUB, and its similarity to other northern European cities. All costs and technical-related data within this study are based on the nominated cities.

For the purposes of the international cost comparison, exchange rates at the time of the costing exercise are applicable. Further details are in Appendix C.

4.3 Adopted Methodology

Based on the study objectives and reflecting on the challenges noted in the literature review above, the adopted methodology - developed to address these points and provide in-depth findings - is captured under two distinct and inter-related areas. These are analysed separately as follows:

1. Cost Comparison
    a. Travelling Box
    b. Local cost ranges
2. Design Comparison
    a. Scope
    b. Unit Sizing
    c. Specification
    d. Standards/Regulations

Cost Comparison

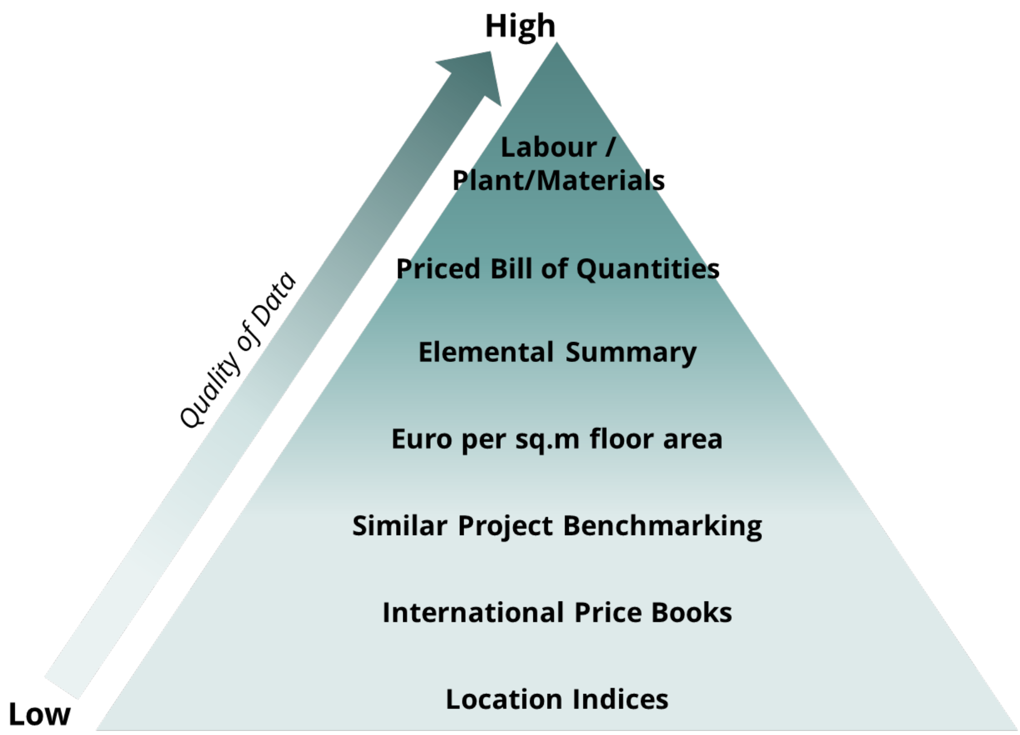
Using Bills of Quantities (BoQs), a baseline costing exercise, undertaken for each case study project, reflects DUB costing levels applicable to Q3 2022. This baseline provides a point of reference for the international comparison.

DUB case study costing is referred to as the baseline costing.

Recognising the challenges noted in the literature review above, the international cost comparison is on two levels. Firstly, a detailed Bill of Quantities (BoQs) was used to cost a typical Irish dwelling as if it was built in the comparator locations in order to identify any noteworthy differences from a materials and labour cost perspective only. This involves a costing exercise of each case study to Irish specifications using construction cost data from each reference location. No two projects are identical, a factor magnified when comparing against international projects. For example, local approaches, different regulations, standards, design efficiency and building technologies make establishing a true comparison difficult. Therefore, to limit the number of variables noted, the same building (travelling box) is costed in each location, i.e. each case study project is costed using the detailed design information and BoQs. A set of costing instructions was provided at the study's outset to the effect that each costing be undertaken, as far as practicable, on the same principles. Table 5 below shows the hierarchy of cost data.

'**Travelling box**' –using a detailed Bill of Quantities to cost a typical Irish dwelling as if it was built in the comparator locations

Table 5: Hierarchy of Cost Data



The ‘travelling box’ costings are presented on a cost-per-sqm and cost-per-unit basis. In each case study, using, effectively, the same individual building, the cost-per-unit is based on the Irish sizing; hence, the findings for both units of measurement are identical. It is recognised that some details and construction approaches in the ‘travelling box’ will not represent normal approaches in certain locations. These were, therefore, identified and costed as far as practicable.

Secondly, as a benchmarking exercise, costs for similar buildings types were compared based on local cost ranges for each location. These were provided by the European cost consultants based on their own cost databases.

The ‘travelling box’ comparison is, nonetheless, limited in that it does not recognise local or region-specific approaches. As such, local cost ranges are based on actual projects built using typical specifications for each individual country or region/city. This enables effective comparison between Irish design approaches and those of comparator locations.

Local cost ranges are also presented on a cost-per-sqm and cost-per-unit basis. Cost-per-sqm data is adjusted such that comparisons are based on the same principles for GFA. Costs-per-unit are generated by adopting the cost-per-sqm ranges and unit sizing typically adopted in the respective locations, with unit sizing for each building type primarily calculated from samplings of actual project data for each location. Where applicable, regard is taken of relevant design standards. This is explained in more detail under the design comparison.

The two cost datasets, i.e. 'travelling box’ costing and local cost ranges, were compared to identify differences.

All cost data is summarised into elemental categories for each individual location and housing type. Elemental categories consist of: substructure, structure, external enclosure, roof enclosure, internal subdivision, internal finishes and fittings, building services and preliminaries. Further details are set out in Appendix D. Elemental cost differences are presented as a percentage difference between the Irish baseline (DUB) and the lowest comparator, as well as in a table with the actual elemental cost data.

Design Comparison

Design comparison identifies key differences under various headings, which may or may not have cost reduction opportunities. It is not intended to be an exhaustive comparison on all aspects of design across the five locations, but is instead aimed at identifying key differences. These may in turn illustrate further cost differences with potential benefit from further research.

Design is reviewed under the following headings:

Table 6: Areas for Design Comparison headings

Heading	Description
Scope	Comparison of scopes from local actual projects to DUB actual projects e.g. fittings and finishes.
Unit Sizing	Comparison of unit sizing across the five locations for house, apartments and student accommodation types.
Specification	Comparison of specifications across locations. This can include quality and type of products or materials used and / or construction details beyond regulatory performance requirements.
Standards & Regulations	Overview of comparisons in the areas of heading design standards (if any) and building regulations.

Design comparison is carried out on each building type.

Differences between the five locations identified for each building type during the cost and design comparison exercise are subsequently compiled for use in cost modelling exercises. A list of items under the above headings are set out in each case study chapter.

4.4 Cost Modelling

Cost modelling involves modelling design and cost comparisons to reconcile the baseline unit cost (DUB) against the lowest cost range's average cost for each building type.

The items modelled are set out in a table under the following headings:

Table 7: Areas for Cost Modelling

Heading	Description
Scope	Adjustment for any scope differences
Unit Sizing	Adjustment for unit sizing
Specification	Adjustment for notable specification differences

The modelled costs are notional. Whilst Table 7 above indicates the items modelled for this exercise, it is not exhaustive and any changes would need to be assessed in the Irish context, taking account of market acceptance, housing typologies and climate.

The cost difference remaining after modelled costs due to scope, specification and unit sizing is indicated in the graph as the residual difference. The residual difference is due to a combination of factors, for example: respective market conditions, labour costs, and planning and building regulatory requirements in each location.

4.5 Analysis

A synthesis of the cost and design comparisons, and feedback from the workshops, is presented as a summary of findings to identify potential cost reduction opportunities, which can inform the recommendations and a set of actions to further develop these opportunities.

4.6 Data Collection

Based on the methodology set out above, the study uses data from various sources.

The cost comparison uses primary cost data from DUB and the selected European locations. This involves construction consultants in each location providing local costing data based on their own cost databases for the ‘travelling box’ costing, as well as cost ranges from actual projects and their respective in-house cost databases. Secondary data and sources, such as literature, were referred to for cross checking cost data, where available.

The design comparison uses various data sources including: observations from local construction consultants, local design standards where available, and reviewing designs of actual projects.

The types of data collection can be summarised as follows:

Table 8: Description of Data Types

Data Type	Description
Primary Data	Quantitative in-house cost data within Irish consultancy and European cost consultancies Qualitative observations of construction norms/practices by European cost consultants. Design metrics generated from sampling of actual projects (sample sizes set out in Appendix F)
Secondary Data	Published Literature and Industry Cost Reports/ Indices Local design standards where available

Unless stated otherwise, commentary presented in this study have been obtained from a combination of sources, including observations from European consultants and/or information reviewed. This is particularly the case for commentary on approaches to construction in the comparison locations. Further information on the data sources is set out in Appendices C&F.

4.7 Cost per Residential Unit

The cost comparison is presented on a cost-per-sqm of Gross Floor Area (GFA) and cost-per-unit basis, similar to the SCSI apartment report. To generate the latter cost, typical unit sizes by building type are established from each location. For the Irish baseline house and apartment unit sizes, the Design Manual for Quality Housing (2022), Design Standards for New Apartments (2018) and Quality Housing for Sustainable Communities (2007) identify target / minimum NFAs. For the Irish baseline PBSA, Dublin City Council's (DCC) Local Development Plan identifies minimum requirements and is widely utilised by other local authorities.

In certain instances, the NFAs and GFAs used are based on actual project data. The rationale for this is explained here and summarised in Table 9 below:

- **3B5P semi-detached** – The majority of dwellings in the study's DUB database range from 110 sqm to 123 sqm. The NFA and GFA of a house are the same. The house selected for Case study #1 is 123 sqm. An additional model of a 110 sqm house was also modelled as a sensitivity check for the lower end of the DUB cost range.
- **2B4P apartment** – Case studies #2 and #3 use a 91 sqm GFA (78.5 sqm NFA) which is based on the study database of actual projects being designed and delivered and takes account of the SCSI (2021) report's basis for unit sizing.
- **Student bedspace** – Based on the study database of 5,300 student beds delivered in Ireland over the last 6 years, 30 sqm is average GFA per bedspace.

Table 9: DUB Unit Sizing used in the study

Housing Type	Unit Type	Areas for Study
Case Study #1	3B5P semi-detached	Case Study – 123 sqm GFA Lower Range – 110 sqm GFA
Case Study #2 + #3	2B4P apartment	91 sqm GFA (based on 78.5 sqm NFA)
Case Study #4	Student bedspace	30 sqm GFA (based on 24 sqm NFA)

Figure 1: Unit Net (NFA) and Gross Floor Area (GFA) explained

Net Floor Area (NFA)

Floor area of apartment or residential unit inside the entrance door. Including the internal structure and dividing walls.

Gross Floor Area (GFA)

Net floor area plus **proportional** allocation of area for circulation, services, structure

Similar data has been collated from the comparator locations. For the UK, the Nationally Described Space Standards (NDSS) is referred to for unit sizing which provides a prescriptive set of spatial standards for different types of residential units with the exception of PBSA. CPH, BER and UTR have different functional spatial requirements, which could be described as performance-based rather than prescriptive. The GFAs and NFAs used in this study are based on a sampling of projects (see appendices) in each location. For all locations, actual project data has been used as a basis for establishing the sqm sizing per bedspace on PBSA building type. Refer to appendices for further details. The unit sizing used in this study are set out in Table 10 below.

Table 10: Unit Sizing used for Study

Housing Type	DUB	BHM	CPH	UTR	BER
Case Study #1	Opt 1 – 123 sqm Opt 2 – 110 sqm	93 sqm	n/a	n/a	n/a
Case Study #2 + #3	91 sqm GFA (based on 78.5 sqm NFA)	89 sqm GFA (based on 70 sqm NFA)	84 sqm GFA (based on 73 sqm NFA)	110 sqm GFA (based on 90 sqm NFA)	105 sqm GFA (based on 89 sqm NFA)
Case Study #4	30 sqm GFA (based on 24 sqm NFA)	31 sqm GFA (based on 23 sqm NFA)	35 sqm GFA (based on 28 sqm NFA)	35 sqm GFA (based on 28 sqm NFA)	33 sqm GFA (based on 26 sqm NFA)

For further detail on the approach to generating the unit sizing for CPH, BER and UTR is available in Appendix F.

Case Study #1
Scheme House

5

5.0 Case Study #1 – Scheme House

5.1 Outline Irish Specification

This case study project is a 3B5P semi-detached house with a Gross Floor Area (GFA) of 123 sqm. The house is a timber frame construction with block/brick external leaf and timber truss roof. The front elevation has brick with render on block finish to side and rear. The windows are double-glazed with fibre cement tiles to the roof. The heating source is an air source heat pump and heat recovery unit. The costs assume a fully fitted out house. Refer to Appendix E for the outline specification.

5.2 Baseline Irish Costing

Figure 2 below shows the baseline unit construction cost (€179,561) and the proportional breakdown into the main building elements based on the costed BoQs. As noted in the methodology, this cost also excludes the costs of site development works, external works and car parking.

The cost of structure is significant at 33%, as are the internal finishes and fittings (17%) and building services (14%).

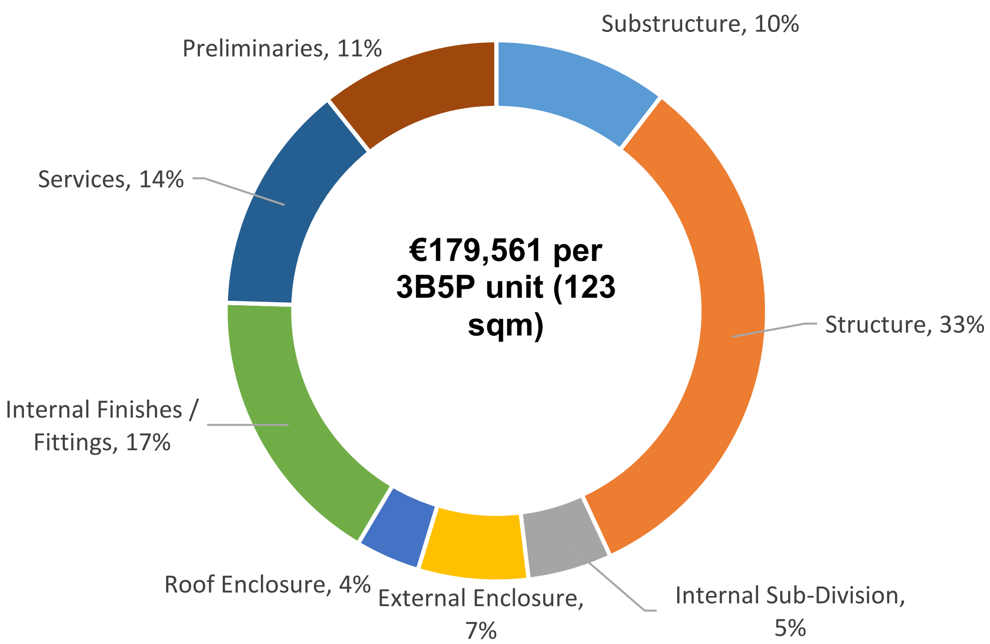


Figure 2: Case Study #1 Elemental Summary of DUB Baseline Costs

5.3 Cost Comparison – Travelling Box Costing

The comparison on Case Study #1 is between DUB and BHM only. The 'travelling box' is not costed in CPH, UTR and BER as this type is not typically built, based on discussions on European cost consultants, and cost range data is not available. The costs are shown in two formats in Figure 3 below, cost-per-sqm of GFA and cost-per-unit. The results indicate that the BHM 'travelling box' costing is approximately 15% less than DUB on both cost-per-sqm (€212 difference) and cost-per-unit (€26,067 difference).

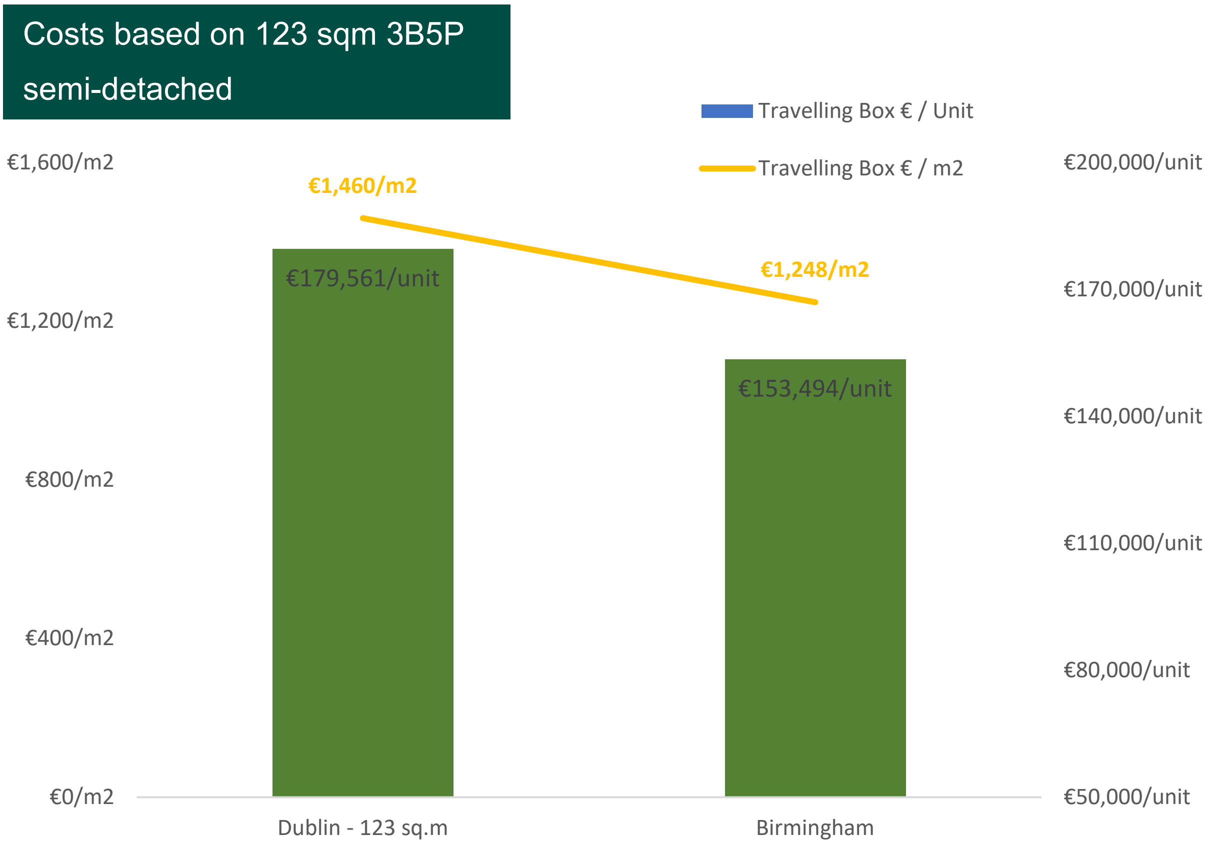


Figure 3: Case Study #1 'Travelling Box' Cost Comparison

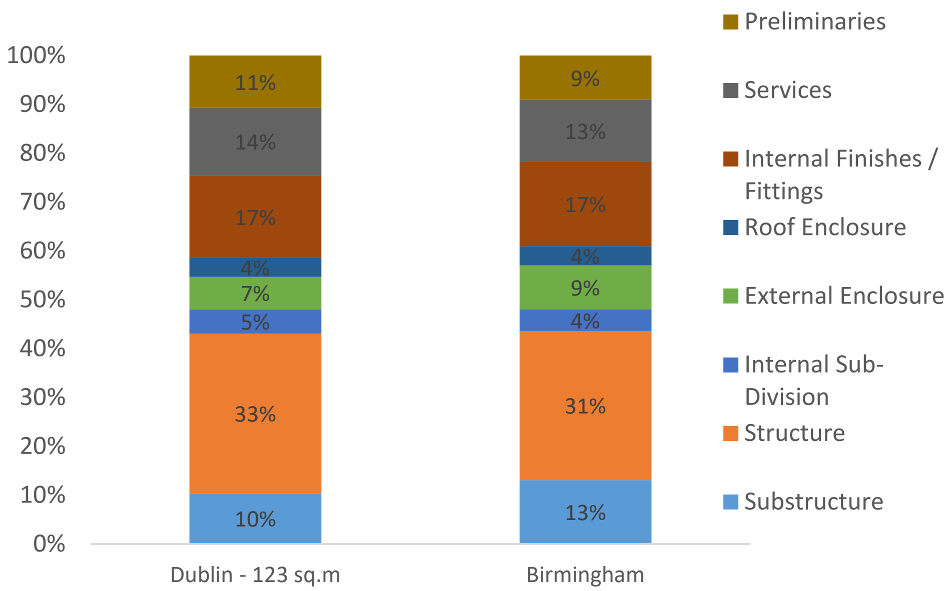


Figure 4: Case Study #1 Travelling Box Elemental % Breakdown

At a more detailed level, there are notable cost differences (up to 26%) in individual elements as can be seen in Table 11 below.

Table 11: Case Study #1 Travelling Box Unit Cost Elemental Comparison

Elemental Summary	DUB	BHM	DUB v BHM
Substructure	18,720	20,110	-7%
Structure	39,410	37,006	+6%
Internal Sub-Division	9,010	6,724	+25%
External Enclosure	31,046	23,732	+24%
Roof Enclosure	6,915	6,041	+13%
Internal Finishes / Fittings	30,431	26,475	+13%
Building Services	24,790	19,451	+22%
Preliminaries	19,239	13,954	+26%
Total Cost-Per-Unit	**179,561**	**153,494**	**+15%**

Highest Cost
Lowest Cost

Apart from substructure, the DUB baseline costing is higher across all elemental categories than BHM. The most notable elements are internal sub-division (25% less in BHM), external enclosure (24% less in BHM), building services (22% less in BHM) and preliminaries (26% lower in BHM). A combination of labour and material costs forms the main difference across the first three. For example, unit rates for items within the internal sub-division category such as internal doors, skirting, and architraves are in the region of 30% less in BHM than DUB. The preliminaries cost is a percentage of construction costs and the cost difference is mainly generated by the difference in overall costs.

