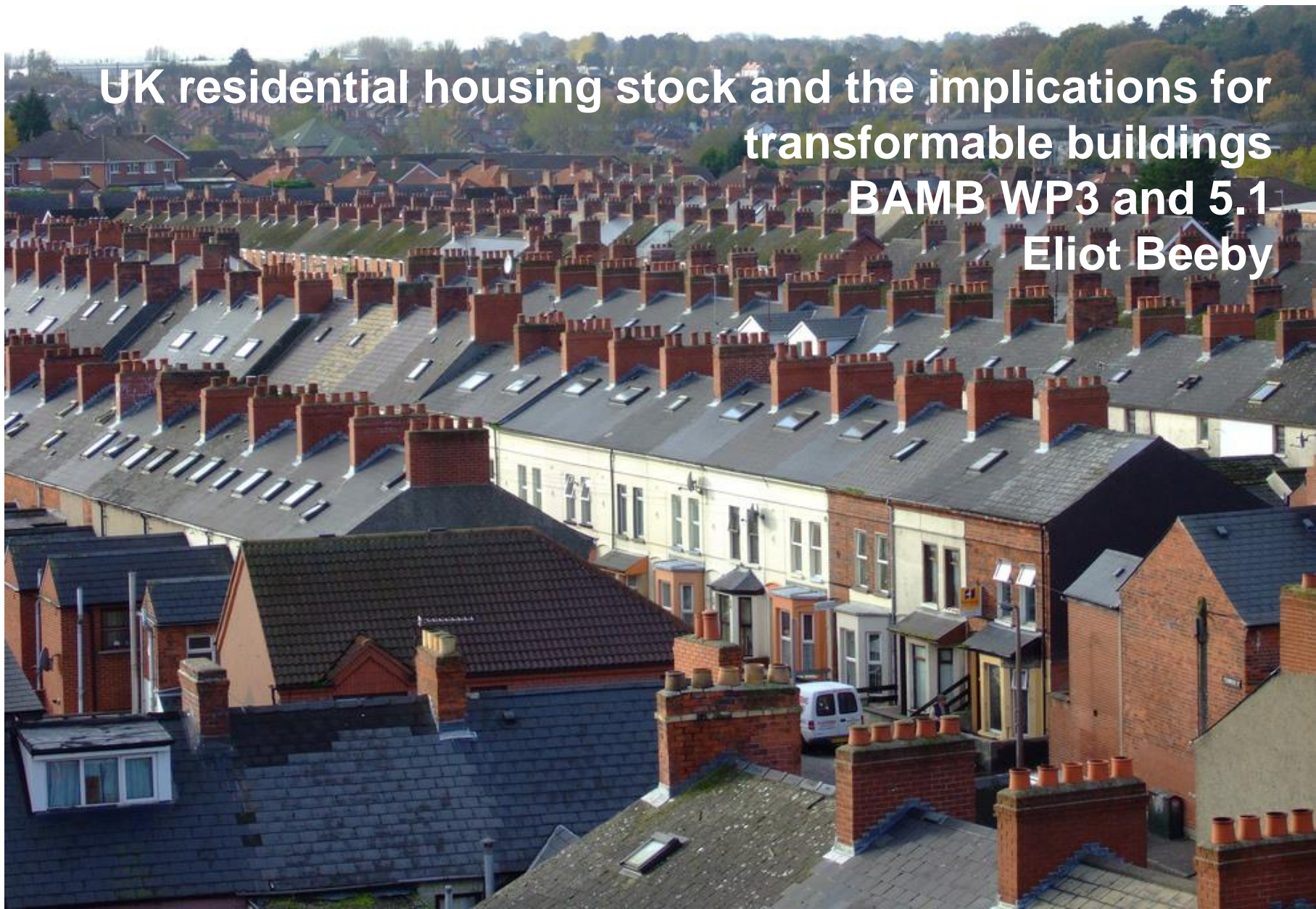
