

Vertical Extension of Existing Buildings

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Background

Civil Engineering (MEng) graduate from The University of Sheffield.

2nd year PhD student working in the RISE (Resources, Infrastructure Systems and Built Environments) Research Group.

Researching the potential for sustainable housing provision through vertical extension.





The Housing Crisis



Estimated number of homeless people in England:



Shelter (2019)



1 in 200 people

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Homelessness by Category

People rough sleeping	4,677	
People who are owed a relief duty but are not accommodated by the council	2,292	
People owed a duty under the Children's Act and are living in temporary accommodation arranged by Social Services	3,937	
People living in temporary accommodation arranged by the council	236,610	
People living in temporary accommodation arranged by themselves	18,317	> 90%
People living in a homeless hostel	14,684	
Total	280,517	

Shelter (2019)



Average cost of a '*first time*' home in the UK:



HM Land Registry (2020)



Existing vs. New Build Housing



HM Land Registry (2020)



Housing Requirements, Targets and Provision





The Climate Crisis



Whole Life Carbon Emissions and UK Waste Breakdown





The Circular Economy





Where?



Urban Sprawl vs. Residential Densification

Sprawl has numerous noted disadvantages:

- Consumption of greenspace
- Carbon-intense building typologies
- Reliance upon personal vehicular travel
- Other socioeconomic implications

These are typically averted through urban densification.





Residential Densification: **Sub-** and **super-**linear Scaling





Global Population Spread



Skyroom (2020)



How?



































Waste Generation

Waste Generation



The Project



Research Questions

- How much reserve structural capacity is present in existing buildings? By how many storeys does this allow them to be extended?
- 2. What are the key non-structural barriers to the adoption of vertical extension,

How may these be overcome?

3. How much floor-space can be generated through vertical extension at different urban scales, *What impacts might this have?*





WP1: Initial Case Study Assessment (completed)

Basic assessment framework for the calculation of reserve structural capacity in multi-storey steel-framed buildings.

Considered axial capacity of columns only.

Identified **22.65 kN/m²** of reserve capacity in a **single** case-study building.

Potential to extend a by **1.8** storeys using existing framing solution and **3.0** using lightweight CLT.



