5.4 Cost Comparison – European (UK Only) Benchmarking

In this section, local cost ranges from the Irish and UK cost consultants' cost databases are compared to the 'travelling box' cost-per-sqm in the orange box as a benchmarking exercise. The 110 sqm (lower range) house is included as a comparison, as explained under the methodology chapter. This allows identification of any notable differences other than the cost difference noted above. The 'travelling box' cost-per-sqm is within the cost-per-sqm range in each category.

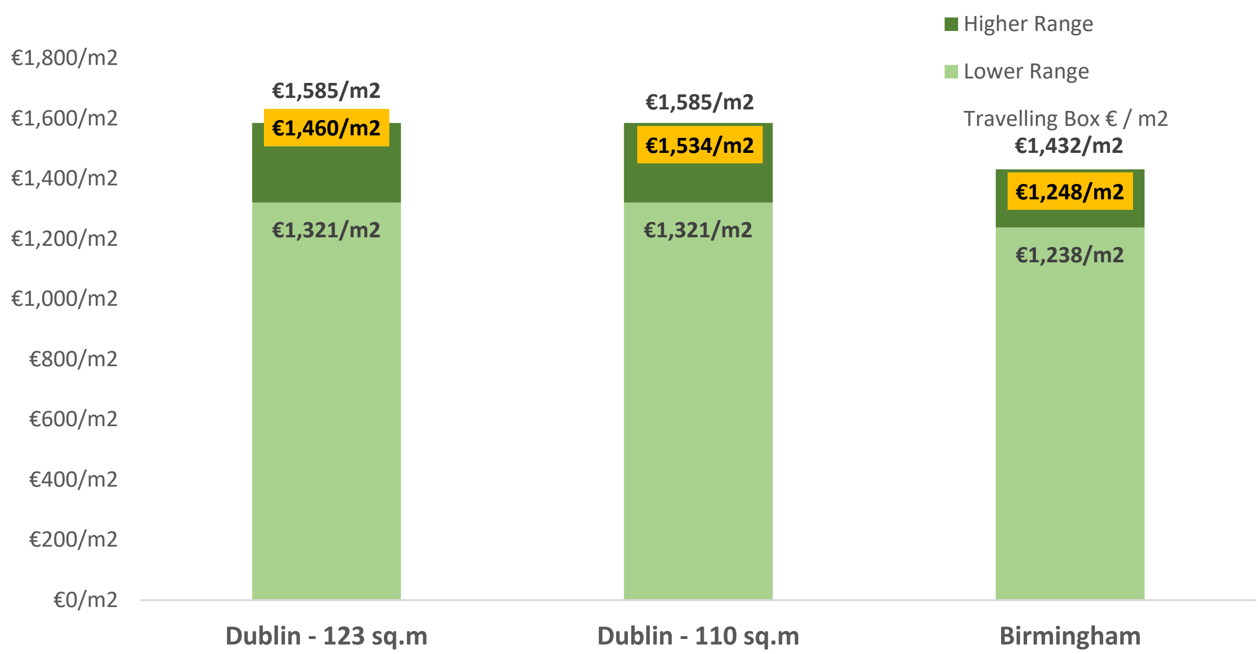


Figure 5: Case Study #1 Local Cost Ranges vs. Travelling Box Cost per Sqm

The findings indicate that the BHM cost ranges are 6 – 10% lower than DUB (compared to 15% under the ‘travelling box’ comparison). However, this is based on cost-per-sqm comparison. The cost-per-unit is assessed below under ‘unit sizing’. Using the headings identified in the methodology, both the 123 sqm and 110 sqm DUB dwellings are compared to the BHM dwelling to identify differences, which may have a cost impact.

Cost

As per the findings under the ‘travelling box’ exercise, the following areas are identified as having a notable cost difference.

- Timber frame and carcassing works (Structure) (6% less in BHM)
- Timber joinery / fittings (Internal Fittings & Finishes, Internal Sub-division) (15% less in BHM)
- Brickwork / blockwork (External Enclosure) (50% less in BHM)
- Building services (22% less in BHM)

Scope

DUB and BHM are similar on scope; however, the following observations are noted from the UK cost consultants

- Fitted joinery (other than kitchen) is typically not provided in BHM (Internal Finishes / Fittings)
- Level of finishes tends to vary in houses in BHM (Internal Finishes / Fittings)
- Ensuites to master bedrooms are often omitted in BHM (see unit sizing) (Internal Sub-division, Internal finishes / Fittings, Building Services)

Unit Sizing

Based on the minimum allowable unit sizing, DUB and BHM have similar requirements for 3B5P semi-detached (see methodology). A number of examples of developments designed and constructed to the UK’s minimum sizing (93sqm[12]) are

[12] The minimum NFA for a 3B5P two-storey dwelling in the UK’s NDSS (2015).

identified in BHM. Based on discussions with various industry stakeholders and a review of designs, built examples of 3B5P at about 98-100sqm have been identified in DUB but with reduced scope.

The case study project is based on 123 sqm, but a 110 sqm has also been modelled to present the lower end of the range of actual projects being delivered of comparable scope. The key difference between these two sizes is that rooms are more compact, but the scope remains largely consistent.

As the GFA reduces closer to 100 sqm and below, scope changes materialise. For example, in the 93sqm house, the master ensuite is generally omitted; additionally, in the UK, the kitchen can be accessed through the living room (i.e. corridor is omitted).

The cost ranges are shown below on a cost-per-unit basis. The cost per typical 3B5P semi-detached house in BHM (93 sqm) ranges from 21% less than the 110 sqm DUB house (lower end of range) to 29% less than the 123 sqm DUB house (upper end of range). However, the unit sizing typically being built in DUB is 15% (110 sqm) to 24% (123 sqm) larger than BHM.

Figure 6: 3B5P House Cost per unit based on local cost range

Specification

Specification in BHM is found to be very similar to DUB. The following observations are noted from the UK cost consultants:

- 100% brick coverage to elevations in BHM compared to typically brick to front elevation only with render on block to sides and rear in DUB. The BHM specification would add cost to the DUB equivalent. A lower labour and material cost is evident for brick-laying from the costed BoQs in BHM than in DUB (External Enclosure)
- Rationalised electrical fittings - quantity of power points and pendant lights only (i.e. no downlights) (Building Services)

Standards/Regulations

Designs are similar, but some differences are noted which are linked to design guidelines and regulatory requirements. For example, BHM cost ranges are based on actual projects with gas-fired boilers. Some of the regulations on u-values are different, which can be linked to some of the cost difference. UK Regulations will change in 2023 in this regard with an increased focus on low carbon heating systems and advanced u-values for the UK reference dwelling. Further details on energy performance requirements are available in Appendix G.

5.5 Cost Modelling

Cost modelling involves modelling design and cost comparisons to reconcile the baseline unit cost (€179,851) against the lowest average comparator. In this case, BHM is the lowest average construction cost (€127,000) based on the cost range noted in Figure 6 above (€115,121-€138,145).

The items modelled are set out in Table 12 below. Cost differences of the modelled items are notional. Whilst Table 12 indicates the items modelled for this exercise, it is not exhaustive and any changes would need to be assessed in the Irish context, taking account of market acceptance, housing typologies and climate.

Table 12: Case Study #1 Cost Modelled Items

Item Type	Modelled Items	Notional Cost	Notional Cost as % of total unit cost
Scope Discretionary	Omit fitted wardrobes Omit post box and electric fire place Omit ensuite to master bedroom (related to achieving the size reduction)	-€12,200	-7%
Size	Baseline is based on **123 sqm** and a lower range for 110 sqm Costs remodelled based on achieving 93 sqm (BHM)	-€13,300	-7%
Specification	Omit all downlights and replace with single pendants	-€250	-0.1%

Using **baseline unit** cost (€179,581) and size (123 sqm GFA), items are modelled to generate a **notional modelled baseline** (€153,800 and 93 sqm GFA). Figure 7 below shows that by adopting the findings noted above, the costs can be reconciled to within 21% of the BHM average construction cost (€127,000).

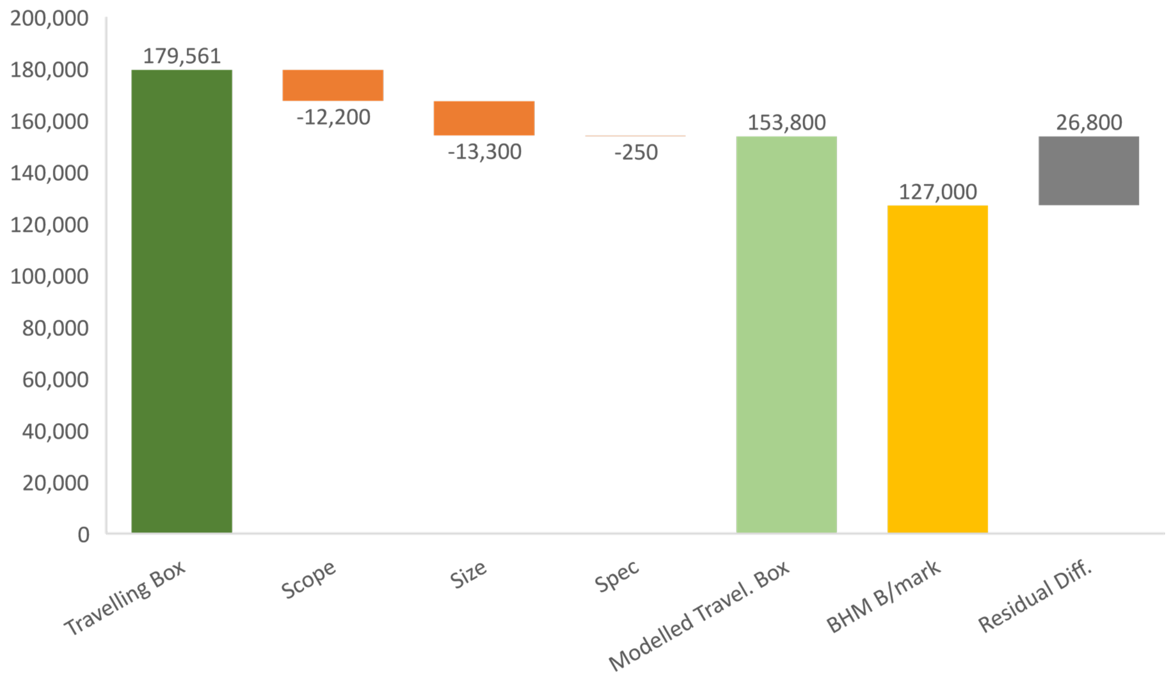


Figure 7: Case Study #1 – House (123 sqm) reconciled vs. BHM

A similar exercise has been undertaken using the **alternative lower range unit** cost (€168,787) and size (110 sqm GFA). The same items are modelled to generate the same **notional modelled baseline** (€151,500 and 93 sqm GFA).

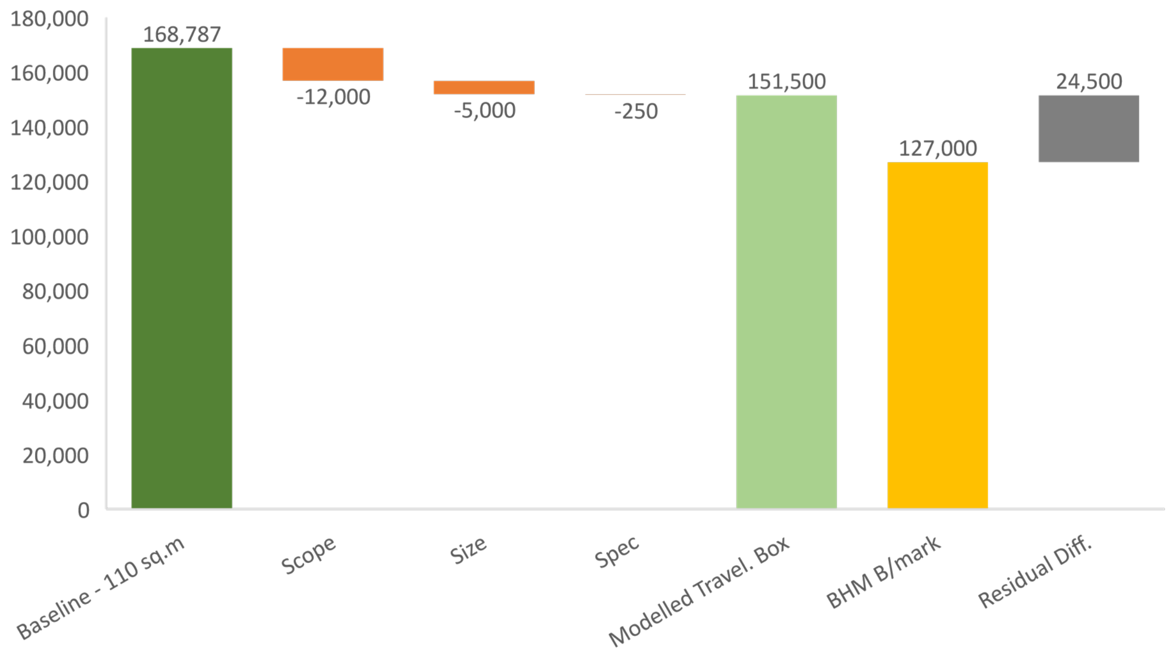


Figure 8: Case Study #1 – House (110 sqm) reconciled vs. BHM

5.6 Summary of Findings

- **'Travelling box' exercise found lower scheme house costs in BHM**
  The 'travelling box' exercise found that construction costs using Irish specifications on a cost-per-sqm rate for the same scheme house were approximately 15% lower in BHM than in DUB.

- **Cost ranges for actual scheme houses are lower in BHM**
  Lower construction costs were also evident in BHM for an actual scheme house when built using the typical specifications for BHM. The cost-per-sqm rate was 6-10% lower in BHM than DUB and the cost-per-unit basis was 21-29% lower in BHM than DUB. This is due to a number of factors set out below.

- **Cost and design comparison found differences in size and specification in BHM**
  Cost comparison indicates that UK can achieve a lower construction cost due to local market conditions and labour costs. This applies to both the 'travelling box' and actual scheme houses.

  Design comparison indicates differences in scope, unit sizing and specification, which lead to a lower cost in BHM than DUB for actual scheme houses. On scope, typically no-ensuite or fitted wardrobes are included in the 3-bedroom semi-detached scheme house in BHM. On unit sizing, the benchmark sampling for this study indicates that **houses** being delivered in BHM[13] are up to 15% (93 sqm vs 110 sqm) smaller than DUB.

- **Cost modelling found potential cost reduction opportunities on unit sizing**
  By adopting some of the design comparison findings, the modelled cost-per-unit is reconciled within 21% of BHM average construction cost.

  Opportunities on the scheme house are primarily linked to **size**. Potential opportunities for cost reduction also exist in scope and specification to a lesser extent.

[13] This unit size comparison is in the private-for-sale market.

Case Study #2
Suburban Apartments

6

6.0 Case Study #2 – Suburban Apartments

6.1 Outline Irish Specification

A five-storey apartment block is the selected case study for the suburban apartments with a building GFA of approximately 5,300 sqm. The structure consists of in-situ concrete frame with precast concrete slabs. The internal walls are a mix of load bearing blockwork and stud partitions. The external façade is finished with brick outer leaf, block inner leaf with double-glazed aluclad windows. There is a flat warm roof with a green roof finish. The block is serviced through an exhaust air heat pump supplying hot water and heating. The bathrooms are prefabricated pods and the apartments are fully fitted-out with kitchens, white goods and wardrobes to bedrooms. Refer to Appendix E for the outline specification.

6.2 Baseline Irish Costing

Figure 9 below shows the baseline unit construction cost (€250,200) and the breakdown into the main building elements based on the costed BoQs. This cost excludes the costs of site development and external works and car-parking. The costs are shown on a cost-per-unit based on a 2B4P apartment with a 91sqm GFA.

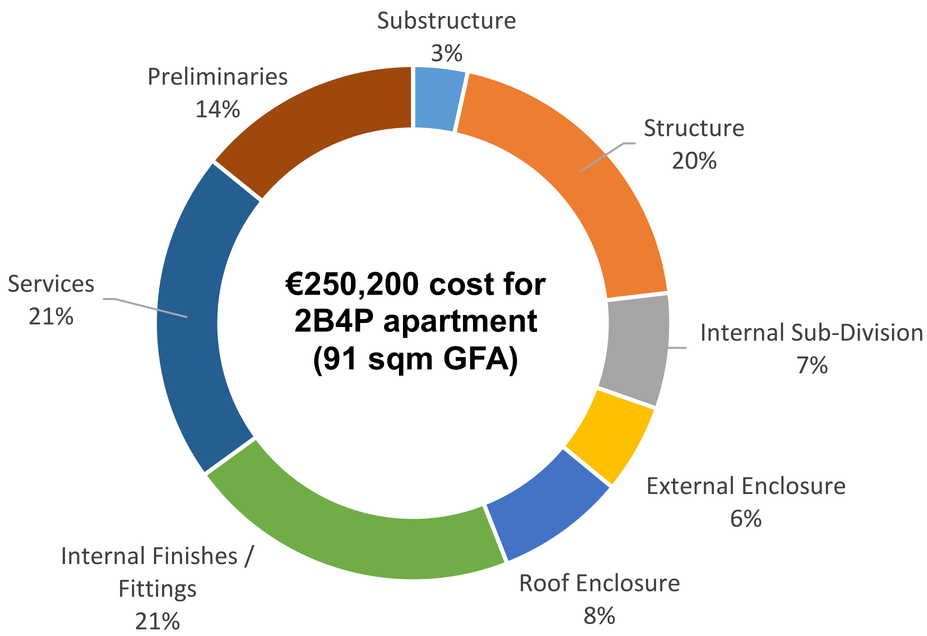


Figure 9: Case Study #2 Elemental Summary of DUB Baseline Costs

6.3 Cost Comparison – 'Travelling Box' Costing

Using the DUB based case study, costing the same project in each location, **the comparison includes the five locations covered under the study.** Costs are presented, again in two formats: cost-per-sqm of GFA and cost-per-unit. As per the methodology, cost-per-unit is based on 91 sqm GFA for 2B4P apartment. Figure 10 below shows that overall costs are comparable across the five locations. The range between the lowest (UTR) and the highest (BER) is 5%.

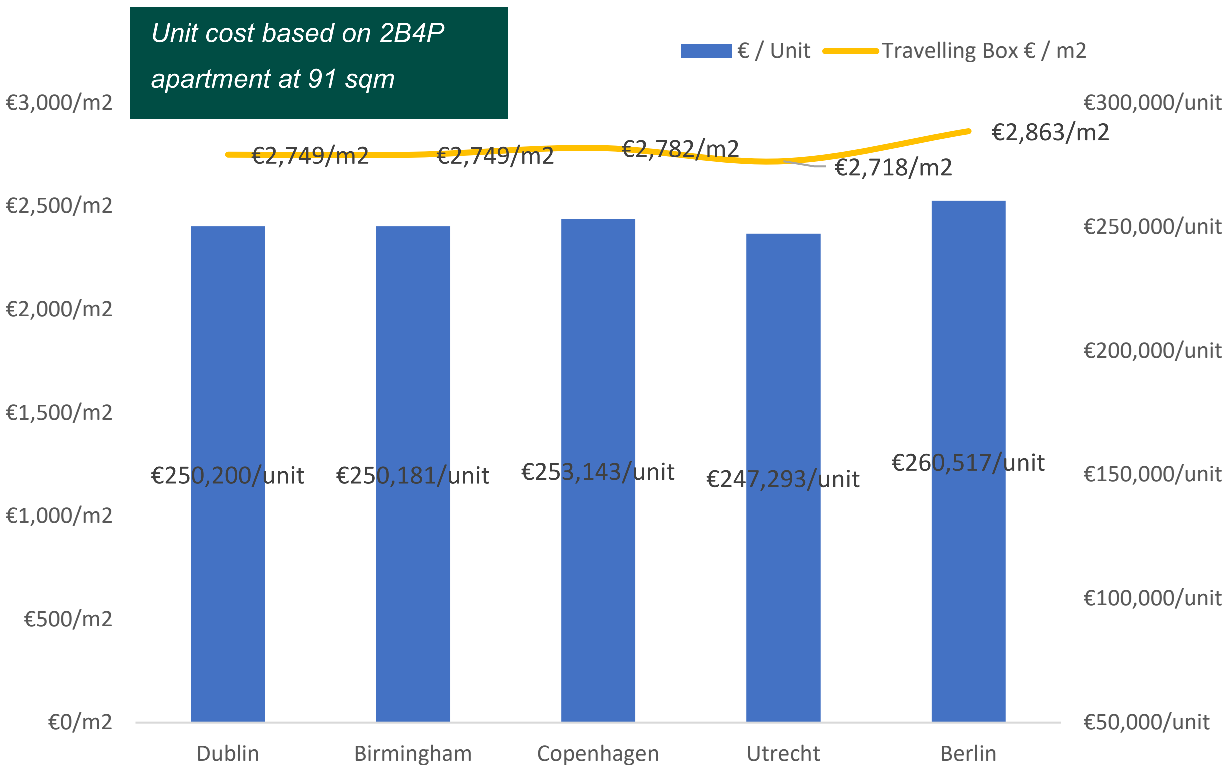


Figure 10: Case Study #2 Travelling Box Cost Comparison

Figure 11 below shows that at a more detailed level, some notable differences between elements are evident when compared to DUB.