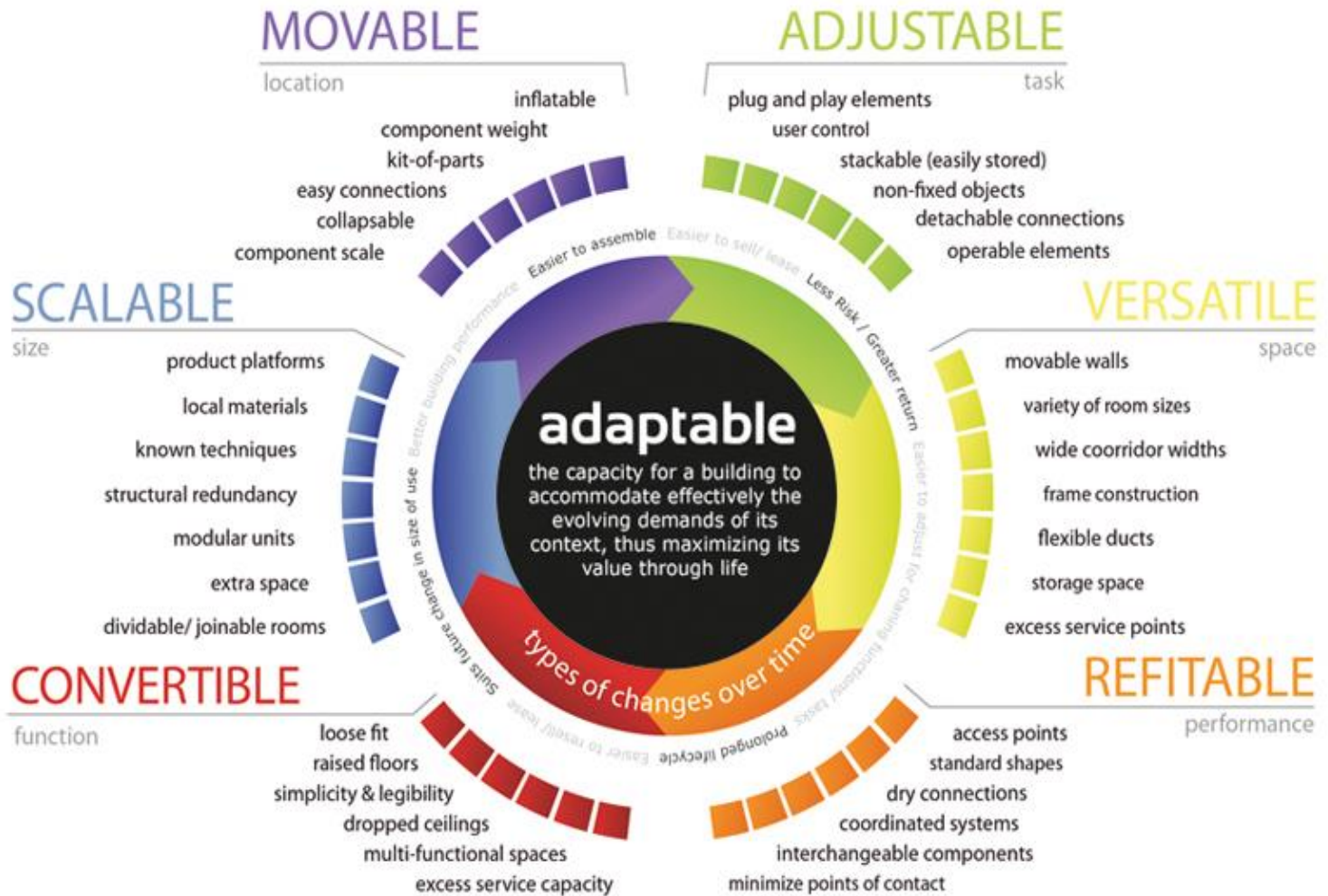