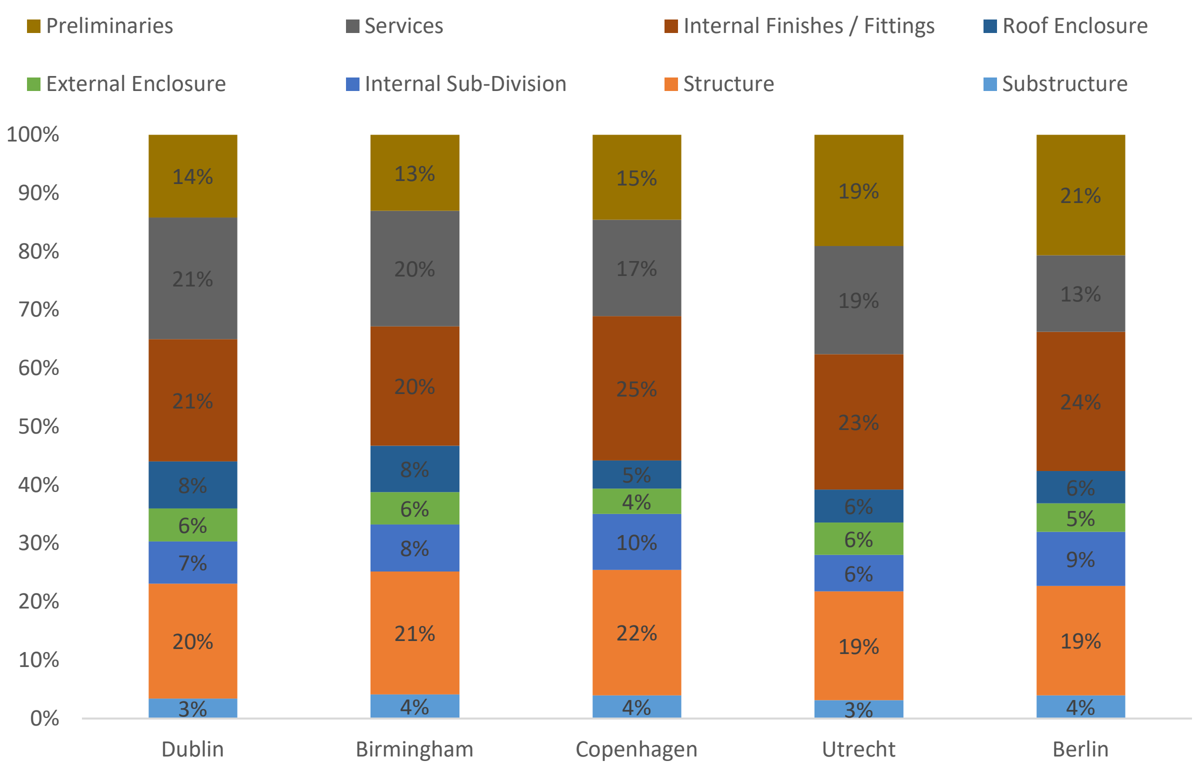


Figure 11: Case Study #2 Travelling Box Elemental % Breakdown

Table 13: Case Study #2 Travelling Box Unit Cost Elemental Comparison

Elemental Summary	DUB	BHM	CPH	UTR	BER	DUB vs. Lowest
Substructure	8,555	10,379	10,062	7,803	10,413	+9%
Structure	49,291	52,599	54,438	46,017	48,830	+7%
Internal Sub-Division	18,136	20,217	24,255	15,506	24,027	+14%
External Enclosure	14,022	13,875	10,927	13,722	12,718	+22%
Roof Enclosure	20,235	19,881	12,212	13,979	14,453	+40%
Internal Finishes/Fittings	52,394	51,186	62,569	57,315	62,146	+2%
Building Services	52,131	49,412	41,898	45,896	34,172	+34%
Preliminaries	35,436	32,362	36,781	47,056	53,728	+8%
Cost-Per-Unit	**250,200**	**250,181**	**253,143**	**247,293**	**260,517**	**+1%**

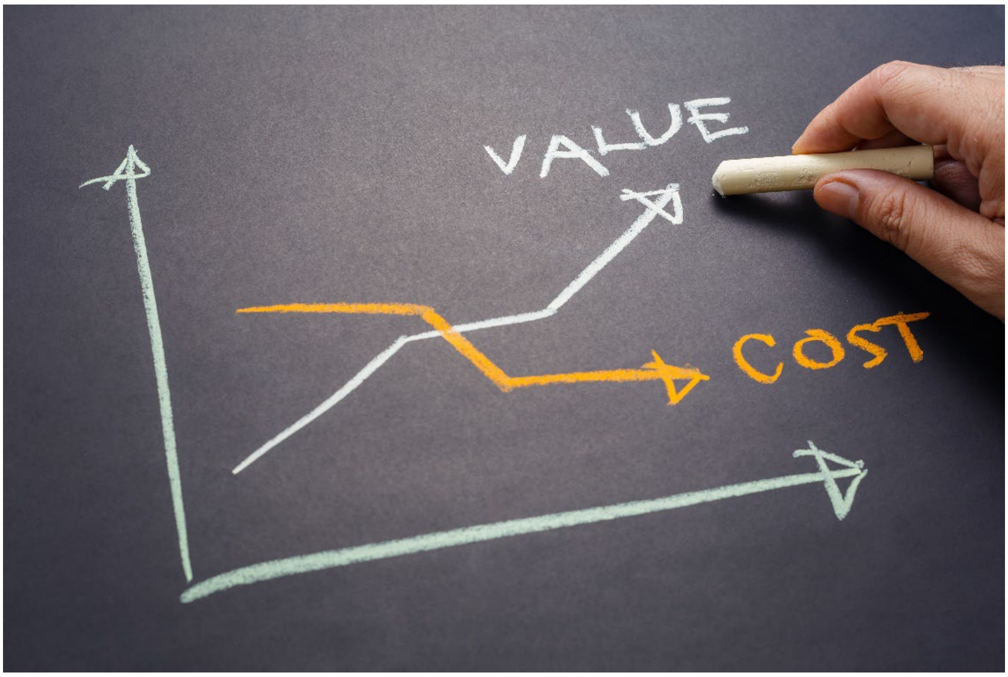
Table 13 above shows that there are cost differences between elements across the respective locations with **no location consistently having the highest or lowest costs**. For instance, DUB is 22% less than BER on substructure but 1% more on structure. DUB is the most location for Building Services with the range in other locations from 5% less (BHM) to 34% less (BER). For the European consultants, the costing of individual items, and therefore distribution of costs to the respective elements, was a challenge due to the level of detail in the BoQs. This is identified later among challenges encountered in the study.

6.4 Cost Comparison – European Benchmarking

The 'travelling box' costing indicates overall similar cost-per-sqm (+/- 4%) in the five locations. In the next step, the five local cost-per-sqm ranges for suburban apartments are compared with the five 'travelling box' costings (cost-per-sqm). Figure 12 below shows contrasting findings between the two cost comparison exercises.

Local cost-per-sqm ranges in DUB and BHM are similar, i.e. within 5%. However, there is a notable difference when DUB is compared against CPH, UTR and BER.

The cost difference ranges from -17% (UTR) -20% (CPH), and -31% (BER) when compared to DUB. Further comparison is required to understand the reasons behind these cost differences because the previous sections (i.e. 'travelling box') illustrate that if the same building is costed, similar overall cost-per-sqm (+/-4%) are evident.



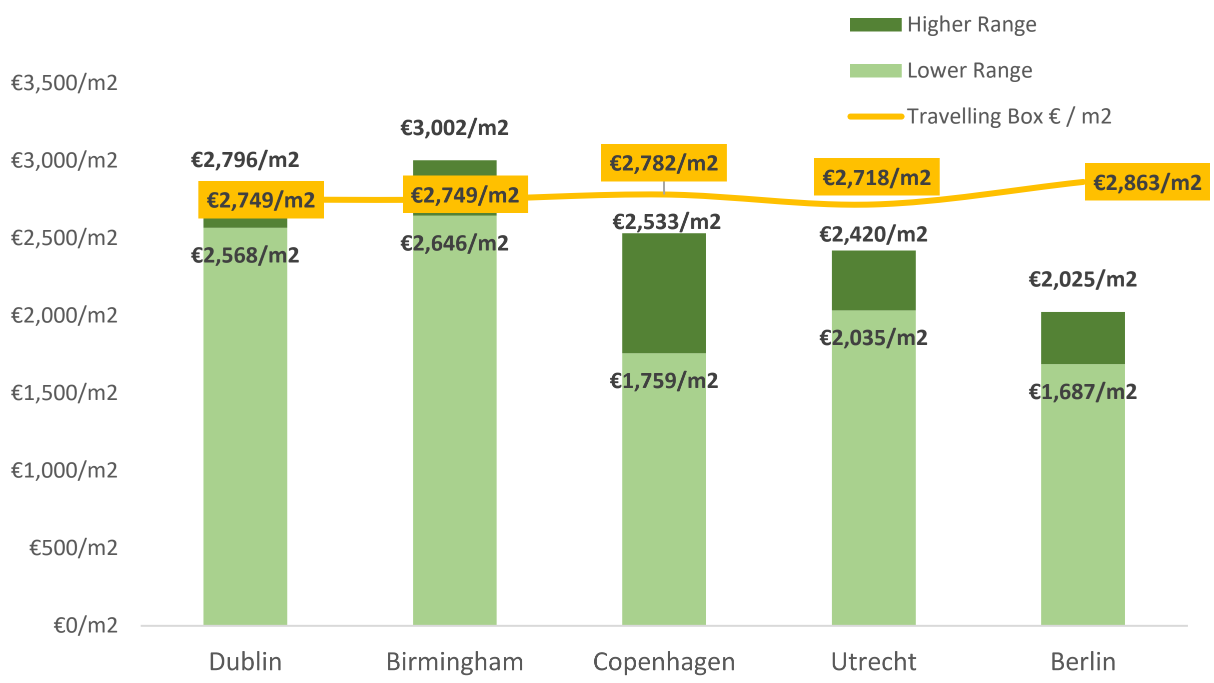


Figure 12: Case Study #2 Local Cost Ranges vs. Travelling Box

Using the headings identified in the methodology, the DUB apartment is compared to the four comparator locations.

Cost

The 'travelling box' comparison demonstrates that overall costs are largely similar across all locations but that there are greater differences between individual elements. These main differences are:

- Concrete and reinforcement rates are up to 40% more in CPH, BER and UTR than in DUB. Refer to Appendix I for composite rates comparison. (Substructure/ Structure)
- Building services are up to 30% less in BER than DUB. Refer to Table 13 above.
- Bathroom pods are more commonly used in apartment buildings in DUB and BHM and are up to 50% less than CPH, BER or UTR. (Multiple Elemental Categories)
- Preliminaries in DUB are notably less (up to 10%) than UTR and BER. Refer to Table 13 above.

Whilst there are cost differences between individual elements, cost alone is not the main difference on the comparison of the local cost ranges.

Scope

DUB and BHM are similar on scope. Some key differences (with relevant elemental categories in brackets) appear when comparing DUB with CPH, UTR and BER, for example:

- Level of fit-out to apartments tends to vary. 'Grey box' (i.e. excluding kitchens, white goods, fitted joinery, and flooring) approach tends to be commonly used in CPH, BER and UTR (Internal Finishes / Fittings).
- Two and three-bedroomed apartments tend to have one bathroom in CPH (i.e. no ensuite to master bedroom) (Multiple Elemental Categories).
- Exposed concrete slab (i.e. no suspended ceilings) in apartments is common. Soffits of concrete slabs are painted only (Internal Finishes / Fittings). See Figure 13 below.
- Rationalised electrical fittings in a typical apartment, e.g. power points, pendant lights (Building Services).

Figure 13: Indicative apartment interior with exposed concrete slab as the ceiling and surface-mounted light fittings.

- Light fittings are not always provided. It is common for light fittings to be fitted by the end-user/ tenant (Internal Finishes/ Fittings).
- CPH and BER benefit from a municipality level district heating network, which removes the need for dedicated central plant rooms or individual heating systems (Building Services).

Unit Sizing

As described in the methodology, construction costs on a cost-per-unit are also analysed. Local cost ranges are multiplied by unit sizing (see methodology) to generate a cost-per-unit range. This provides a lower and higher cost range for typical 2B4P apartment with the exception of CPH. **2B4P apartments are not typically constructed, hence 3B4P is used for the unit sizing, based on the review of actual designs from CPH.** Figure 14 below shows the cost ranges.

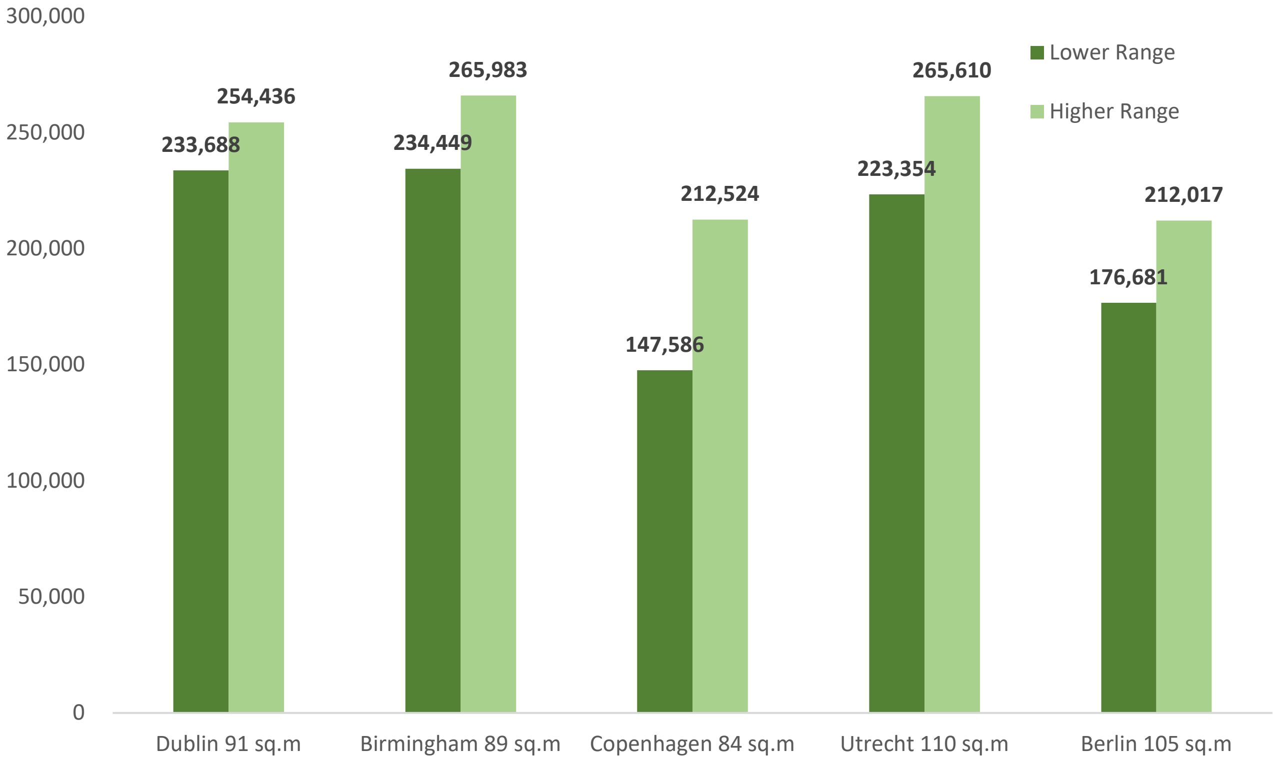


Figure 14: 2B4P Apartment Cost per unit based on local cost ranges

Due to variations in unit sizing (i.e. CPH -8% smaller and UTR +21% larger), the cost-per-unit provides a different comparison to the cost-per-sqm. For instance:

- UTR is circa 17% less than DUB on cost-per-sqm but on an average cost-per-unit is similar (i.e. within 4% on lower range).

- BER is 31% less but falls to 24% on a cost-per-unit comparison.
- CPH is on the lower range is approximately 37% less than DUB but this is 20% on the cost-per-sqm.

Specification

DUB and BHM were similar on specification. CPH, BER and UTR have a number of specification differences with observations from the European cost consultants noted below.

- Traditional stud partition walls are not as common. Load bearing concrete / pre-cast or gypsum block[14] are adopted instead (Internal Sub-division/ External Enclosure).
- uPVC windows are commonly adopted in BER. Composite aluminium and timber windows (i.e. aluclad) are seen as a premium product, but in DUB aluclad is seen as a standard specification on apartment buildings (External Enclosure).
- External wall build-ups and detailing are notably different. CPH, BER and UTR tend to use a single leaf with insulation or a sandwich panel type system (a type of MMC), as opposed to system typically adopted in DUB (i.e. large cavities, structural steel angles to carry masonry external leaf) (External Enclosure).
- Traditional labour-intensive trades such as brickwork and blockwork are either not used or used minimally in CPH, BER and UTR. Panellised façade systems (a type of MMC) are adopted mostly instead (External Enclosure).
- CPH adopts pre-fabrication of building elements more than DUB. However, bathrooms pods are not as common in apartment buildings in CPH, BER and UTR (Multiple Elemental Categories).

[14] http://bauservice-stephan.com/documents/mg_gypsumpanels_en.pdf

- Standardisation of components (e.g. windows, doors) is particularly common in CPH. Products are specified from standard supplier / manufacturer range (External Enclosure).
- Exposed concrete walls are common (i.e. no dry lining to walls) with paint finish only in CPH, BER and UTR (Internal Fittings/Finishes).
- Building services vary between locations, but some differences include:
  - Water supply direct from mains with metering in each apartment in CPH and BER.
  - Heat exchanger from district heating system (also noted under scope).
  - Limited / no lighting provided in CPH and BER (noted under scope).
- Deck access apartments are common in CPH and UTR.

Standards/Regulations

DUB and BHM are similar. However, some differences exist, which are linked to design guidelines and regulatory requirements (when comparing DUB with CPH, UTR and BER) which indicate cost impacts:

- External wall build-ups (as noted under specification) most likely driven by local building regulations.
- Regulations do not require sprinklers in equivalent residential buildings in CPH, BER and UTR and therefore, are not typically installed.
- Performance based spatial requirements in CPH, BER and UTR (as noted under methodology). The CPH Municipal Plan 2019 notes that 50% of the building GFA must consist of units of at least 95 sqm[15] on average to meet needs for families. The remaining 50% of building GFA can be used to build smaller units. The minimum allowable unit size is 50sqm in suburban areas and 40sqm in urban areas.

[15] Link to the Municipal Plan https://kp19.kk.dk/retningslinjer/boliger-og-byliv/boligstoerrelser

- Based on a sample of projects[16], DUB designs appear more efficient overall when key design metrics are compared (see Table 14 below). The average net-to-gross (NFA: GFA) ratio in CPH, BER and UTR is influenced by deck access arrangement in some projects.
- UTR and CPH have a number of examples of deck access housing with benefits from cross ventilation.

Table 14: Design Efficiency Comparison

Location	Apartments Per Core	Dual Aspect	NFA: GFA
DUB	8 – 11	33 – 50%	79 – 88%
BHM	6 – 10	28 – 31%	74 – 80%
CPH	2 – 4	100%	c. 80%
UTR	c.7	100%	c.90%
BER	3 – 7	c. 70%	c.85%

6.5 Cost Modelling

Cost modelling involves modelling design and cost comparisons to reconcile the baseline unit cost against the lowest average comparator. In this case, CPH is the lowest average construction cost (€180,000) based on the cost range noted in Figure 14 above (€147,586-€212,524).

The items modelled are set out in Table 15 below. Cost differences of the modelled items are notional. Whilst Table 15 indicates the items modelled for this exercise, it is not exhaustive and any changes would need to be assessed in the Irish context, taking account of market acceptance, housing typologies and climate.

[16] Based on the following project sample - BHM –1,320 apartments; CPH - 1,100 apartments; UTR - 490 apartments; BER - 500 apartments

Table 15: Case Study #2 & #3 List of Modelled Items

Item Type	Modelled Items	Notional Cost	Notional Cost as % of total unit cost
Scope Discretionary	• Omit fitted joinery • 50% exposed concrete slab to apartments • Omit ensuite to master bed (including reduction in GFA)	-€15,200	-6%
Scope Displacement	• Omit kitchen & appliances	-€12,800	-5%
Size	• Baseline is based on 2B4P apartment of 91 sqm GFA • Costs remodelled based on achieving 84 sqm GFA (CPH)	-€2,100	-1%
Specification	• Render sandwich panel external wall system in lieu of masonry brick facades • uPVC windows in lieu of aluclad • Notional value for standardisation to windows and doors • Omit all downlights and replace with single pendants	-€8,200	-3%

	• Gypsum block in lieu of an internal non-load bearing partitions[17] • Exposed concrete walls with paint finish only (i.e. no lining to inner face of external walls)		

Using **baseline unit** cost (€250,200) and size (91 sqm GFA), items are modelled to generate a **notional modelled baseline** (€212,000 and 84 sqm GFA). Figure 15 below shows that by adopting the findings noted above, the costs can be reconciled to within 18% of the CPH average construction cost (€180,000).