**UK residential housing stock and the implications for transformable buildings**  
**BAMB WP3 and 5.1**  
**Eliot Beeby**

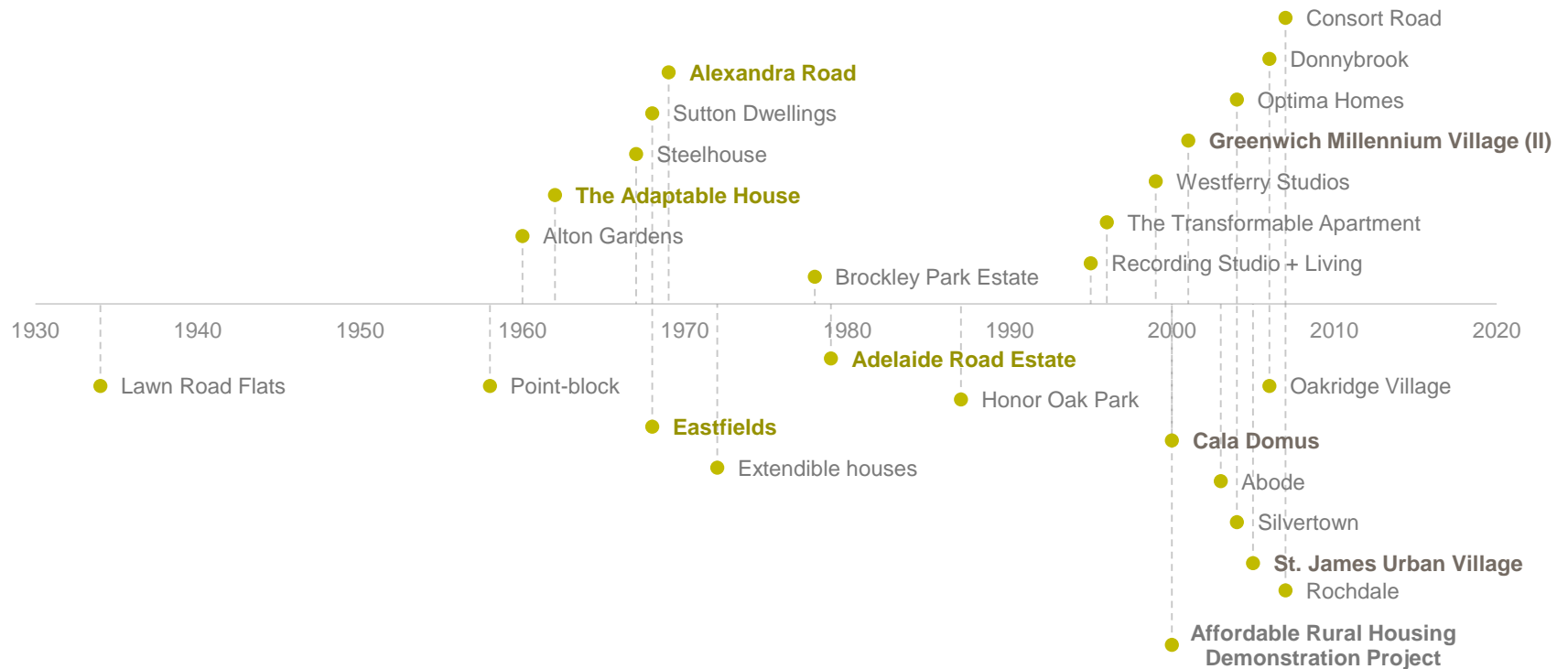


## Introduction

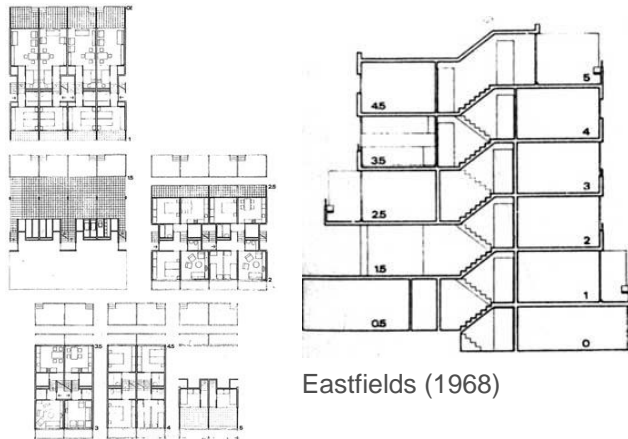
- Transformable building design context
  - Brief history of transformable buildings in UK
- Existing UK residential building stock
- Identification of major construction types in UK residential building stock
  - Material and technical characteristics
  - Spatial characteristics
- Lessons from the existing stock
- Next steps



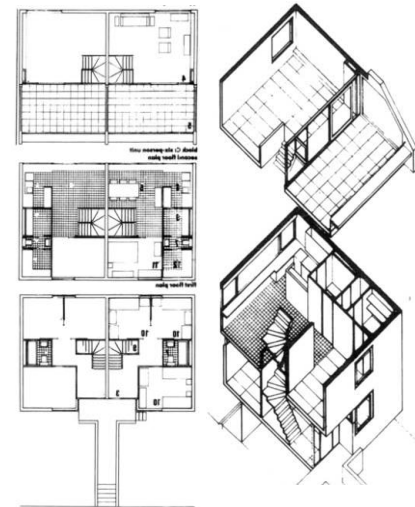
# History of transformable building in the UK



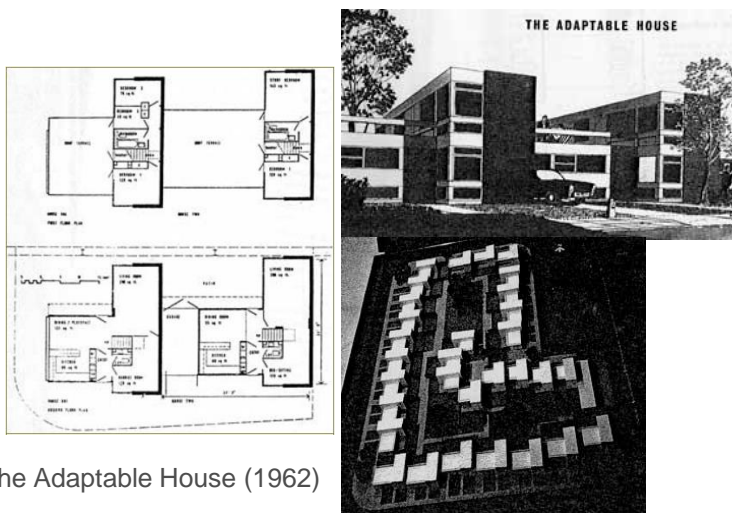
# 1960s-early 1980s



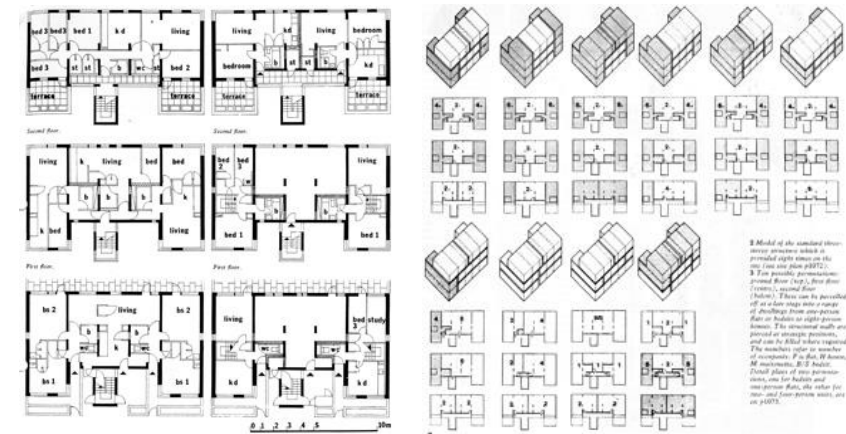
Eastfields (1968)



Alexandra Road (1969-1978)

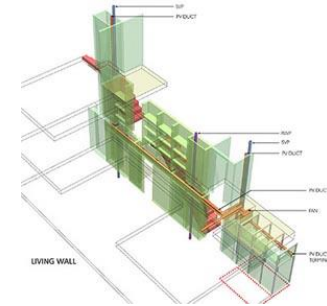
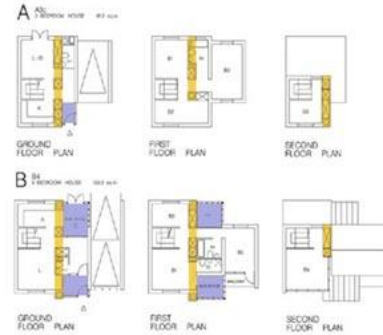
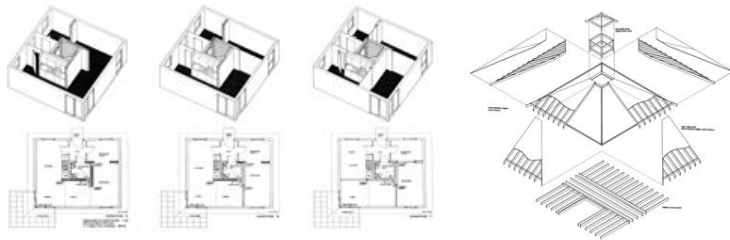


The Adaptable House (1962)

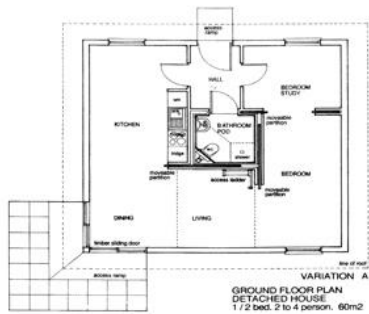
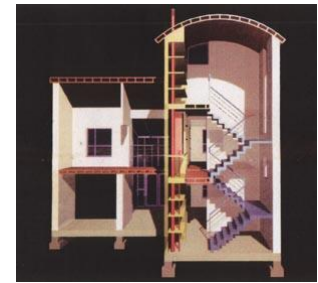


Adelaide Road Estate (1979)

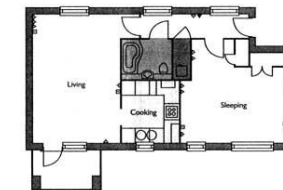
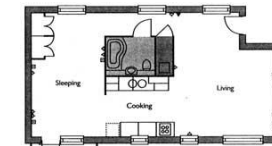
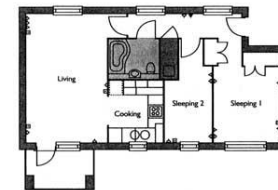
# Late 1990s-today



Cala Domus (2000)



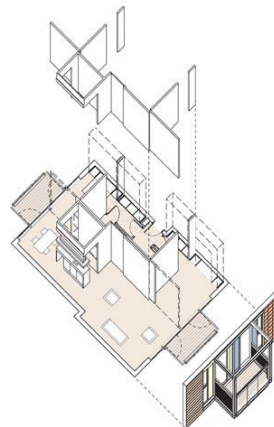
Affordable Rural Housing Demonstration Project (2000)



St. James Urban Village (2005)