[17] For further information on gypsum blocks, refer to link: manufacturer link http://bauservice-stephan.com/documents/mg_gypsumpanels_en.pdf

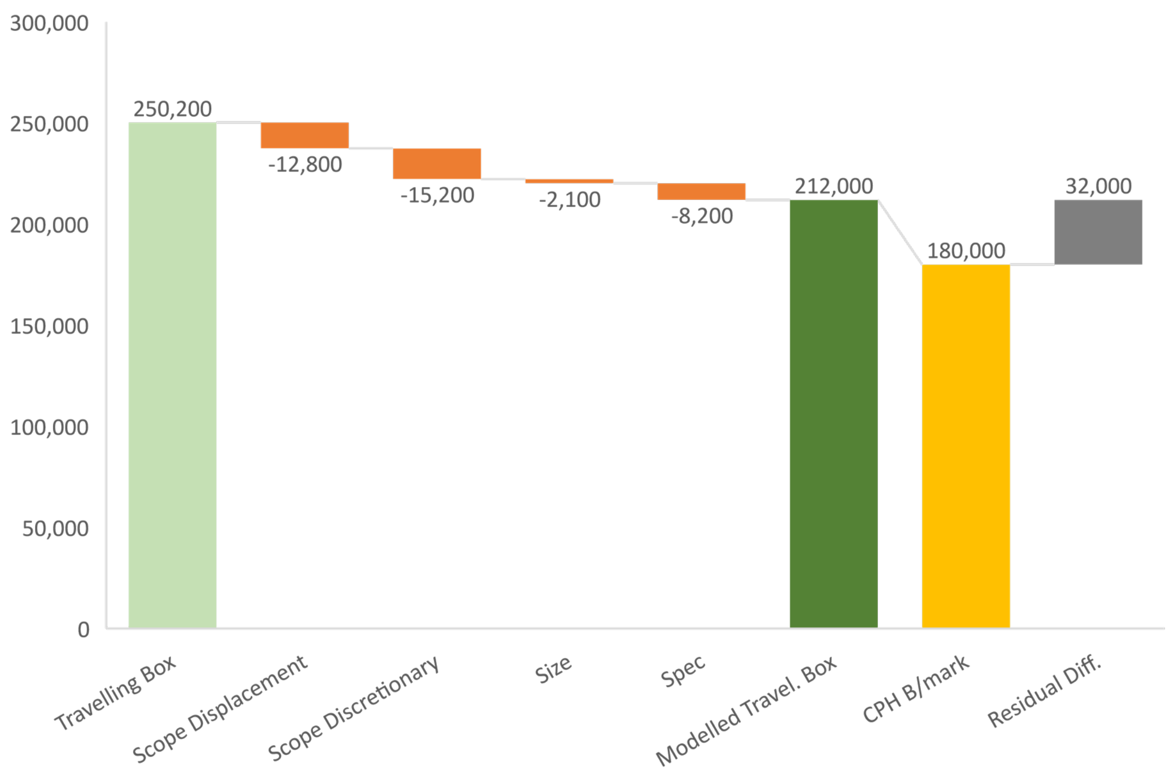


Figure 15: Case Study #2 – 2B4P reconciled vs. CPH

6.6 Summary of Findings

- **'Travelling box' exercise found similar apartment construction costs in all locations**

  The 'travelling box' exercise found that overall construction costs using Irish specifications on a cost-per-sqm rate for the same apartment building are broadly in line (+/- 4%) with construction costs in the four European comparator locations.

- **Cost ranges for actual apartment buildings are lower in CPH, BER and UTR**

  Lower construction costs were evident in CPH, BER and UTR than DUB (and BHM) for actual apartment buildings when built using the typical specifications for those locations on a cost-per-sqm rate (up to 31% differences identified).

- **Cost and design comparison found differences in scope, size and specifications in CPH, BER and UTR**

  On the design comparison, cost differences were identified related to differences in scope, unit sizing and specification. It is common in CPH, BER and UTR to sell or rent apartments with exposed concrete slab (bare ceilings), no floor finish, no fitted wardrobes, no light fittings and sometimes minimal or no fitted kitchen. In addition, it is common for apartments to have a single bathroom shared between two or three bedrooms and no ensuites. Stakeholders providing feedback during the study's Stage 2 Workshop noted that some of these scope and specification choices are market driven, and some may require further assessment in relation to achieving technical performance requirements including sound, hygiene and fire.

When typical construction practices in two locations are compared, it is difficult, and not always possible to quantify cost impacts of all differences in individual regulations, standards or norms. Not all standards and regulations are prescriptive. For example, CPH, BER and UTR requirements for apartment sizes are more performance-based than prescriptive and a significant range of apartment sizes is evident in these locations.

- **Cost modelling found potential cost reduction opportunities on scope and specification**

  By modelling the items identified in the comparison findings on the case study projects' Irish baseline unit cost, the cost-per-unit is reconciled to within 18% of the lowest comparison which was CPH.

  Potential cost reduction opportunities on apartments are primarily linked to scope and standardisation.

Increased use of standardisation in construction systems and specification of components such as windows is evident in the CPH, BER and UTR for apartments. Manufactured panel systems (a type of MMC) are more common in CPH, BER and UTR than labour-intensive site-based activities (such as block- or brick-laying). CPH, BER and UTR also deliver a higher proportion of apartments with associated efficiencies. Stakeholders in Stage 2 Workshop noted that diversity in the design and appearance of housing can increase construction costs. Diversity also makes it more challenging to increase standardisation, including materials selection.

Case Study #3
Urban Apartments

7

7.0 Case Study #3 – Urban Apartments

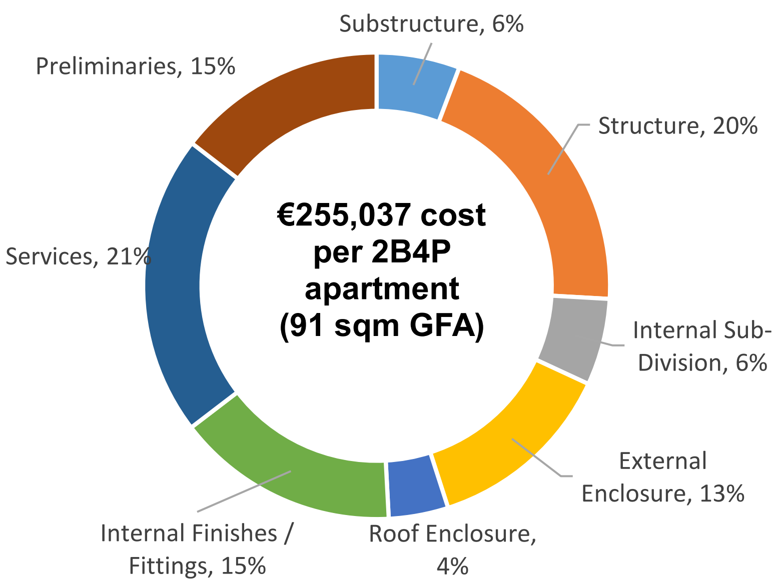
7.1 Outline Irish Specification

A seven-storey apartment block is the selected case study for the urban apartments with a building GFA of approximately 5,500 sqm. The structure consists of precast walls and precast concrete slabs. The external façade is finished with brick outer leaf, precast walls inner leaf and double-glazed aluclad windows with sliding doors to balconies. The roofs are a mix of standing seam on profiled metal roofs and green roof covering to flat areas. The block is serviced through an exhaust air heat pump supplying hot water and heating. Bathrooms are prefabricated pods and the apartments are fully fitted out with kitchens, white goods and wardrobes to bedrooms. Refer to Appendix E for full outline specification.

7.2 Baseline Irish Costing

Figure 16 below shows the baseline unit construction cost (€255,037) and the breakdown into the main building elements. This is based on a 2B4P apartment at 91 sqm GFA generated from the building's cost-per-sqm rate. As noted in the methodology, the baseline unit cost excludes the costs of site development works, external works and car-parking. Structure (20%), Services (21%) and Internal Fittings & Finishes (15%) are again significant costs, along with the External Enclosure (13%) and Prelims (15%).

Figure 16: Case Study #3 Elemental Summary of DUB Baseline Costs



7.3 Cost Comparison – 'Travelling Box' Comparison

The 'travelling box' cost comparison for Case Study #3 is shown in Figure 17 below and includes the five locations covered under the study. As noted previously, costs are shown as both cost-per-sqm and cost-per-unit.

Similar to Case Study #2, costs are comparable across all locations, although the range is wider with BHM a 9% higher cost than DUB.

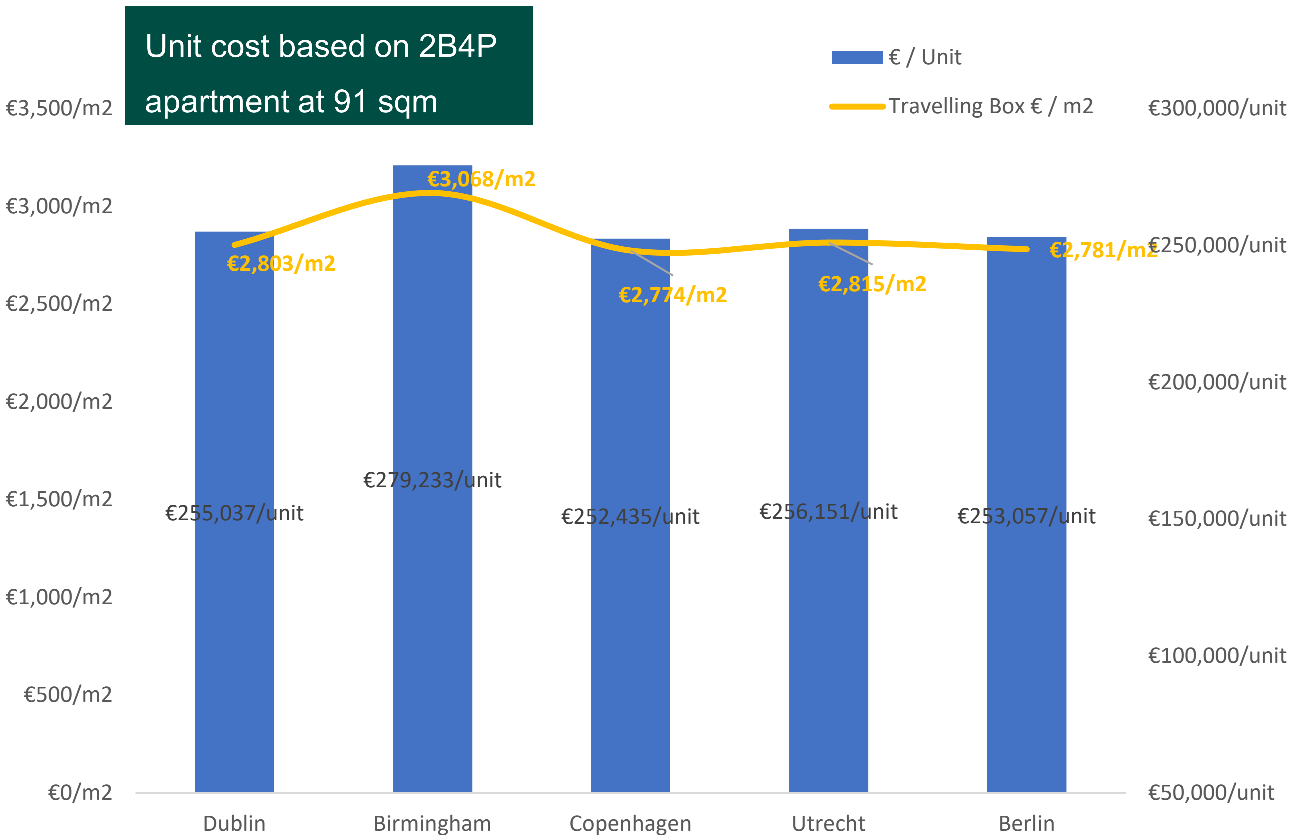


Figure 17: Case Study #3 Travelling Box Cost Comparison

As before, in Figure 18 below, cost distribution across the main building elements is shown.

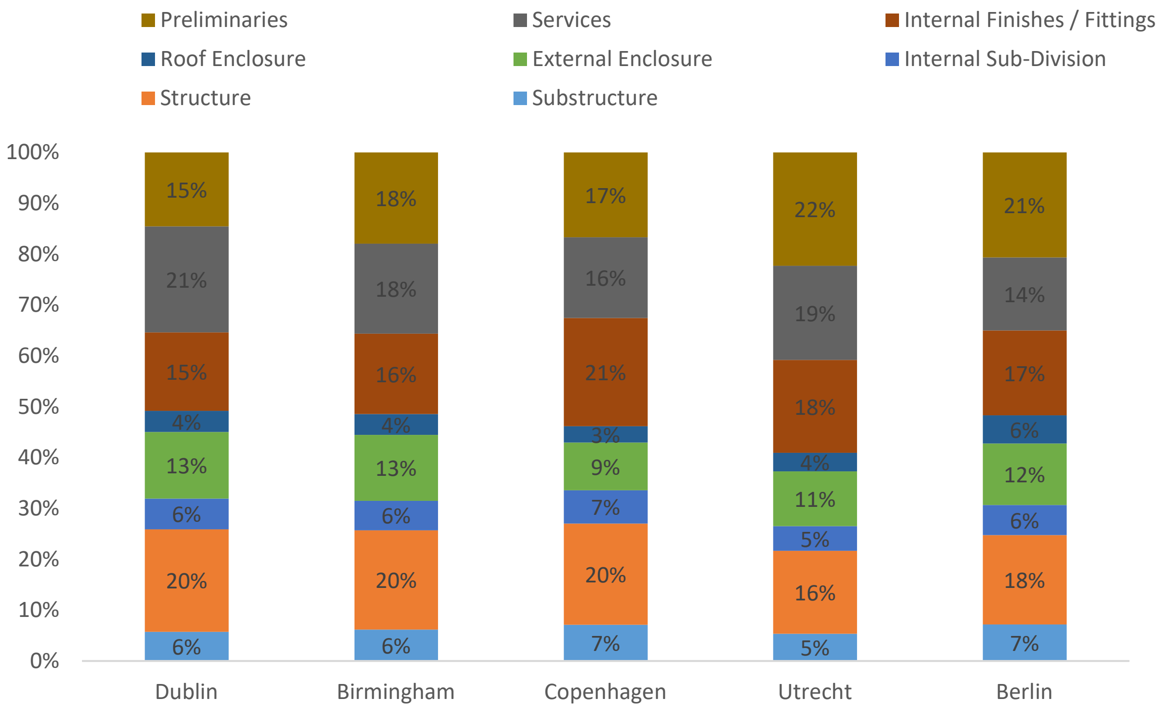


Figure 18: Case Study #3 Travelling Box Elemental % Breakdown

Table 16: Case Study #3 Travelling Box Unit Cost Elemental Comparison

Elemental Summary	DUB	BHM	CPH	UTR	BER	DUB vs. Lowest
Substructure	14,697	17,288	18,010	13,792	18,130	+6%
Structure	51,348	54,463	50,203	41,693	44,590	+19%
Internal Sub-Division	15,347	16,278	16,469	12,388	14,869	+19%
External Enclosure	33,490	36,097	23,702	27,683	30,645	+29%
Roof Enclosure	10,522	11,388	8,178	9,301	14,002	+22%
Internal Finishes / Fittings	39,368	44,188	53,725	46,739	42,173	0%
Building Services	53,208	49,367	40,076	47,434	36,429	+32%
Preliminaries	37,057	50,166	42,073	57,121	52,218	0%
Cost-Per-Unit	**255,037**	**279,233**	**252,435**	**256,151**	**253,057**	**+1%**

The commentary on individual elements is similar to Case Study #2 in that there is **no location which is consistently the lowest or highest cost**. As per Case Study #2, UTR is the lowest cost on substructure, structure and internal sub-division. Preliminaries in UTR are 54% lower than DUB. The previous comment on challenges when costing the BoQs apply here also.

In summary, high-level comparison indicates that overall costs are comparable between DUB and the comparator locations. Similar to Case Study #2, there are larger (up to 29%) cost differences at the individual elemental level.

7.4 Cost Comparison – European Benchmarking

The 'travelling box' costing indicates similar cost-per-sqm with DUB at 9% less than BHM (highest) and 1% more than BER and CPH (lowest). These findings are now compared with the local cost ranges from each location.

As per Case Study #2, local cost ranges indicate notable differences between DUB and CPH, UTR and BER. These locations range from 19% to 33% lower costs than DUB. The analysis carried out on Case Study #2 is relevant and most Case Study #2 findings are applicable to Case Study #3. For Scope, Cost, Specification & Design comments, refer to Case Study #2 for details. Below are different findings under Unit Costing specifically applicable to Case Study #3 only.

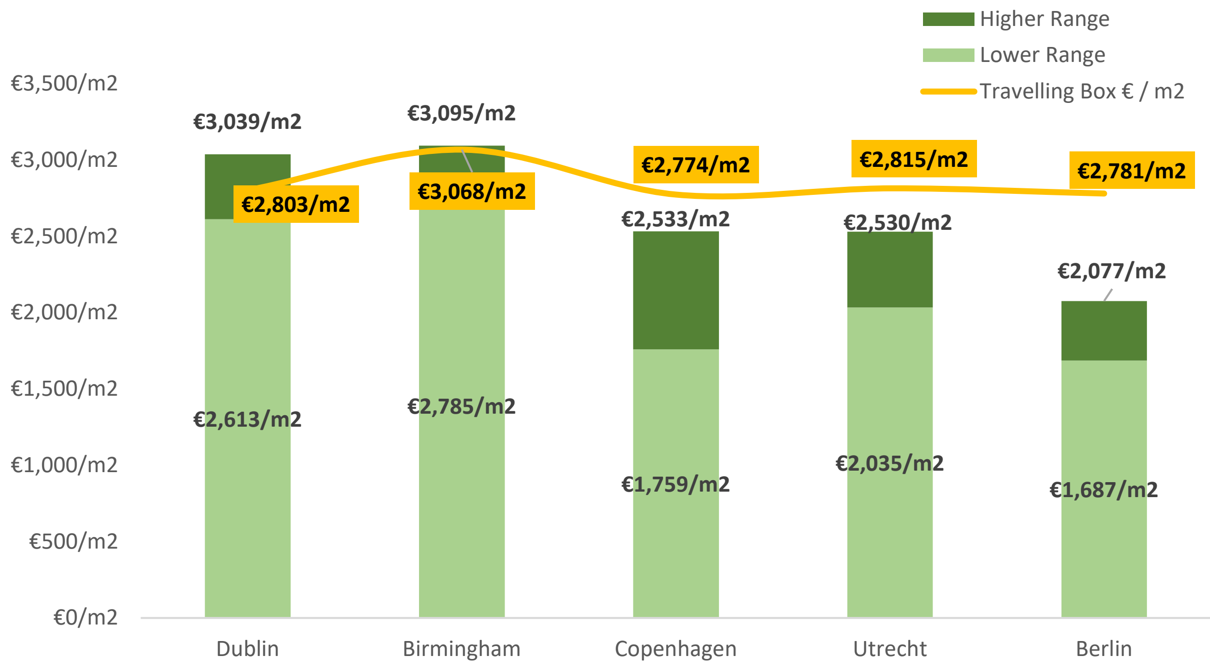


Figure 19: Case Study #3 Local Cost Ranges vs. Travelling Box

Unit Sizing

The unit sizing is similar to Case study #2 apart from BHM, which increases to 95 sqm (89 sqm in Case Study #2) based on the sampling of projects analysed. In Figure 20 below, the unit sizing noted previously is multiplied by the local cost-per-sqm range in each location to provide a cost-per-unit range. Due to the variance in unit sizing, the cost-per-unit provides a different comparison to the cost-per-sqm. For instance;

- UTR is 19% less than DUB on cost-per-sqm compared to 6% on cost-per-unit.
- BER is 33% less than DUB on cost-per-sqm but 26% on cost-per-unit
- CPH is 38% less than DUB on the cost-per-unit. The difference is only 24% on cost-per-sqm.

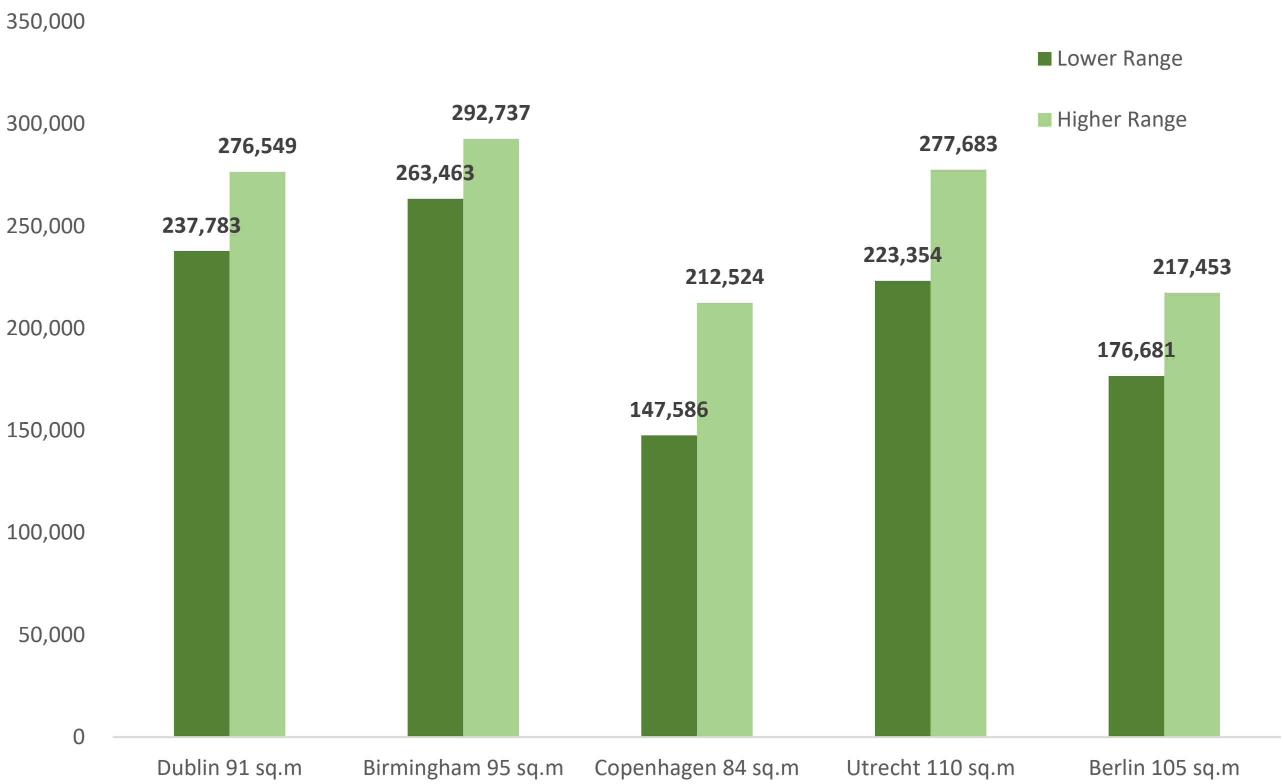


Figure 20: 2B4P Apartment Cost Per unit based on local cost ranges

7.5 Cost Modelling

Cost modelling involves modelling design and cost comparisons to reconcile the baseline unit cost (€255,037) against the lowest average comparator. In this case, as in CS #2, CPH is the lowest average construction cost (€180,000) based on the cost range noted in Figure 20 above (€147,586-€212,524).