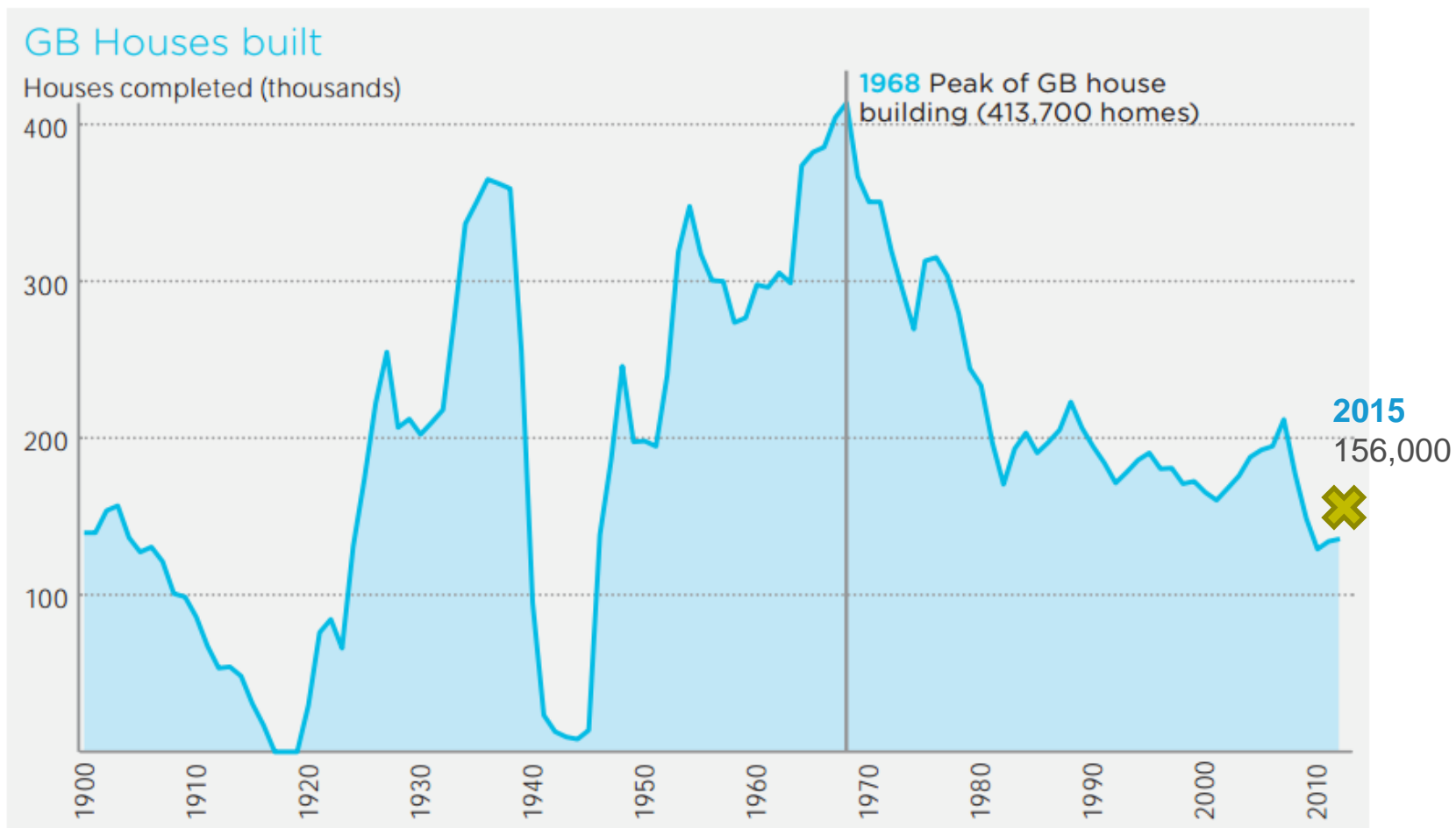
Greenwich Millennium Village II (2001)