The items modelled are set out in Table 17 below. Cost differences of the modelled items are notional. Whilst Table 17 indicates the items modelled for this exercise, it is not exhaustive and any changes would need to be assessed in the Irish context, taking account of market acceptance, housing typologies and climate.

Table 17: Case Study #2 & #3 List of Modelled Items

Item Type	Modelled Items	Notional Cost	Notional Cost as % of total unit cost
Scope Discretionary	• Omit fitted joinery • 50% exposed concrete slab to apartments • Omit ensuite to master bedroom (including reduction in GFA)	-€18,900	-7%
Scope Displacement	• Omit kitchen & appliances	-€13,900	-5%
Size	• Baseline is based on 2B4P apartment of 91 sqm GFA • Costs remodelled based on achieving 84 sqm GFA (CPH)	-€2,100	-1%
Specification	• Render sandwich panel external wall system in lieu of masonry brick facades • uPVC windows in lieu of aluclad • Notional value for standardisation to windows and doors • Omit all downlights and replace with single pendants • Gypsum block in lieu of an internal non-load bearing partitions • Exposed concrete walls with paint finish only (i.e. no lining to inner face of external walls)	-€8,000	-3%

Using **baseline unit** cost (€255,037) and size (91 sqm GFA), items are modelled to generate a **notional modelled baseline** (€212,000 and 84 sqm GFA). Figure 21 below shows that by adopting the findings noted above, the costs can be reconciled to within 18% of the CPH average construction cost (€180,000).

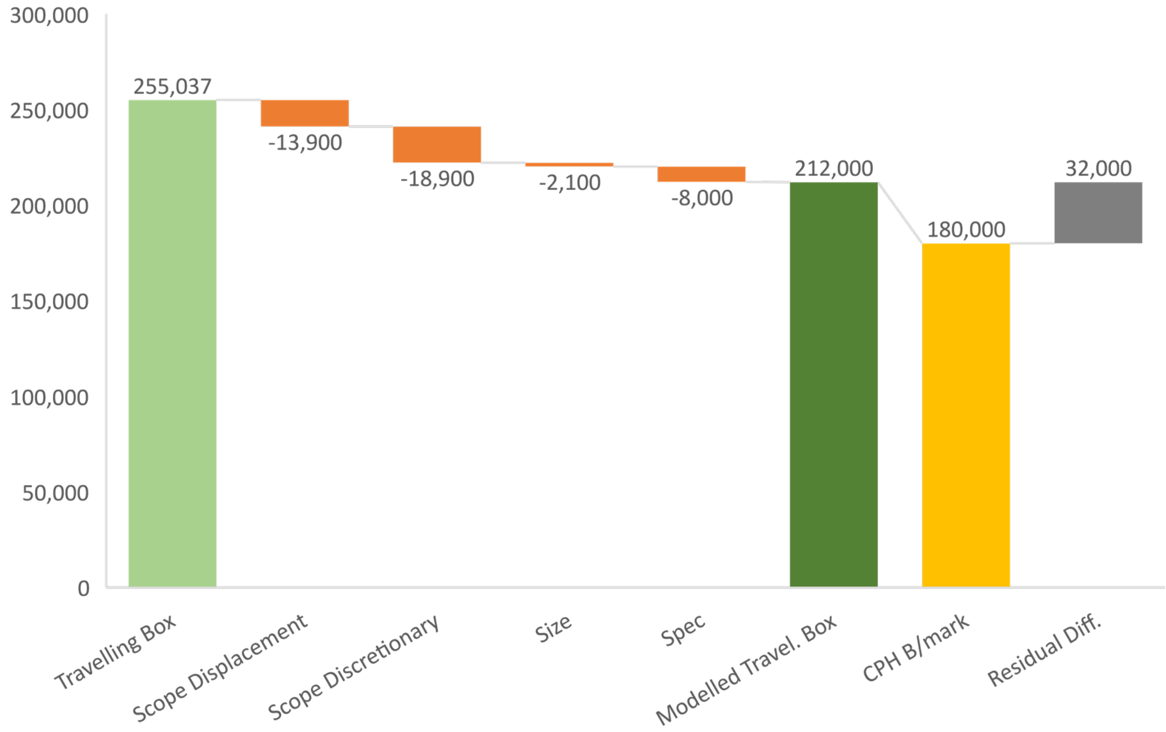


Figure 21: Case Study #3 – 2B4P Reconciled vs. CPH

7.6 Summary of Findings

- **'Travelling box' exercise found similar apartment construction costs in all locations**

  The 'travelling box' exercise found that overall construction costs using Irish specifications on a cost-per-sqm rate for the same apartment building are broadly in line (up to +9%) with construction costs in the four European comparator locations.

- **Cost ranges for actual apartment buildings are lower in CPH, BER and UTR**

  Lower construction costs were evident in CPH, BER and UTR than DUB (and BHM) for actual apartment buildings when built using the typical specifications for those locations on a cost-per-sqm rate (up to 33% differences identified).

- **Cost and design comparison found differences in scope, size and specifications in CPH, BER and UTR**

  This is the same as Case Study #2.

- **Cost modelling found potential cost reduction opportunities on scope and specification**

  This is the same as Case Study #2.

Case Study #4
PBSA

8

8.0 Case Study #4 – PBSA

8.1 Outline Irish Specification

A four-storey PBSA building is the selected Case Study #4 with a building GFA of approximately 4,000 sqm. The accommodation schedule comprises clusters of 7 to 8 ensuite bedrooms with communal kitchen and living rooms. The structure consists of in-situ concrete frame and slabs. The external façade is finished with brick outer leaf, block inner leaf and double-glazed aluclad windows with localised privacy screens. The PBSA building is serviced through a centralised plant room with heat interface units to each cluster supplying hot water and heating via radiators. The bathrooms are prefabricated pods and the rooms are fully fitted with all fitted and loose fittings and furnishings.

8.2 Baseline Irish Costing

Figure 22 below shows the baseline unit construction cost (€97,044) and the breakdown into the main building elements. The costs are shown as cost-per-unit (student bedspace) with a 30 sqm GFA. As noted in the methodology, the baseline unit cost excludes the costs of site development works, external works and car-parking.

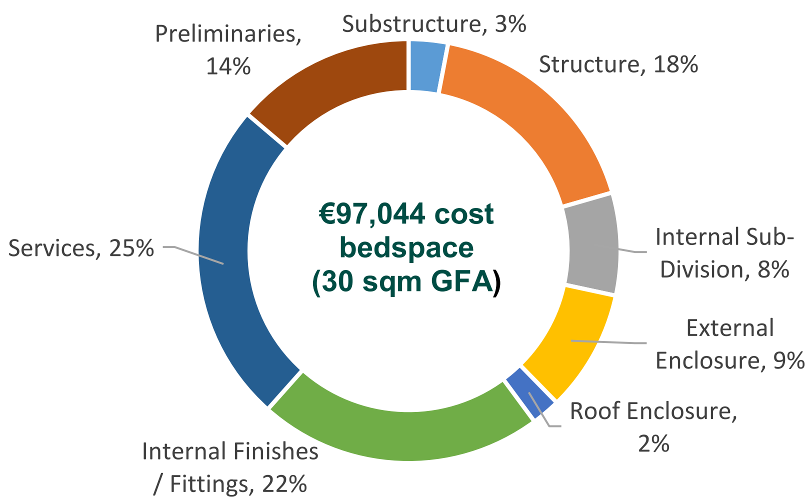


Figure 22: Case Study #4 Elemental Summary of DUB Baseline Costs

8.3 Cost Comparison – 'Travelling Box' Costing

The PBSA case study project was costed in the five comparator locations and the results are compared below. The costs are shown as cost-per-sqm of GFA and cost-per-unit (student bedspace).

Figure 23 below shows that the costs are comparable across all locations with an 11% range between the lowest cost (DUB) and highest cost (BER).

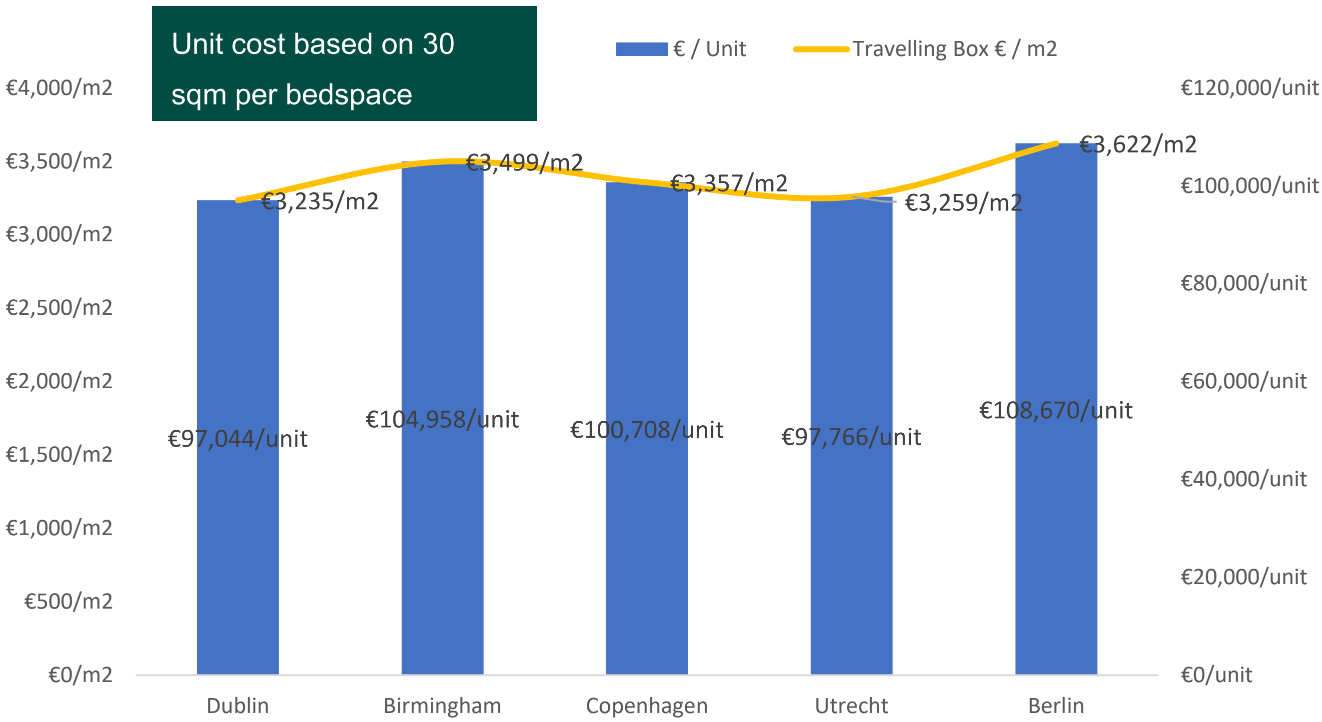


Figure 23: Case Study #4 Travelling Box Unit Cost Comparison

Similar to Case Studies #2 and #3, the distribution of costs is varied at an elemental level.

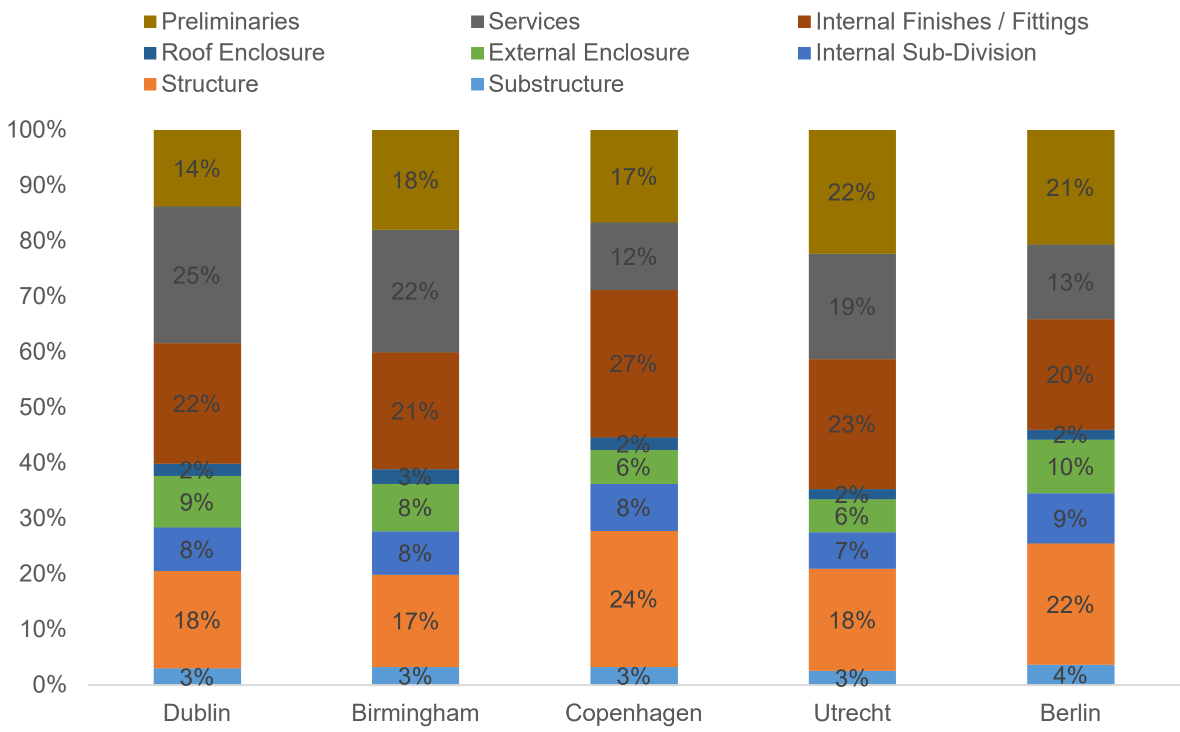


Figure 24: Case Study #4 Travelling Box Elemental % Breakdown

Table 18: Case Study #4 Travelling Box Elemental Comparison

Elemental Summary	DUB	BHM	CPH	UTR	BER	DUB vs. Lowest
Substructure	2,913	3,443	3,300	2,501	3,953	+14%
Structure	17,025	17,374	24,659	17,972	23,745	0%
Internal Sub-Division	7,602	8,286	8,511	6,456	9,873	+15%
External Enclosure	9,028	8,906	6,154	5,785	10,472	+36%
Roof Enclosure	2,131	2,781	2,315	1,785	1,948	+16%
Internal Finishes/ Fittings	21,060	22,095	26,742	22,935	21,638	0%
Building Services	23,900	23,216	12,243	18,531	14,619	+49%
Preliminaries	13,385	18,856	16,785	21,802	22,424	0%
Cost-Per-Unit	**97,044**	**104,958**	**100,708**	**97,766**	**108,670**	**0%**

The commentary on individual elements is similar to Case Studies #2 and #3. DUB is the lowest cost in the three elements of Structure, Internal Finishes and Preliminaries. Similar to the apartment buildings, DUB is at the higher end (+49% above the lowest cost) under Building Services.

8.4 Cost Comparison - European Benchmarking

The 'travelling box' cost comparison presents similar costs across the comparator locations with 12% separating the lowest (DUB) and highest (BER). As per previous sections, the 'travelling box' exercise is compared with the local cost ranges. On Figure 25 below, DUB is the highest on the cost ranges with BHM (-10%), CPH (-31%), UTR (-28%) and BER (-32%) all lower than the baseline cost on a cost-per-sqm comparison. In order to understand the difference, the two cost comparison exercises are reviewed under the same headings as identified before.

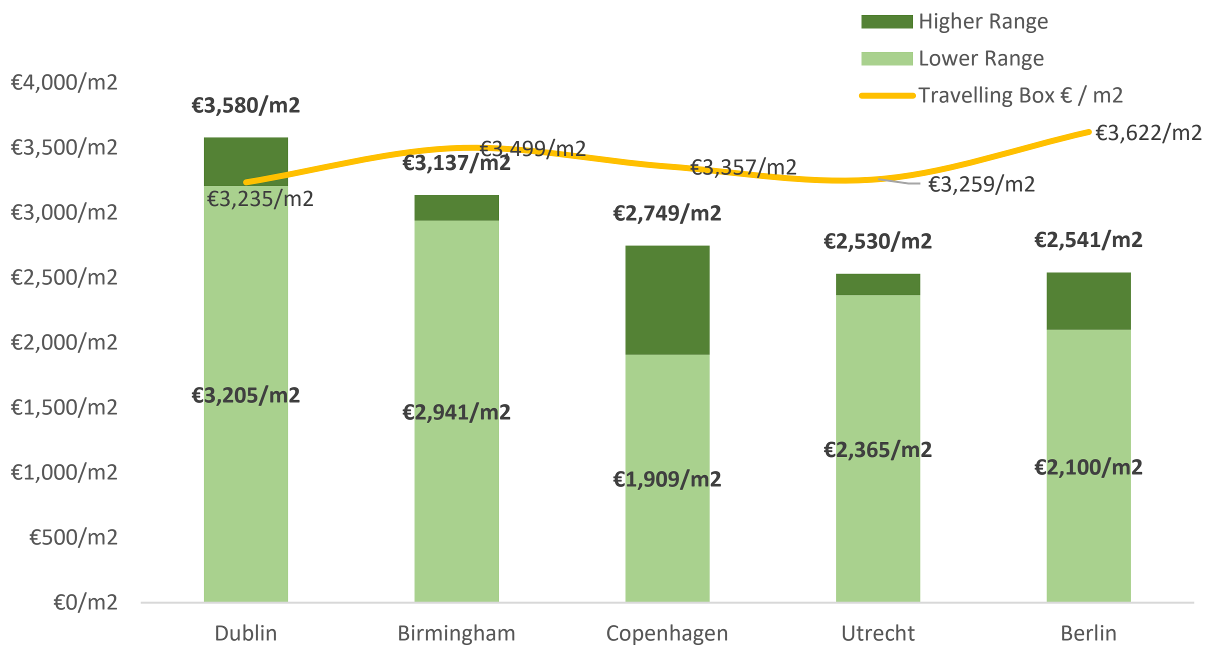


Figure 25: Case Study #4 Local Cost Ranges vs. Travelling Box

Cost

The 'travelling box' exercise indicates that costs are largely similar across all locations but the elemental comparison identifies notable differences when compared to DUB. Some findings are consistent with the apartment analysis:

- Concrete and reinforcement rates are less in DUB.
- Building services are notably less in CPH, UTR and BER.
- Bathroom pods are frequently used in PBSA in DUB and BHM, so are less than the other locations.
- Preliminaries in DUB are notably less than UTR and BER.

It would appear that while there are cost differences between individual elements that cost alone is not the main difference on the local cost comparison.

Scope

There are differences in scope across the five comparator locations. Some observations on scope differences when comparing DUB (and BHM) to CPH, BER and UTR are noted below:

- Furniture, Fixtures and Equipment (FF&E) (both fitted & loose) are typically excluded from construction costs and procured separately by the operator.
- Exposed concrete slab in bedrooms / studios is common (i.e. no suspended ceiling). Soffits of concrete slabs are left exposed or painted only.

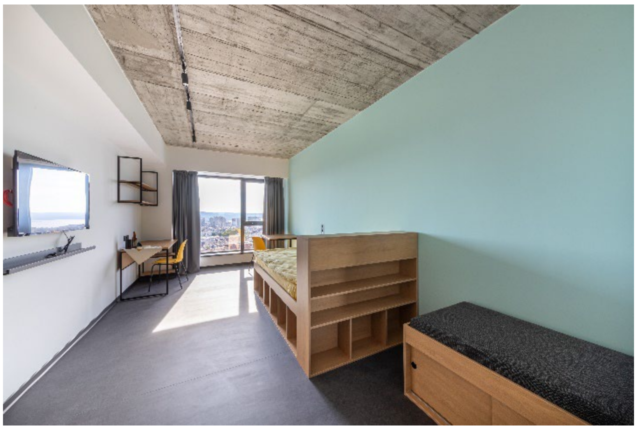


Figure 26: Example of exposed concrete slab (unpainted ceiling) finish in a student studio

- Rationalised electrical fittings, i.e. quantity of power points, pendant lights.
- District heating servicing buildings in CPH and BER removes the need for dedicated central plant.
- Studio / one bedroom apartment type units are more common in CPH, UTR and BER as opposed to cluster-style arrangements in DUB and BHM.

Unit Sizing

As set out in the methodology chapter, average sqm of GFA per bedspace is generated based on respective local design approaches to provide unit sizing for comparison. As stated above, this varies due to the cluster vs studio type units adopted in respective locations.

A cost-per-unit range is then calculated by multiplying the average sqm of GFA per bedspace in each location by the local cost ranges (in cost-per-sqm) in the respective location. This generates a lower and higher cost range for a typical bed space. DUB and BHM have the best efficiencies of GFA per bedspace due to a preference for cluster style units. Once the unit sizing is applied to the local cost ranges, the comparison to the other locations changes.

- CPH is over 30% less than DUB on cost-per-sqm but reduces to 20% less on a cost-per-unit.
- UTR reduces to 16% above DUB on a cost-per-unit compared to 28% on cost-per-sqm.
- Difference to BHM and BER reduce marginally from the cost-per-sqm comparison.

This change on the costs is due to the unit sizing and overall efficiency. This forms part of the modelling in the next section.