## Why look at the existing stock?

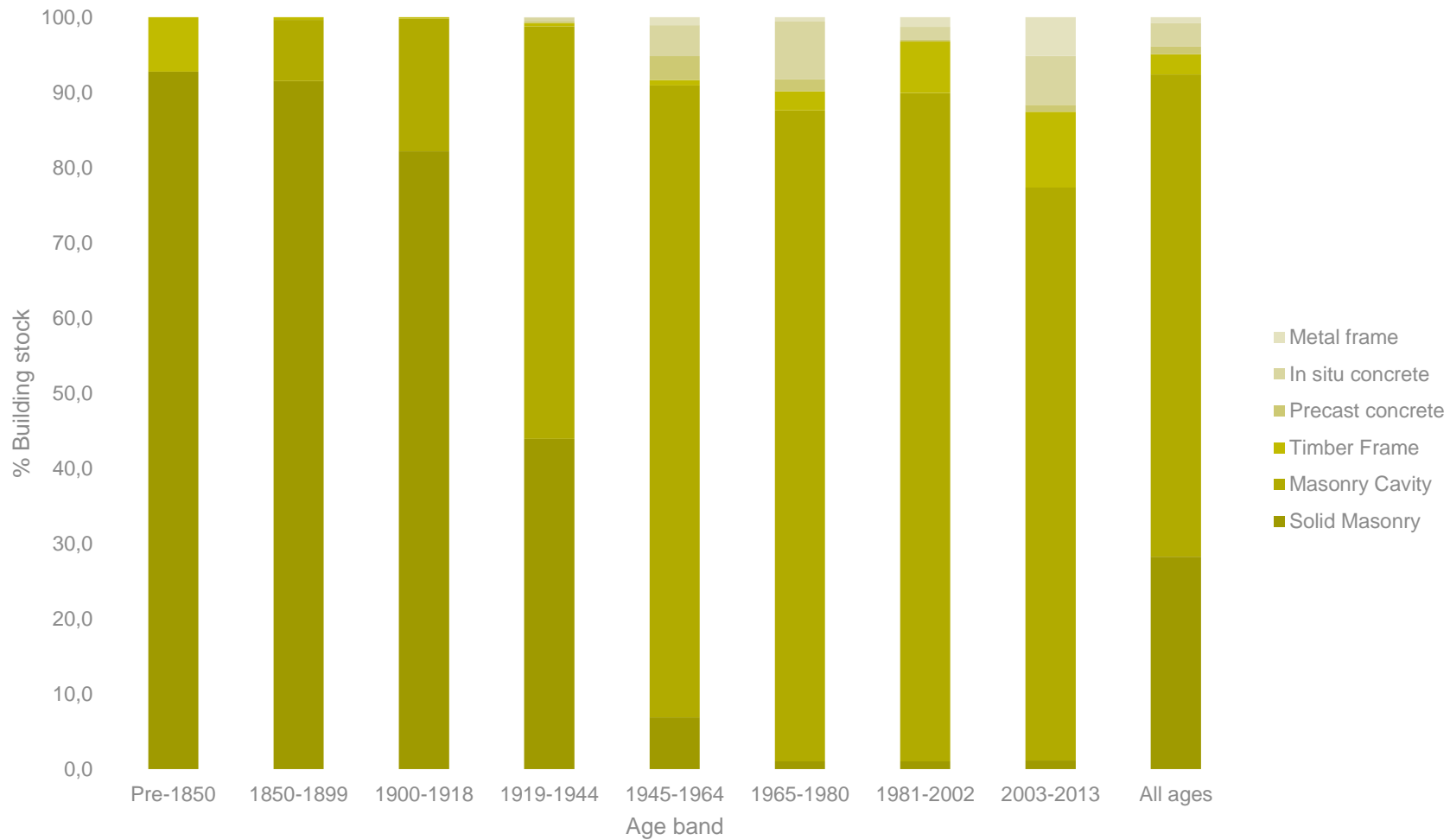


# House stock growth in the UK

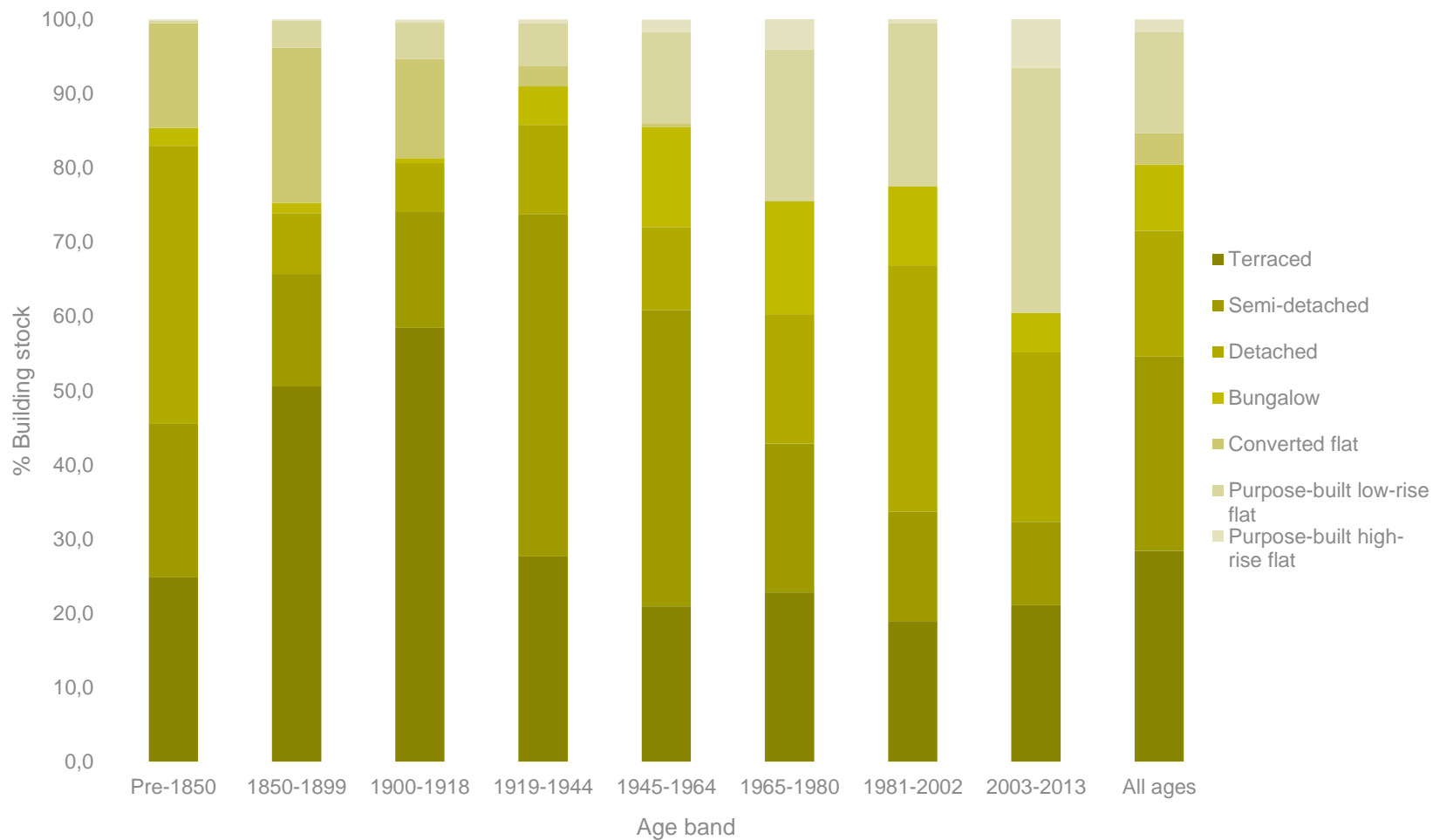




## Statistical overview - construction type



## Statistical overview - typology