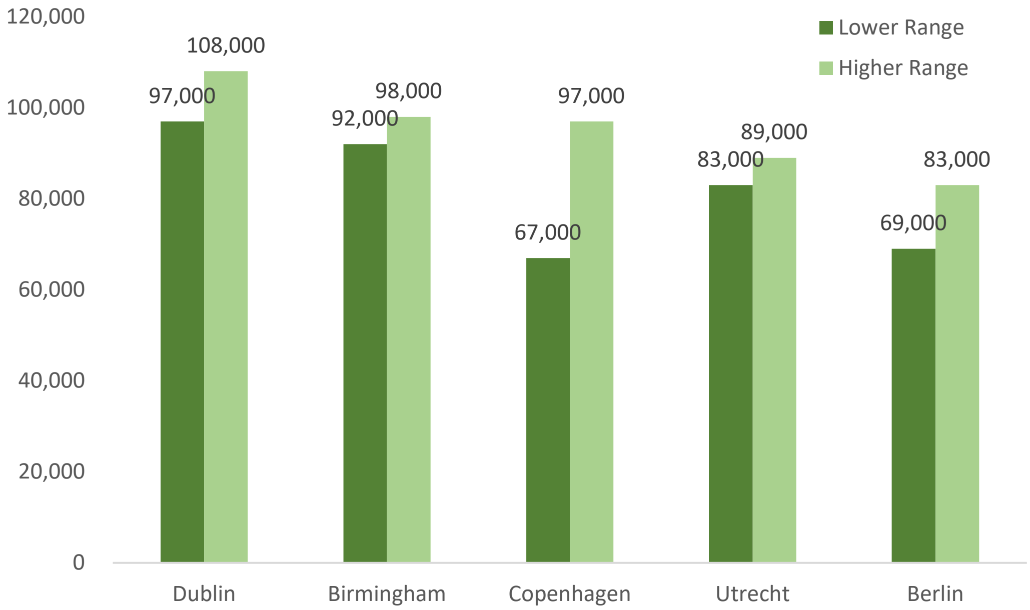


Figure 27: Case Study #4 – Cost-per-unit based on local cost ranges

Specification

The PBSA specification is similar in DUB and BHM. The differences between DUB (and BHM) and CPH, UTR and BER are similar to the differences in the apartment buildings. Refer to Case Study #2 for the detailed list.

Design

DUB and BHM are similar on design also. Refer to Case Study #2 for the design differences between DUB (and BHM) and CPH, UTR and BER.

8.5 Cost Modelling

Cost modelling involves modelling design and cost comparisons to reconcile the baseline unit costs (€97,044) against the lowest average comparator. In this case, BER is the lowest average construction cost (€75,400) based on the cost range noted in Figure 27 above (€69,000-€83,000).

The items modelled are set out in Table 19 below. Cost differences of the modelled items are notional. Whilst Table 19 indicates the items modelled for this exercise, it is not exhaustive and any changes would need to be assessed in the Irish context, taking account of market acceptance, housing typologies and climate.

Table 19: Case Study #4 – List of Modelled Items

Item Type	Modelled Items	Notional Cost	Notional Cost as % of total unit cost
Scope Displacement	• FF&E (both fitted, wardrobes, kitchenettes, etc., and loose, and fitted)	-€8,400	-9%
Scope Discretionary	• 50% exposed concrete slab as ceiling to apartments	-€800	-0.8%
Size	• Baseline is based on 30 sqm per bedspace • No change modelled here as the IRE sizing is more efficient	-	-
Specification	• Render sandwich panel external wall system in lieu of masonry brick facades • Notional value for standardisation to windows and doors • Gypsum block in lieu of internal non-load bearing partitions • uPVC windows in lieu of aluclad • Exposed concrete walls with paint finish only (i.e. no lining to inner face of external walls)	-€3,800	-4%

Using **baseline unit** cost (€97,044) and size (30 sqm GFA per bedspace), items are modelled to generate a **notional modelled baseline** (€84,000 and 30 sqm GFA). Figure 28 below shows that by adopting the findings noted above, the costs can be reconciled to within 11% of the BER average cost (€75,400).

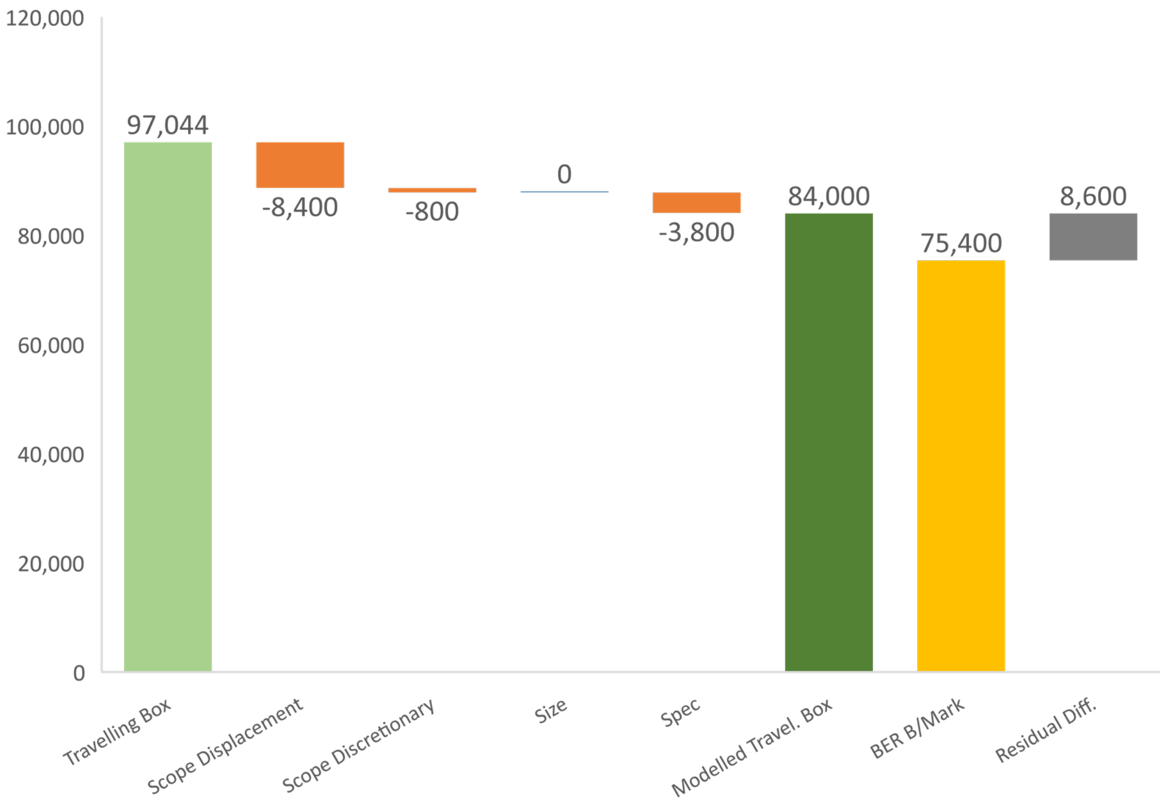


Figure 28: Case Study #4 – Cost per Bedspace Reconciled vs. BER

8.6 Summary of Findings

- **'Travelling box' exercise found higher PBSA costs in European locations**
  The 'travelling box' exercise found that overall construction costs using Irish specifications on a cost-per-sqm rate for the same PBSA building are higher (up to 11%) in the four European comparator locations albeit with the costs distributed differently between the building elements.

- **Cost ranges for actual PBSA buildings are lower in CPH, BER and UTR**
  Lower construction costs were evident in CPH, BER and UTR for actual PBSA buildings when built using the typical specifications for those locations on a cost-per-sqm rate (10% to 32% differences identified).

- **Cost and design comparison found differences in scope, size and specification in CPH, BER and UTR**
  On the design comparison, the study found that DUB typically builds a different typology to CPH, BER and UTR. These European locations design and build

more studio/1-bedroom units as opposed to the 6 to 8 beds per cluster arrangement common in DUB (and BHM).

When typical construction practices in two locations are compared, it is difficult, and not always possible to quantify cost impacts of all differences in individual regulations, standards or norms. Not all standards and regulations are prescriptive.

Increased use of standardisation in construction systems and specification of components such as windows is evident in PBSA in CPH, BER and UTR. Manufactured panel systems (a type of MMC) are more common in CPH, BER and UTR than labour-intensive site-based activities (such as block- or brick-laying).

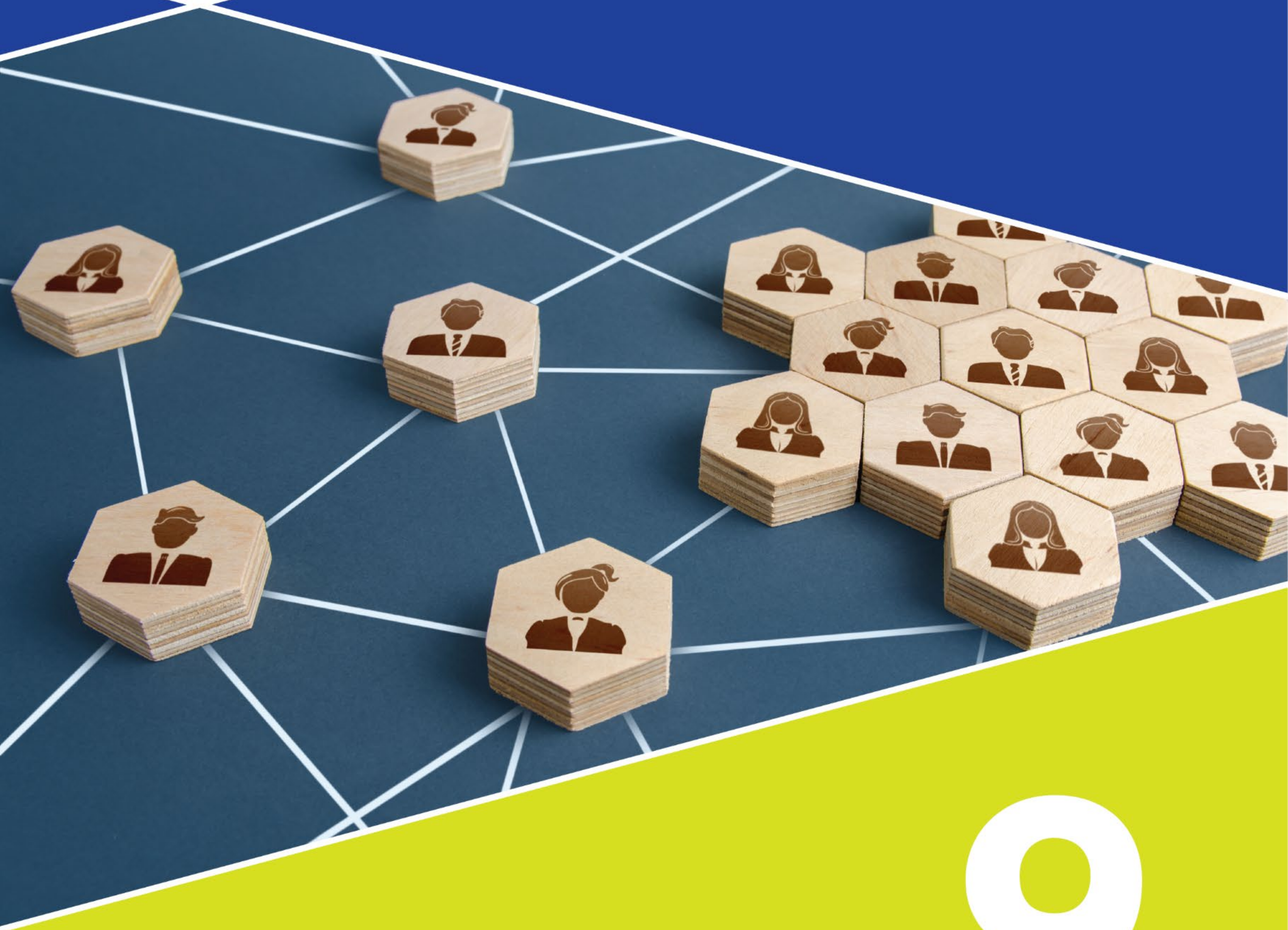
- **Cost modelling found potential cost reduction opportunities on scope and specification**

  By adopting some of the findings and modelling them against the case study project, the cost-per-unit is reconciled to within 11% of the lowest comparator location (BER).

  The value of having a design standard for PBSA with typology options (clusters, ensuites/ shared bathrooms, studios) and applications (on-campus/ off-campus) was discussed at the Stage 2 Stakeholder Workshop. There is currently no national design standard for PBSA.

  Potential cost reduction opportunities for PBSA were identified as design standards and unit sizing, as well as scope and specification.

Engagement with Stakeholders



9

9.0 Engagement with Stakeholders

9.1 Introduction

To maximise stakeholder engagement, workshops were hosted at the completion of study stages 1, 2, and 3. This was to provide updates and context to stakeholders and to gather their feedback. Each workshop theme is listed below:

- **Workshop 1** - Completion of Stage 1 (Irish baseline costing exercise)
- **Workshop 2** – Completion of Stage 2 (European construction cost comparison, 'travelling box' and local benchmarking)
- **Workshop 3** – Completion of Stage 3 (Cost modelling and analysis)

Summary notes from each stakeholder workshop are provided below. Further details and a register of attendees is available in Appendix H.

During each workshop the scope, methodology and findings at each stage were discussed and questions clarified. Feedback was integrated where applicable and comments considered in terms of both this and potential future studies.

9.2 Workshop 1

The Consultants placed emphasis here on clarifying construction cost differences between locations. These differences were based on processes and practices.

Questions from stakeholders and subsequent responses centred on broad cost-drivers, as well as potential cost-mitigates such as in the context of Modern Methods of Construction. Other questions applied to mechanical and electrical engineering, waste and labour costs, as well as the possible cost impacts of forms of contract and risk variations between locations. Engineering / waste / labour were deemed within; and contract forms / risk variations deemed outside of study scope.

Notably, inconsistency within both planning practices and regulatory requirements was raised as a recurring challenge by stakeholders. Additionally, the inclusion of other housing types in the context of density was raised as warranting future consideration.

9.3 Workshop 2

Following further overview and update, and subsequent presentations by the Consultants, breakout groups were formed from stakeholder attendees; each group focussing on one of the three building types (House / Apartments / PBSA).

Three common questions were then put to each group as follows:

- Could approaches from the comparator locations such as those related to scope, specification and increased standardisation be applied within IRE?
- What challenges might inhibit / impede such approaches?
- Any other recommendations were sought specific to housing type to support cost reduction, e.g. those related to standardisation, building services, MMC, housing design or construction materials/systems.

A number of themes fed back from the presentations and breakout groups. The following comments give an impression of the wide-ranging discussion.

Building Regulations

- Less demanding regulatory requirements appear to apply in some areas among comparator locations e.g. fire safety & accessibility. It was noted that a comprehensive comparative study of regulations is outside the scope of this study and that **regulatory requirements do need to be understood in their full context.**
- The potential cost benefits of **mid-rise (3-4 storey) walk-up apartment building types common in European cities** were highlighted. Such designs, however, need to be understood in their wider regulatory context, which inhibits their delivery in Ireland.
- The importance of **consistency of application of Irish Building Regulations** was emphasised. Frequent regulatory changes were also deemed challenging.
- **Building services were found to have a higher cost in Ireland across all dwelling types**. District heating, more common in CPH and BER, could reduce costs.

Construction Systems & Processes

- Repetition of processes and systems is more prominent in Europe and if implemented more broadly in Ireland would reduce costs here.
- 'Dry' construction processes (such as taped as opposed to skimmed linings) are common in the UK and could reduce cost in Ireland.
- **Support is needed for more offsite construction systems (MMC).** It was noted that any guidance on standardisation of plans and/or components should be accompanied by performance and economic best practice guidance.
- **Irish cavity external wall construction was noted as adding to cost.** Alternatives could reduce cost.

Scope, Specification & Finishes

- It is more **common in European cities to omit items from scope such as kitchens and/or appliances, fitted wardrobes, suspended ceilings**. These omissions result in reduced costs.
- The concept of 'grey-box' came up in feedback. However, compliance with Building Control (Amendment) Regulations was deemed challenging for implementation of 'grey-box' domestically.
- **Standardisation (of components such as windows) is more widespread in Europe and could reduce costs in Ireland.** The precedent of the Georgian House was cited as an example of effective standardisation.

Planning Requirements & Processes

- **Stakeholder feedback suggested that design requirements for the appearance of housing can increase costs**. This factor also inhibits standardisation, including materials selection.
- It was noted by stakeholders in the Stage 2 Workshop that further **standardised guidance for student accommodation would be of benefit.** National design guidance for student accommodation would inform design approaches. A range of design options for students would be preferable, incl.

small studios and clustered bed-spaces, both with and without ensuites. Shared rooms was also suggested as an option.

9.4 Workshop 3

Following a further recap / overview, the Consultants, using PowerPoint, drew reference from their findings to the significant impact of scale on costs, the 'like-for-like' application to scope, as well as specification and methodology differences between comparator locations. The potential benefits of increased standardisation were underscored.

Fundamentally, the Consultants detailed that the study does not indicate any particular 'silver-bullet' solution, but does instead illustrate an aggregation of 'grey-pellets', i.e. cost reduction opportunities that could be applied both individually and incrementally. The study specifically identifies numerous Irish residential construction industry practices that differ from comparator locations which impact on construction costs.

In addition, stakeholders alluded to the impact of construction programmes on construction cost and forms of contract on the overall construction costs. A shorter construction programme and the allocation of risk in the form of contract could potentially lead to cost reduction.

Concluding, a number of key findings from stakeholders were discussed, and particular emphasis was placed on development of actions to be taken following the study.

9.5 Summary of Findings

- **Building Services Costs are Higher in DUB**
  Building services costs were found to be higher in DUB than other locations across all dwelling types. Amongst one of the main areas of difference, district heating, i.e. CPH, as opposed to site-based heat generation, which is adopted in Ireland.

- **Other Dwelling Types Required**
  Stakeholders at the Stage 2 and Stage 3 Workshops noted the importance of considering other dwelling typologies to achieve a medium level of density, which may have potential cost reduction opportunities.

- **Design Standard for PBSA Beneficial**
  It was noted by stakeholders in the Stage 2 Workshop that further standardised guidance would be of benefit. National design guidance for student accommodation would inform design approaches. A range of design options for students would be preferable, incl. small studios and clustered bed-spaces, both with and without ensuites. Shared rooms was also suggested as an option.
- **Opportunity for Standardisation**
  Potential benefits of increased standardisation were cited by stakeholders in the workshops. Support is needed for more offsite construction systems and components, such as Modern Methods of Construction (MMC). It was noted that any guidance on standardisation of plans and/or components should be accompanied by performance and economic best practice guidance.
- **Application of Planning Guidance**
  Feedback noted that the variation in the application of planning design requirements for the appearance of housing can increase costs. This also makes it more challenging to increase standardisation, including materials selection.
- **Further studies Required**
  Areas for further studies which were raised included the areas of soft costs, cost impact of construction programme and cost impact of different forms of contract.

Summary of Findings

10

10.0 Summary of Findings

10.1 Findings

Findings from each case study and from the workshops are summarised below. In addition, a number of specific findings are listed in Appendix J, which informed the choice of modelled items in the cost modelling exercise.

In addition, a key finding from the literature review is the need to avoid comparing construction costs based on the top line or level, which ignore fundamental differences. Significant scope, which is omitted from the reported construction cost and displaced to residents or others, should be factored into construction cost comparison as a minimum.

10.2 General Findings

10.2.1 Case Study (CS) #1 - Scheme House

- **'Travelling box' exercise found lower scheme house costs in BHM**
  The 'travelling box' exercise found that construction costs using Irish specifications on a cost-per-sqm rate for the same scheme house were approximately 15% lower in BHM than in DUB.

- **Cost ranges for actual scheme houses are lower in BHM**
  Lower construction costs were also evident in BHM for an actual scheme house when built using the typical specifications for BHM. The cost-per-sqm rate was 6-10% lower in BHM than DUB and the cost-per-unit basis was 21-29% lower in BHM than DUB. This is due to a number of factors set out below.

- **Cost and design comparison found differences in size and specification in BHM**
  Cost comparison indicates that UK can achieve a lower construction cost due to local market conditions[18] and labour costs. This applies to both the 'travelling box' and actual scheme houses.

  Design comparison indicates differences in scope, unit sizing and specification, which lead to a lower cost in BHM than DUB for actual scheme houses. On

[18] This refers to scale, supply and demand of goods and services, imported goods, population base, regulatory framework of the construction sector which is unique or local to a particular location.

scope, typically no-ensuite or fitted wardrobes are included in the 3-bedroom semi-detached scheme house in BHM. On unit sizing, the benchmark sampling for this study indicates that **houses** being delivered in BHM[19] are up to 15% (93 sqm vs 110 sqm) smaller than DUB.

- **Cost modelling found potential cost reduction opportunities on unit sizing**
  By adopting some of the design comparison findings, the modelled cost-per-unit is reconciled within 21% of BHM average construction cost.

  Opportunities on the scheme house are primarily linked to **size**. Potential opportunities for cost reduction also exist in scope and specification to a lesser extent.

10.2.2 Case Studies (CS) #2 & #3 – Suburban and Urban Apartments

- **'Travelling box' exercise found similar apartment construction costs in all locations**
  The 'travelling box' exercise found that overall construction costs using Irish specifications on a cost-per-sqm rate for the same apartment building **are** broadly in line (+/- 4% for CS #2 and up to +9% for CS #3) with construction costs in the four European comparator locations.

- **Cost ranges for actual apartment buildings are lower in CPH, BER and UTR**
  Lower construction costs were evident in CPH, BER and UTR than DUB (and BHM) for actual apartment buildings when built using the typical specifications for those locations on a cost-per-sqm rate (up to 30% differences identified)**.**

- **Cost and design comparison found differences in scope, size and specifications in CPH, BER and UTR**
  On the design comparison, cost differences were identified related to differences in scope, unit sizing and specification**.** It is common in CPH, BER and UTR to sell or rent apartments with exposed concrete slab (bare ceilings), no floor finish, no fitted wardrobes, no light fittings and sometimes minimal or no fitted kitchen. In addition, it is common for apartments to have a single bathroom shared between

[19] This unit size comparison is in the private-for-sale market.

two or three bedrooms and no ensuites. Stakeholders providing feedback during the study's Stage 2 Workshop noted that some of these scope and specification choices are market driven, and some may require further assessment in relation to achieving technical performance requirements including sound, hygiene and fire.

When typical construction practices in two locations are compared, it is difficult, and not always possible to quantify cost impacts of all differences in individual regulations, standards or norms. Not all standards and regulations are prescriptive. For example, CPH, BER and UTR requirements for apartment sizes are more performance-based than prescriptive and a significant range of apartment sizes is evident in these locations.

- **Cost modelling found potential cost reduction opportunities on scope and specification**

  By modelling the items identified in the comparison findings on the case study projects' Irish baseline unit cost, the cost-per-unit is reconciled to within 18% of the lowest comparison which was CPH.

  Potential cost reduction opportunities on apartments are primarily linked to scope and standardisation.