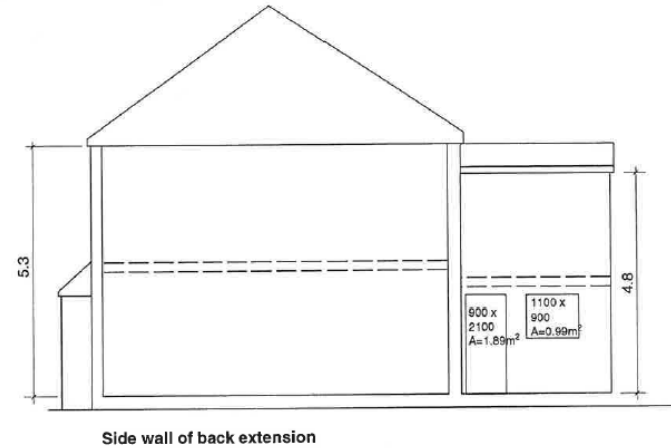
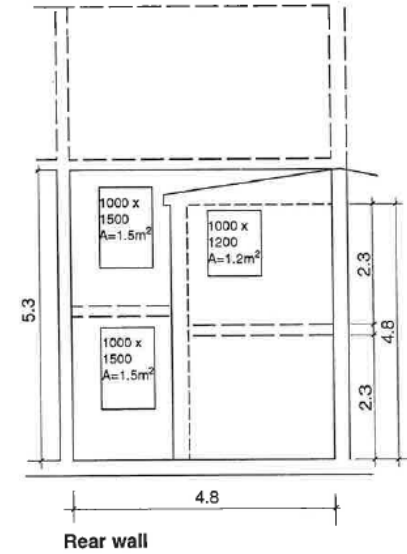
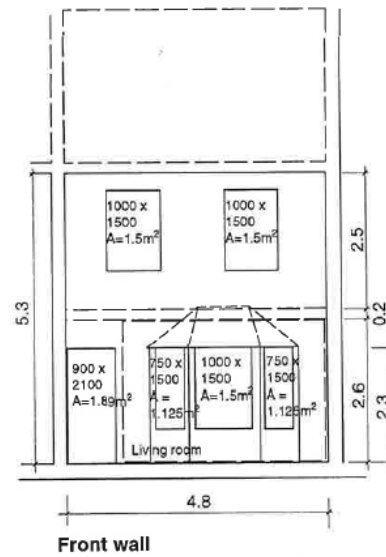
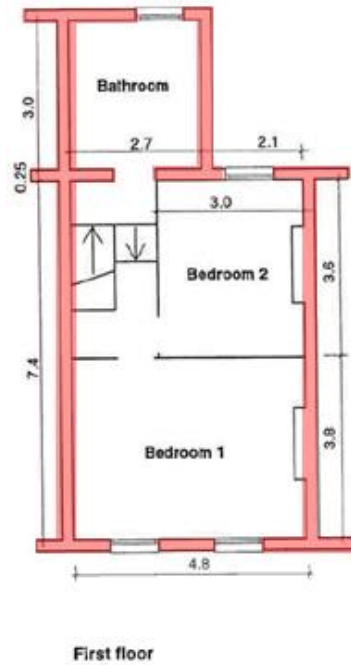
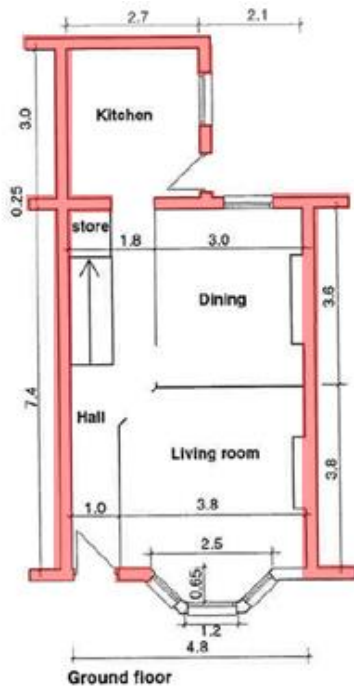
## Typical 1850-1899 terraced house