  Increased use of standardisation in construction systems and specification of components such as windows is evident in the CPH, BER and UTR for apartments. Manufactured panel systems (a type of Modern Methods of Construction (MMC)) are more common in CPH, BER and UTR than labour-intensive site-based activities (such as block- or brick-laying). CPH, BER and UTR also deliver a higher proportion of apartments with associated efficiencies. Stakeholders in Stage 2 Workshop noted that diversity in the design and appearance of housing can increase construction costs. Diversity also makes it more challenging to increase standardisation, including materials selection.

  If the European approaches were adopted, it is estimated the construction cost of a two-bed apartment has the potential to be reduced by up to 14%. This consists of 3% savings by small reductions in specification, 6% savings could be achieved by reducing scope (e.g. omitting ensuites and extent of finishes) and standard scope could be deferred (e.g. kitchen, joinery and flooring), saving a further 5%.

The scope deferral whilst still a cost would be borne by the end-user in line with their budget and timing.

10.2.3 Case Study (CS) #4 – PBSA

- **‘Travelling box’ exercise found higher PBSA costs in European locations**
  The ‘travelling box’ exercise found that overall construction costs using Irish specifications on a cost-per-sqm rate for the same PBSA building are higher (up to 11%) in the four European comparator locations albeit with the costs distributed differently between the building elements.

- **Cost ranges for actual PBSA buildings are lower in CPH, BER and UTR**
  Lower construction costs were evident in CPH, BER and UTR for actual PBSA buildings when built using the typical specifications for those locations on a cost-per-sqm rate (10% to 32% differences identified).

- **Cost and design comparison found differences in scope, size and specification in CPH, BER and UTR**
  On the design comparison, the study found that DUB typically builds a different typology to CPH, BER and UTR. These European locations design and build more studio / 1-bedroom units as opposed to the 6 to 8 beds per cluster arrangement common in DUB (and BHM).

  When typical construction practices in two locations are compared, it is difficult, and not always possible to quantify cost impacts of all differences in individual regulations, standards or norms. Not all standards and regulations are prescriptive.

  Increased use of standardisation in construction systems and specification of components such as windows is evident in PBSA in CPH, BER and UTR. Manufactured panel systems (a type of MMC) are more common in CPH, BER and UTR than labour-intensive site-based activities (such as block- or brick-laying).

- **Cost modelling found potential cost reduction opportunities on scope and specification**
  By adopting some of the findings and modelling them against the case study project, the cost-per-unit is reconciled to within 11% of the lowest comparator location (BER).

  The value of having a design standard for PBSA with typology options (clusters, ensuites/ shared bathrooms, studios) and applications (on-campus/ off-campus) was discussed at the Stage 2 Stakeholder Workshop. There is currently no national design standard for PBSA.

  Potential cost reduction opportunities for PBSA were identified as design standards and unit sizing, as well as scope and specification.

10.2.4 Other Findings

- **Building Services Costs are Higher in DUB**
  Building services costs were found to be higher in DUB than other locations across all dwelling types. Amongst one of the main areas of difference, district heating, i.e. CPH, as opposed to site-based heat generation, which is adopted in Ireland.

- **Other Dwelling Types Required**
  Stakeholders at the Stage 2 and Stage 3 Workshops noted the importance of considering other dwelling typologies to achieve a medium level of density, which may have potential cost reduction opportunities.

- **Design Standard for PBSA Beneficial**
  It was noted by stakeholders in the Stage 2 Workshop that further standardised guidance would be of benefit. National design guidance for student accommodation would inform design approaches. A range of design options for students would be preferable, incl. small studios and clustered bed-spaces, both with and without ensuites. Shared rooms was also suggested as an option.

- **Opportunity for Standardisation**
  Potential benefits of increased standardisation were cited by stakeholders in the workshops. Support is needed for more offsite construction systems and components, such as Modern Methods of Construction (MMC). It was noted that

any guidance on standardisation of plans and/or components should be accompanied by performance and economic best practice guidance.

- **Application of Planning Guidance**
  Feedback noted that the variation in the application of planning design requirements for the appearance of housing can increase costs. This also makes it more challenging to increase standardisation, including materials selection.

- **Further Studies Required**
  Areas for further studies which were raised included the areas of soft costs, cost impact of construction programme and cost impact of different forms of contract.

Conclusion

11

11.0 Conclusion

11.1 Conclusion

The Residential Construction Cost Study supports both the reduction in residential construction costs and increased standardisation. This study compares construction costs between Ireland and four comparator locations. It identifies potential cost reduction opportunities, which could be implemented in Ireland.

The study identifies opportunities for cost reduction in terms of scope, size and specification on each of the case study projects, however the value of implementing these needs to be assessed on a project-by-project basis, and considered in the context of overall development costs and market values, among other considerations, such cost displacement to residents or others, and long-term management and maintenance.

There are challenges to international construction cost comparisons. This is because each country / region adopts different approaches to design, construction and to reporting on construction to varying degrees. For example, construction costs in some European countries are reported based on gross external floor area, which can be 8 – 10% larger than gross internal floor area; whereas in Ireland, conversely, costs are reported based on gross internal floor area.

Furthermore, local market conditions which refer to scale, supply and demand of goods and services, imported goods, population base, regulatory framework of the construction sector which is unique or local to a particular location all play a part in determining construction costs.

Challenges also confront the 'travelling box' methodology. Finding a comparable scheme house and cost data in CPH, BER or UTR was not possible as they do not typically build semi-detached type houses. Houses are more commonly delivered there on an individual basis (with mass housing typically in higher-density housing typologies) and in apartment buildings. This is reflected in data on the housing type mix in each comparator location where DUB and BHM have a significantly higher proportion of scheme houses in the housing stock. Hence, CPH, UTR and BER are not analysed under Case Study #1.

With European cost consultants unfamiliar with some details and terminology when costing the ‘travelling box,’ this necessitated frequent correspondence and engagement with each to explain this information. Photographs and simple language were utilised to assist in such instances. This extended the overall study timeframe from what was initially allocated. Also, certain material specifications and/or construction details are less commonplace in some locations. Hence, the consultants there based costings on what was defined as far as practicable. In limited situations where this was not possible the closest local equivalent was used.

An additional challenge materialised in that European construction consultants do not typically use a BoQs or similar for costing construction works. In DUB, and to a lesser degree in BHM, a BoQs or similar is typically adopted to facilitate the costing of construction works. This document is a detailed quantification and description of the construction works which for an apartment block can extend into many pages (i.e. Case study #2 is approx. 90 A4 pages). However, CPH, BER and UTR, similar to the majority of European locations, tend to use less detailed documents for costing construction works.

Obtaining a sufficiently wide sampling of projects in CPH, BER and UTR to establish typical unit sizing was also more challenging than anticipated. Sensitivity around releasing design information on projects was one of the main factors behind this. Nonetheless, various data sources in each location were utilised, including a sample of designed and built schemes and discussions around same with European cost consultants and other design consultants based in the respective locations.

Fundamentally, a similar ‘travelling-box’ methodology could be applied to any housing typology, such as those outside the scope of this study but referenced during the workshops, as long as sufficient design and cost information were available and comparable housing typologies could be identified. This limitation can be seen in Case Study #1 Scheme House, where costing or local cost range data was not available in CPH, BER or UTR.

The findings also identify a number of topics, which fell outside the scope of this study but could potentially warrant a separate study in the future. These are included in the list of recommendations below.

11.2 Recommendations

The study sets out recommendations below based on the findings, and are followed by a set of actions to be implemented following this study.

General

1. Take account of the general findings in development of future policy and incentivisation measures. Refer to Action 1.

2. Review standardisation of housing design and construction, to include the size ranges of houses specifically. Standardisation of plans and/or components should be indicative only and accompanied by performance and economic best practice guidance. This work should be coordinated with work ongoing by The Housing Agency on examination of innovation/efficiencies in design regarding affordable housing types, form and density, which includes a review of case examples both nationally and in other EU Member States (concluding in Q2 2023); Refer to Actions 2.

3. Review technical specifications relating to building elements, such as external walls, windows and building services. Continue to support the development of city-wide district heating in urban areas. Refer to Actions 2 and 6.

4. Disseminate the findings of the study to ensure that the construction cost implications of decision-making at all stages in a project, including early design development and planning, are considered, taking account of observations made by stakeholders in the stage workshops. Refer to Action 3.

5. Develop a design standard for PBSA, taking account of observations made by stakeholders in the stage workshops. Refer to Action 4.

Research

1. Utilise cost information from this study and other studies to analyse overall development costs. This work should be coordinated with work ongoing in related areas having regard to other studies in this area. Refer to Action 7.

2. Undertake a market research study on market expectation and cultural factors e.g. whether there is a market for apartments in Ireland (for sale or rental) without fitted kitchens and wardrobes, and/or one bathroom and no ensuite, and/or whether bare ceilings with electrical services visible would be considered acceptable to potential buyers / renters. Consider undertaking a study on the technical aspects and market appetite, and raise awareness for the 'grey box' approach on apartments (i.e. flooring, kitchens, integrated appliances, wardrobes, suspended ceilings provided by owner / tenant), including handover and compliance procedures. Review certain standards around apartment fittings and finishes.

3. Undertake a similar cost study at regular intervals, utilising the methodology developed in this study, including new comparator locations and housing types to expand the data available and to track trends occurring internationally.

4. Undertake a study of the cost of the social and physical infrastructure that is needed to service new development and the resulting correlation between density and cost per unit.

5. Conduct a study on design innovation and cost efficiency for medium and high density housing typologies taking account of forthcoming Sustainable and Compact Settlement Guidance by Planning Division on settlement forms/density standards.

6. Support research into productivity in construction study, in conjunction with a selection of construction partner and technical experts. Align with other existing/ongoing work in this area such as DETE MMC data dashboard.

11.3 Actions

A number of actions are generated from the findings and recommendations of this study. These are set out in Table 20 below. A collaborative approach with industry to develop standardised approaches for housing design and construction which can inform the design of policy initiatives and be used as best practice by industry is proposed to realise the cost reduction opportunities identified by the study.

Table 20: Table of Actions arising from the study

Action Number	Action Description	Proposed Approach	Commencement Date	Completion Date
General				
1	Have regard for, and take into account the findings of this study when developing future policy measures.	Cross-Government	Q2 2023	Ongoing
2	Develop standardised approaches to the design of housing for wider application to inform policy and encourage simplified layouts. These approaches are to include the development of: a.) standardised dwelling types b.) standardised specifications, including for building services (i.e. plumbing, heating and ventilation	DHLGH in collaboration with Industry[20] and Housing Delivery bodies with MMC Leadership and	Q2 2023	Q4 2024

[20] Industry includes professional bodies, housing delivery bodies and homebuilders for example to include Royal Institute of Architects of Ireland (RIAI), Construction Industry Federation and Irish Home Builders Association (CIF/IHBA), Society of Chartered Surveyors of Ireland (SCSI) and Engineers Ireland (EI), Association of Consulting Engineers of Ireland, Chartered Institute of Building Services Engineers, MMC Manufacturers.

	systems and electrics) and standardised components The aim is to raise awareness of standardised housing design with compliant and simplified layouts and examples of standardised details, building on the Design Manual for Quality Housing but for a wider application than social housing.	Integration Group and construction research support		
3	Deliver a training and awareness programme, in relation to the cost impact of materials and finishes commonly used in the residential construction sector in order to inform high-quality, cost-effective design and to assist in the planning and development process.	DHLGH, LGMA, LAs, and Professional Bodies	Q4 2023	Q2 2024
4	The development of standardised design specifications for student accommodation in Ireland.	DFHERIS	Q4 2023	Q4 2024
5	As part of the commitment in Housing for All to achieve a significant increase in the use of MMC, pursue the development of standardisation across various building components and detailing in innovative construction, including open-source	DHLGH in collaboration with Industry[21] and Housing Delivery bodies	As per HfA Actions.	As per HfA Actions.

[21] Industry includes professional bodies, housing delivery bodies and homebuilders for example to include Royal Institute of Architects of Ireland (RIAI), Construction Industry Federation and Irish Home Builders Association (CIF/IHBA), Society of Chartered Surveyors of Ireland (SCSI) and Engineers Ireland (EI), Association of Consulting Engineers of Ireland, Chartered Institute of Building Services Engineers, MMC Manufacturers.

	construction details, to include promotion of Design for Manufacture and Assembly (DFMA) design approaches. Incorporate the various steps required for delivery as part of the forthcoming roadmap for MMC in public procurement of residential construction.	supported and coordinated by the MMC Leadership and Integration Group and construction research.		
6	Carry out a review of external wall build-ups, assess and test alternatives for suitability, including external leaf, for Irish climatic conditions, for new houses and apartment buildings.	Construction research body supported by DHLGH	Q4 2023	Q4 2024
Research				
7	Building on this and previous studies, incorporate construction costs and ‘soft’ costs (e.g. fees, land) into an overall development cost.	DHLGH	Q2 2023	Q2 2024

Appendices

12

Appendices	
Appendix A	Case Study Details
Appendix B	Reference Literature
Appendix C	Basis of Costs
Appendix D	Case Study Specification
Appendix E	Elemental Categories
Appendix F	Spatial Standards
Appendix G	Energy Performance Regulations
Appendix H	Workshop Schedule and Attendees
Appendix I	Key Rates
Appendix J	Specific Findings

Appendix A

Notional and Actual Case Study Details

Table 21: Notional Residential Schemes set out in RFT

Case Study	Notional Scheme	Additional Requirements
Case Study #1	Suburban Housing Scheme (1-3 storeys)	35+ dwellings @ 35-45 dph mix of 2,3 and 4-bed houses
Case Study #2	Suburban medium rise apartment scheme (3 – 6 storeys)	60+ dwellings @ 60-90 dph mix of 1,2 and 3-apartments
Case Study #3	Urban medium rise apartment scheme (5 – 8 storeys)	100+ dwellings @ 90-150 dph mix of 1,2 and 3-apartments
Case Study #4	Urban student accommodation scheme (5 – 8 storeys)	200+ units @ 150-225 dph

Table 22: Case Studies adopted for the Study

Case Study	Case Study	Notes
Case Study #1	**Type** - Circa 500 units housing development **Location** – Suburban **Status** – completed	3B5P semi-detached selected for purpose of the study
Case Study #2	**Type** - Circa 600 nr. units split across multiple blocks **Location** – Suburban **Status** – construction stage	5 storey block with approximately 70 units selected for the study
Case Study #3	**Type** - Circa 550 nr. units split across multiple blocks **Location** – Urban **Status** – construction stage	7 storey block with approximately 60 units selected for the study
Case Study #4	**Type** - Circa 400 nr. beds split across multiple blocks **Location** – Urban **Status** - completed	4 storey block with approximately 120 bedspaces selected for the study

Appendix B

Reference Literature

- Arcadis (2022) International Construction Costs – The Year of Inflation
- Department of Housing Local Government and Heritage (2022) Design Manual for Quality Housing
- Department of Housing, Planning and Local Government (2018) Review of Delivery Costs and Viability for Affordable Residential Developments
- Department of Housing, Planning and Local Government (2018) Sustainable Urban Housing: Design Standards for New Apartments for Planning Authorities
- Department of the Environment, Heritage and Local Government (2007) Quality Housing for Sustainable Communities
- European Council of Construction Economics (2022) CEEC Office Cost Model
- Eurostat (2018) Mean hourly earnings in Construction https://ec.europa.eu/eurostat/web/labour-market/earnings/database
- Housing Agency (2018) Comparison of Residential Construction Costs in Ireland to other European Countries
- Housing Agency (2020) Social, Affordable and Co-operative Housing in Europe
- Irish Institutional Property (2020) Residential Cost Benchmark Two Bed Unit – Build to Sell
- Irish Institutional Property (2021) Ireland Apartment Sizes Among Largest in Europe
- Neitzel, M. (2019) Boosting the (affordable) housing supply: Measured to reduce construction and development cost
- Society of Chartered Surveyors Ireland (2020) The Real Cost of New Housing Delivery
- Society of Chartered Surveyors Ireland (2021) The Real Cost of New Apartment Delivery
- Turner & Townsend (2022) International Construction Markey Survey 2022

Appendix C

Basis of Costs

Basis of Costs – 'Travelling Box'

The following sets out the basis of Irish costing and were the instructions provided to the European construction consultants to enable them to undertake the same costing of the four case study projects and ensure consistency. The costing is based on specific cities or regions rather than national averages. The basis of the costing across the respective case studies is set out below;

- Costing reflects third quarter 2022 costing levels
- Construction costs are representative for each reference city (DUB, BHM, CPH, UTR and BER)
- Single stage competitive tender with traditional (i.e. fully designed) procurement (CS #2,3 &4)
- Costing assumes lump sum fixed price contract (CS #2,3 &4)
- Costing levels reflecting Tier 1 / 2 contractor costing, except Case Study #1 which is based on Developer / House Builder self-delivery model
- Preliminaries were costed based on percentage of overall value and would reflect typical percentages for both Irish and local projects within each location. Percentages for preliminaries were provided by the European cost consultants for the 'travelling box' exercise. These were based on their internal benchmark and prevailing rates for similar projects. Percentages vary from location to location and from case study to case study.

Basis of Costs – European Benchmarking

The following sets out the basis for gathering the local cost ranges data for use in the benchmarking exercise. The costing is based on specific cities or regions rather than national averages;

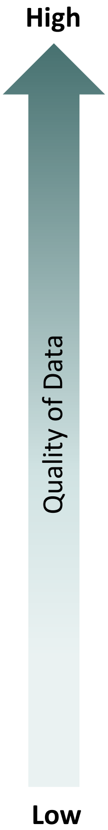
- Costing reflects third quarter 2022 costing levels
- Construction costs are representative for each reference city (DUB, BHM, CPH, UTR and BER)
- Single stage competitive tender with traditional (i.e. fully designed) procurement
- Costing assumes lump sum fixed price contract (CS #2,3 & 4)
- Costing levels reflecting Tier 1 / 2 contractor costing, except Case Study #1 which is based on Developer / House Builder self-delivery model
- Preliminaries were costed based percentage of overall value and would reflect typical percentages for local projects in each location.

Cost Data Hierarchy Explained

Various levels of cost data were identified that are typically available and that are used for compiling and comparing construction costs. Each type of data represents varying levels of detail and has a particular use in different circumstances. Data types were ranked on a scale of 'Low' to 'High' in terms of quality of data that can be used for construction cost comparisons. This created a hierarchy which informed the final methodology. Based on the study objectives, it was agreed that the data quality needed to be in the higher categories (i.e. BoQs and Labour / Plant / Materials).

Typically in DUB, BoQs are produced to capture the costing of construction works and are generated from drawings and specifications. Adopting this level of detail for each case study optimises the layer of detail for analysis. Cost benchmark data is used as a secondary source to cross-check the costed BoQs, both in DUB and the comparator locations.

Table 23: Types of Cost Data



Cost Data Type	Description
Labour / Plant / Materials	Building works broken into labour and material costs and costed accordingly
Costed Bill of Quantities (BoQs)	BoQs costed by contractor to construct the building
Elemental Summary	Summary level estimating of the main building elements (e.g. substructure, structure, façade, MEP, fit-out). Usually on a Euro per sqm
Euro per sqm floor area	Euro per sqm floor area based on the total floor area. Usually derived from benchmark data
Similar Project Benchmarking	Cost benchmark data from similar projects
International Price Books	'Spons' or similar international price books based on national averages
Location Indices	Location index / factor to determine the percentage difference between countries

European Benchmarking

Local cost ranges were gathered from the European cost consultants for the benchmarking exercise. These costs are presented as ranges and represent typical construction values in each location. For the purposes of this study, ranges are adjusted so that they represent cost-per-sqm on gross internal floor area, which is the basis of the 'travelling box' costings. This adjustment is in the region of 8-10% where the costs are based on gross external floor area.

The local consultant in each location relied upon their respective databases to generate the cost ranges. The values represent the total value of construction works under the respective building type.

Table 24: European Cost Consultants Databases

	Apartments	Student Housing
BHM	€15+ billion 68,000+ units	€720+ million 8,300+ units
CPH	€300+ million	€80+ million
UTR	€7+ billion 30,000+ units	€250+ million 2,500+ units
BER	€270+ million	€70+ million

Observations from European Cost Consultants

As part of the primary and secondary data gathering, observations were gathered which largely consists of feedback from construction professionals who are actively practicing in the respective location or who have relevant experience in one or more of the comparator locations. Where required, secondary sources, such as published reports, design standards, and review of actual projects, were used to verify any observations from construction professionals.

Exchange Rates

For cost comparison purposes, the foreign exchange rates set out below are the basis of the costings.

Table 25: FX rates for Cost Comparison

Location	Local Currency	FX Rate to Euro
BHM (UK)	British Pound (GBP)	1 GBP : €1.15
CPH (Denmark)	Danish Krone (DKK)	1 DKK : €0.13
UTR (Netherlands)	Euro	n/a
BER (Germany)	Euro	n/a

Appendix D

Elemental Categories

Explanation of what is included element

Element	Description
Substructure	Excavation/filling to existing ground Foundations – strip, raft, piled foundations Ground bearing slab and associated layers (e.g. damp proof membrane, insulation)
Structure	Building structural frame, beams and columns Suspended floor structures Roof structure Stairs
Internal Sub-Division	Internal walls and partitions including individual layers which make-up walls Internal doors, windows, screens, and associated components (e.g. ironmongery) Handrails and balustrades to stairs
External Enclosure	External walls including cladding, glazing and associated layers External doors and windows and associated components External wall finishes including tiling, insulation, render, decoration
Roof Enclosure	Rooflights, balustrades, walkways, ironmongery Roof finishes – waterproof membrane / coatings and screeds, roof paving, flashings, edgings, decoration
Internal Finishes / Fittings	Wall finishes internally – tiling, sheeting, decoration Floor finishes - applied finishes, coatings, screeds, decoration Ceiling finishes – applied finishes, plasterboard, tiling, decoration Stair finishes – coatings, screeds, decoration Fittings & furniture – statutory and directional signage, fitted joinery (i.e. kitchens and appliances, wardrobes), storage cupboards, sanitary fittings, prefabricated bathroom pods, blinds

Building Services	**Mechanical** – central plant, fuel supply and storage, drainage, waste water disposal, water distribution, hot water, space heating and cooling, ventilation and air conditioning **Electrical** – electrical supply and main distribution, power, lighting, Audio visual and electronic communications, security and protection (i.e. sprinklers) **Lift** – passenger lifts including all associated equipment and finishes to lift car
Preliminaries	Items that cannot be allocated to a specific element Preliminaries include the main contractor's costs associated with: site management and staff, site establishment, site offices, temporary services, site security, safety and environmental protection, scaffolding, cranes, any other general plant and machinery, temporary works, the maintenance of site records, completion and post-completion requirements, site cleaning, waste removal, sites services and insurances, bonds, guarantees and warranties

Appendix E

Case Study Specifications

Case Study #1 – 3B5P Semi-Detached Scheme House

Outline Specification

Element	Details
Substructure	Reinforced concrete slab with strip foundations
Structure	Pre-fabricated timber frame construction for inner leaf of external walls, first floor and timber roof trusses; roof trusses have flexibility for future attic conversion
Internal Sub-division	Load-bearing and non-load-bearing timber stud walls with timber doors
External Enclosure	Brick to front elevation with recon stone sill. Rendered block to side and rear elevation with precast sills Timber main entrance door with side screen uPVC double glazed windows
Roof Enclosure	Fibre cement tile laid on felt & battens over trusses uPVC gutters and downpipes
Building Services	Air source heat pump & heat recovery unit. Radiators to upper floor
Internal Finishes/ Fittings	Porcelain tiles to living / kitchen / dining / bathrooms MDF skirting & architrave Fitted kitchen with white goods Fitted utility with white goods Fitted wardrobes to all bedrooms Sanitary fittings to ensuite, family bathroom and downstairs WC

Case Study #2 - Suburban Apartment Block

Outline Specification

Element	Details
Substructure	Reinforced concrete strip foundations and pads; concrete slab poured on insulation on DPM and Radon
Structure	200mm thick precast concrete slabs with in-situ concrete frame; 215mm thick loadbearing blockwork
Internal Sub-division	Combination of blockwork and stud partitions; with timber doors to apartments; metal doors to risers and the like
External Enclosure	Brick outer leaf with block inner leaf; Double-glazed aluclad external windows. Localised curtain walling to core Steel cantilevered balconies with mild steel balustrade. Aluminium soffits and composite decking
Roof Enclosure	Extensive green roof to roof covering
Building Services	Exhaust air heat pump; supplying hot water and radiators
Internal Finishes/ Fittings	Laminate flooring to apartments with mix of tiles and carpet to common areas Softwood skirting & architraves Glass splashback to kitchens Plasterboard suspended ceilings Fitted kitchen with quartz stone top; breakfast bar; including white goods Wardrobes to bedrooms Blinds to bedrooms / living / kitchens Prefabricated bathroom pods

Case Study #3 – Urban Apartment Block

Outline Specification

Element	Details
Substructure	Piled foundation with pads and ground beams **Note:** Block sits on a single level podium. For the purpose of costing and study the block sits at grade (with substructure) and podium costs are excluded
Structure	200mm thick precast hollow core concrete slabs with 200mm thick pre-cast walls
Internal Sub-division	Mix of stud partitions & precast walls; quiet wall system to dividing walls; timber doors to apartments
External Enclosure	Brick outer leaf with precast wall inner leaf Double glazed aluclad external windows Sliding doors to balconies / winter gardens Localised curtain walling to core Steel cantilevered balconies with mild steel balustrade Aluminium soffits and aluminium decking
Roof Enclosure	Standing seam roofing system to loft roof; laid on profiled metal roofs laid on precast structural slab; green roof covering to flat areas
Building Services	Exhaust air heat pump; supplying hot water and radiators
Internal Finishes/ Fittings	Laminate flooring to apartments with carpet tiles to common areas MDF skirting & architraves Fitted kitchens (some with breakfast bar); including white goods; stone worktop Wardrobes to bedrooms Storage units Prefabricated pods to bathrooms

Case Study #4 – Student Accommodation

Outline Specification

Element	Details
Substructure	Reinforced concrete strip foundations and pads / ground beams; ground bearing concrete slab
Structure	In-situ reinforced concrete frame (columns and walls) with flat slab
Internal Sub-division	Plasterboard stud partitions; with timber doors throughout; pre-finished timber solid core doors; metal doors to risers and the like
External Enclosure	Brick outer leaf with block inner leaf PPC double glazed windows with localised louvres Localised element of curtain walling
Roof Enclosure	Heavy duty bitumen roof covering laid on insulation
Building Services	Centralized boilers serving HIU's in each cluster, in serving radiators and providing hot water
Internal Finishes/ Fittings	Vinyl floor tiles throughout MDF skirting & architraves Glass splashback to kitchens Living / Kitchen / Dining spaces – fitted kitchens with quartz stone top and white goods Bedrooms – study desk, fitted wardrobe + loose furniture (e.g. beds, bedside lockers, study chair) Prefabricated bathrooms pods Amenity space – fitted storage units + loose furniture (e.g. tables, chairs, pool table, vending machines) Communal Laundry room – fitted units with white goods

Appendix F

Spatial Standards

Study Unit Sizing

House

As described in the methodology section, two sizes for the DUB based 3B5P semi-detached houses are modelled. Case Study #1 is a 123 sqm house. A 110 sqm house is also modelled. The target minimum size is 92 sqm (QHfSC, 2007). No built examples in DUB of houses at 92sqm have been identified in this study.

IRE and UK have similar minimum spatial standard for a 3B5P semi-detached house. In the UK, actual projects which have achieved the minimum spatial standard were reviewed. For this reason, the comparison size adopted for the study is 93 sqm. Net (NFA) and Gross Floor Areas (GFA) for a house are the same. A summary is provided in Table 26 below.

Table 26: 3B5P House Sizing

Location	Unit Size (GFA)
DUB (Case Study)	123 sqm
DUB (Lower Range)	110 sqm
DUB (Min. Allowable)	92 sqm
BHM	93 sqm

Apartments

IRE and UK

The national design standards in IRE cite 73 sqm NFA for 2B4P. However, as identified in the SCSI report (2021), 73 sqm NFA for a 2B4P apartment is difficult to achieve whilst meeting the various design standards (e.g. bedroom dimensions, dual aspect). 78.5 sqm NFA is used instead in the study.

The UK has a prescribed requirement of 70 sqm NFA and actual developments achieving this unit sizing on apartments have been reviewed. Over 1,300 apartments in BHM were accessed via public planning portals and reviewed. The review included unit sizing as well as analysis of key design metrics (i.e. net-to-gross (NFA: GFA) ratio, dual aspect, apartments per core). The minimum spatial standards in IRE and UK are noted in Table 27 below.

Table 27: IRE & UK Apartment Spatial Standards

Housing Type	IRE (NFA)	UK (NFA)
1B2P Apartment	45 sqm	50 sqm
2B4P Apartment	73 sqm	70 sqm
3B5P Apartment	86 sqm	86 sqm

DK, NL and GER

Due to the absence of prescriptive spatial standards, an analysis of a sample of actual projects in the CPH, UTR and BER areas was undertaken. Floor plans for apartment development were gathered from a mix of sources including; local construction professionals, local authority portals and data available on public websites. The depth of sampling from each location is summarised as follows:

- CPH – over 1,100 units
- UTR - over 490 units
- BER – over 500 units

From the floor plans reviewed, average unit sizing (NFA and GFA) are generated as well as the design metrics mentioned previously. Based on the above, the unit sizing adopted for the study are noted in Table 28 below.

Table 28: 2B4P Unit Sizing

Location	Unit Size (NFA)	Unit Size (GFA)
DUB	78.5 sqm	91 sqm
BHM	70 sqm	89 sqm
CPH	73 sqm	84[22] sqm
UTR	90 sqm	110 sqm
BER	89 sqm	105 sqm

[22] The CPH NFA/GFA are based on a 3B4P apartment as set out in the text.

PBSA

All locations

Apart from the DCC local development plan, there are no national spatial standards for student accommodation in IRE. From research carried out, there appear to be no equivalent student specific standards in the comparator locations. For this reason, average sqm of GFA per bedspace was generated. This is generated from reviewing and analysing actual floor plans as well as discussions with construction professionals in each comparator location. As mentioned in this study, the type of bedspace provided is different in IRE and UK to DK, NL and GER. The cluster style arrangement in IRE and UK has a better ratio of GFA per bedspace as opposed to the studio / one bedroom apartments arrangement in CPH, BER and UTR.
The GFAs noted in Table 29 below are used in this study.

Table 29: Area per Bedspace

Location	Bedspace (NFA)	Bedspace (GFA)
DUB	24 sqm	30 sqm
BHM	23 sqm	31 sqm
CPH	28 sqm	35 sqm
UTR	28 sqm	35 sqm
BER	26 sqm	33 sqm

Appendix G

Energy Performance Requirements

Nearly Zero Energy Buildings (NZEB) is an EU requirement under the Energy Performance of Buildings Directive (EPBD) and applies to new buildings across all member states. For the comparator countries referenced in this study Denmark and Netherlands have similar overall energy performance requirements to Ireland. A 2021 BPIE study[23] references Germany as requiring 40kWh/sqm/yr for new dwellings. The UK overall energy performance requirement will be similar to that for Ireland from mid-2023.

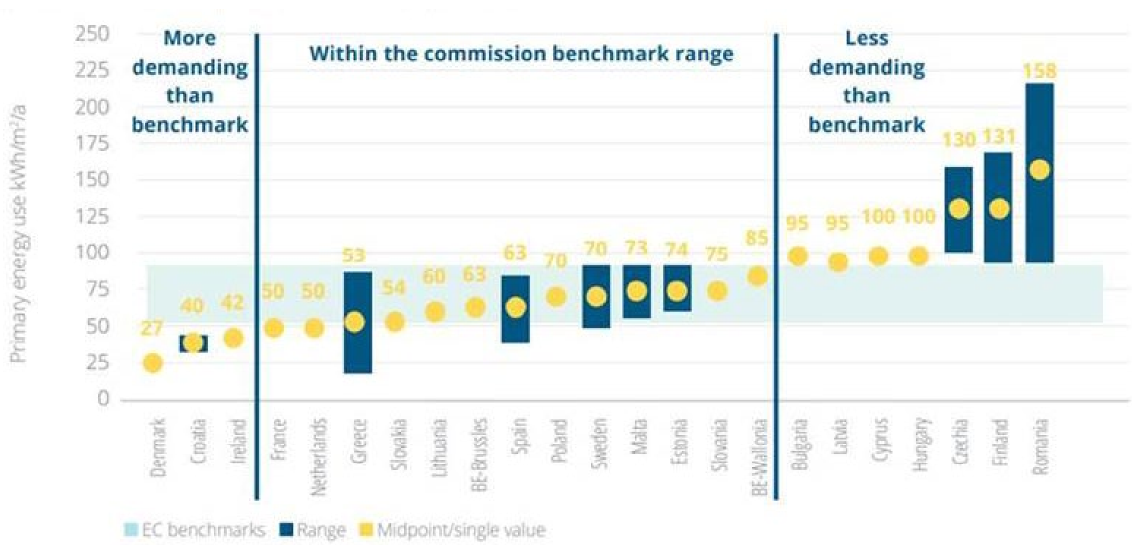


Figure 29 nZEB kWh/sqm per year values for single family homes in the EU

[23] https://www.bpie.eu/wp-content/uploads/2021/12/BPIE_Assessing-NZEB-ambition-levels-across-the-EU_HD.pdf

Appendix H

Workshop Schedule and Attendance

Workshop 1

Date	**16 August 2022 / 10am – 1 pm**
Location	Custom House Conference Room 1.01 / Remote via Webex
Attendees (22 total)	
Department of Housing, Local Government and Heritage (DHLGH) (9)	
Mitchell McDermott Construction Consultants (MMD) (2)	
CSG Steering Group (SCSI, RIAI, LGMA, CIF) (4)	
Construction Sector Group / Innovation and Digital Adoption Sub-Group (1)	
Department of Public Expenditure and Reform (3)	
Housing Agency (1)	
Department of Finance (2)	
Property Industry Ireland (1)	
Department of Enterprise Trade & Employment (2)	

Workshop 2

Date	25 October 2022 / 1.30 pm – 5pm
Location	Custom House Conference Room 1.01 / Remote via Webex
Attendees (55 total)	
Department of Housing, Local Government and Heritage (DHLGH) (10)	
Mitchell McDermott Construction Consultants (MMD) (2)	
CSG Steering Group (SCSI, RIAI, CIF) (3)	
Construction Sector Group/Innovation and Digital Adoption Sub-Group (1)	
Department of Public Expenditure and Reform (4)	
Housing Agency (1)	
Department of Finance (1)	
Property Industry Ireland (1)	
Department of Enterprise Trade & Employment (2)	
Construction Industry Federation/ Contractors (4)	
Society of Chartered Surveyors Ireland (5)	
Department of Further and Higher Education Research and Skills (2)	
Royal Institute of the Architects of Ireland / Architects (6)	
ACEI/ Arup Engineers (1)	
Sustainability Energy Authority of Ireland (1)	
Irish Planning Institute (1)	
Engineers Ireland (1)	
Dublin City Council (3)	
South Dublin County Council (1)	
Tipperary County Council (1)	

Cork County Council (1)
Louth County Council (1)
Meath County Council (1)
Monaghan County Council (1)

Workshop 3

Date	**8 February 2023 / 11.00 – 13.00**
Location	Custom House Conference Room 1.01
Attendees (32 total)	
Department of Housing, Local Government and Heritage (DHLGH) (10)	
Mitchell McDermott Construction Consultants (MMD) (2)	
CSG Steering Group (LGMA, RIAI, CIF) (3)	
Department of Public Expenditure and Reform (3)	
Housing Agency (1)	
Department of Finance (1)	
Property Industry Ireland (1)	
Department of Enterprise Trade & Employment (1)	
Department of Further and Higher Education Research and Skills (1)	
Department of the Taoiseach (1)	
Royal Institute of the Architects of Ireland/ Architects (2)	
ACEI / Arup Engineers (1)	
Society of Chartered Surveyors Ireland (1)	
Engineers Ireland (1)	
Trinity College Dublin (1)	

Appendix I - Key Rates Review

Composite Rates

From the ‘travelling box’ costing exercise and completed BoQs received from European cost consultants, some main composite rates are noted in Table 30 below to illustrate how the DUB baseline costing compares to the four comparator locations. The composite rates are all-inclusive rates (i.e. labour, plant, material).

Table 30: Selection of Composite Rates from Case Study #2 Travelling Box

Key Rates	Unit	DUB	BHM	CPH	UTR	BER
Hardcore filling to make up levels	m³	€43	€40	€33	€24	€50
Poured concrete	m³	€172	€230	€156	€233	€239
Formwork	m²	€49	€58	€88	€74	€79
Reinforcement	ton	€1,700	€1,955	€2,470	€1,800	€2,994
Precast concrete slabs 200mm thick	m²	€65	€64	€69.00	€72	€79
Structural steelwork	ton	€3,500	€3,795	€4,160	€3,600	€4,551
215mm thick blockwork	m²	€90	€134	€124	€90	€124
Double glazed windows	m²	€650	€633	€455	€595	€625
Non-fire rated partition	m	€92	€126	€72	€62	€90
Single timber door; non fire rated; ironmongery	nr	€660	€518	€1,040	€694	€950
Painting to walls	m²	€5	€7	€28	€11	€8

Highest Cost	
Lowest Cost	

In five of eleven cost categories, DUB has the lowest unit cost and is the second lowest in a further three categories. DUB is the highest in one category only. This would indicate that DUB costs, for key components typical of various building types, are trending at the lower end of the comparator locations.

Labour Rates

Data in relation to construction labour costs was gathered from European cost consultants. This aspect proved more challenging to verify due to wide and varied labour rates within the respective local markets.

The Eurostat index (2018) on mean hourly earnings in construction across EU member states provides an indication on relative earnings in construction. The results are indexed with IRE set at index 100 for ease of comparison. Both of these indexes are based on national averages and may differ from labour rates provided by European cost consultants, which are specific to the comparator locations (e.g. BHM or CPH). Of the countries covered in this study, IRE is the second lowest national average with GER the lowest (index 87) and DK the highest (index 158).

Table 31: Mean Hourly Earnings in Construction, 2018

Location	Index
EU (27 member) Average	71
GER	87
IRE	**100**
UK	104
NL	107
DK	158

The mean hourly earnings in manufacturing are set out below. Of the countries covered in this study, IRE (index 100) is the second highest with DK the highest (index 142) and UK the lowest (index 82).

Table 32: Mean Hourly Earnings in Manufacturing, 2018

Location	Index
EU (27 member) Average	66
UK	82
NL	86
GER	98
IRE	**100**
DK	142

Appendix J

Specific Findings

Specific findings from the cost and design comparison exercise are noted below. These are a mix of findings applicable to all building types unless stated otherwise. Only some findings were brought forward to the cost modelling stage and these are identified with comments in Table 33 below.

Table 33: Commentary on Specific Findings and Modelled Items

Finding/ Observation Description	Modelled Y/N	Comment
Specification		
Traditional stud partition walls are not as common in CPH, BER and UTR. Load bearing concrete / pre-cast or gypsum block are used primarily. Applicable to CS #2,3,4	Y	Gypsum block modelled in lieu of internal non-load bearing partitions in CS #2,3,4
Composite aluminium and timber windows (i.e. aluclad) are seen as a premium product in some locations, i.e. uPVC used in BER. In DUB, aluclad is seen as a standard specification on apartment buildings. Applicable to CS #2,3,4	Y	uPVC windows modelled in lieu of aluclad in CS #2,3,4
External wall build-ups and detailing are notably different in CPH, UTR and BER. They tend to use a single leaf with insulation or a sandwich panel type system as opposed to more sophisticated external build-up with large cavities, and structural steel angles to carry masonry external leaf which is typically adopted in DUB and BHM. Traditional labour-intensive trades such as brickwork and blockwork are either not used, or are used minimally in CPH, BER and UTR.	Y	Render sandwich panel external wall system in lieu of masonry brick facades in CS #2,3,4

CPH adopts pre-fabrication of building components more than DUB. There is a cost premium in CPH for labour-intensive trades typically carried out on site (i.e. brickwork, in-situ concrete works, and formwork). Higher labour rates, as reported by Eurostat (see appendices) supports this finding. Applicable to CS #2,3,4		
In CPH, BER and UTR, more standardised components are utilised, such as window types. ‘Off the shelf’ products tend to be specified and adopted rather than bespoke component specification and sizing, which would lead to repetition and economies of scale. Applicable to CS #2,3,4	Y	Notional value for standardisation to windows and doors in CS #2,3,4
Bathroom pods in residential buildings are more prevalent in DUB than CPH, BER or UTR. Applicable to CS #2,3,4	N	No cost reduction opportunity identified, as bathroom pods are already a cost-effective solution.
Building services (i.e. plumbing and electrics) vary across the different locations. In general, construction costs for services are a lower cost in CPH, BER and UTR, but there are some scope differences and this requires further examination. Applicable to CS #2,3,4	N	Not possible to isolate specific costs for modelling within the scope of this study. BoQs cost data based on composite rates. Further assessment required.
Municipal level district heating serving buildings in CPH and BER reduces the construction cost and removes the need for dedicated plant rooms. Applicable to CS #2,3,4	N	Not possible to cost in the scope of this study. A municipality level district heating network is considered to reduce costs for individual apartments and is being considered under the

		Climate Action Plan 2023.
Exposed concrete walls with paint finish only are common in CPH, BER and UTR (i.e. no lining to inner face of external walls) Applicable to CS #2,3,4	Y	Notional modelling.

Scope		
Exposed concrete slab (bare ceilings) are common in CPH, BER and UTR (i.e. no suspended ceilings, paint finish only) Applicable to CS #2,3,4	Y	Notional cost for 50% exposed concrete slab to apartments
Apartments are often delivered as a 'grey box' in CPH, BER and UTR with the purchaser / tenant responsible for completing the fit-out (e.g. kitchens, lighting, fitted wardrobes). Applicable to CS #2,3	Y	Omission of these items modelled
Ensuites are not typically included in 2 or 3 bedroomed apartments in CPH, BER and UTR Applicable to CS #2,3	Y	Omission of ensuites modelled
Ensuites are often not included in 3 bedroomed houses in BHM Applicable to CS #1	Y	Omission of ensuite modelled
Construction costs for student accommodation in CPH, BER and UTR, typically exclude the fixed and loose FF&E as this is normally completed separate to the main construction works. The finishes are similar to IRE. Applicable to CS #4	Y	FF&E (both fitted, wardrobes, kitchenettes, etc., and loose, and fitted) modelled
Unit Sizing		

123sqm & 110sqm(DUB) vs 93sqm (BHM) scheme house GFA to assess the level of cost difference related to size Applicable to CS #1	Y	Notional modelling of baseline costs (DUB) if unit sizing in BHM was adopted
91sqm (DUB) vs 84sqm (CPH) apartment GFA to assess the level of cost difference related to size Applicable to CS #2,3	Y	Notional modelling of baseline costs (DUB) if unit sizing in CPH was adopted
Baseline is based on 30 sqm per bedspace Applicable to CS #4	N	No change modelled here as the DUB unit sizing is more efficient
Costs		
Based on a selection of the most common buildings components, DUB composite rates (i.e. labour and materials combined) are at the lower end against the comparator locations. Applicable to CS #1,2,3,4	N	Not implementable in Ireland

Standards/ Regulations		
Overall NZEB energy performance requirements are similar in the EU countries compared. The UK adopted a standard similar to NZEB in 2022, however the cost ranges used in the study are based on actual projects in BHM that pre-date the adoption of NZEB. Applicable to CS #1,2,3,4	N	No cost reduction opportunity identified.
Fire safety regulations differ in each comparator location. For example, sprinklers are generally not required in CPH, BER and UTR for residential buildings. Applicable to CS #1,2,3,4	N	Fire safety must be considered holistically and this study does not comment on a comparison of fire safety regulations.

www.gov.ie

Department of Housing, Local Government and Heritage

Rialtas na hÉireann
Government of Ireland