## Material and technical characteristics – terraced house

Building Element	Material description	Connections	Re-use/recycling potential
Foundation	Rubble foundation	Laid within ground	Possible depending on whether it is possible to separate and sort steel and concrete cost-effectively
Ground floor	Timber joists with timber floor boards, occasionally slate flagged solid flooring	Joists clear spanning between opposing walls or intermediate sleeper walls, floor boards nailed onto joists	Recyclable; possibly reusable depending on size, structural integrity - reclaimed timber is popular; slate flags possible re-use as hardcore
Upper floor	Timber joists with timber floor boards	Joists bolted together, floor boards nailed on	Recyclable; possibly reusable depending on size, structural integrity
	Lime plaster ceiling	Plastered onto timber laths nailed to floor joists	Can be recycled as aggregate, likely calcified so unsuitable for reuse
External walls	Double layer brickwork bonded with lime mortar, with pyramid footings at base	Lime mortar bonded to bricks	Lime mortar facilitates reuse more easily than cement mortar, but internal plastering must be removed; can be recycled as aggregate
Internal walls	Mainly brick single skin or occasionally timber stud walls	Bonded to external walls and support upper floors	Recyclable; possibly reusable depending on size, structural integrity
	Lime plaster	Plastered onto brick or timber laths nailed to timber studs	Can be recycled as aggregate, likely calcified so unsuitable for reuse
Roof	Slate tiles	Nailed to battens	Use as aggregate; possible to reclaim and reuse if care taken at removal
	Reinforced bituminous felt	Nailed to battens	Theoretically recyclable but rarely done
	Timber rafter roof with King post truss and purlins	Bolted	Recyclable; possibly reusable depending on size, structural integrity
	Mineral wool insulation (retrofitted)	Sits within cavity	If recovered relatively contaminant free, possible to recycle in closed loop system
	Lime plaster	Plastered onto timber laths nailed to ceiling joists	Can be recycled as aggregate, likely calcified so unsuitable for reuse
Windows and doors	Wooden frames	Screwed/nailed into masonry	Recyclable
	Double glazed window	Fitted into frame	Glazing is recyclable
	Wooden door frames	Screwed	Recyclable; demand for reclaimed timber products could facilitate reuse

# Spatial characteristics – terraced house



# UK building stock matrix

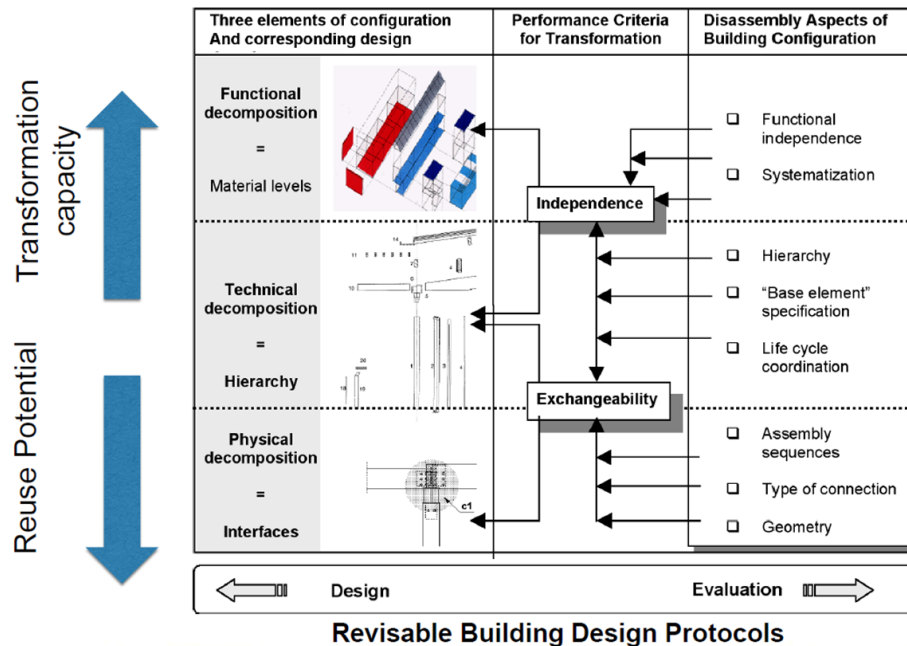
	Photo	Front & Rear	Side	Interiors
1930S DETACHED HOUSE				
1960S DETACHED HOUSE				
1930S SEMI-DETACHED HOUSE				
1960S SEMI-DETACHED HOUSE				
DETACHED BUNGALOW				
SEMI-DETACHED BUNGALOW				
FLAT/MAINTENANCE UNIT/TERRACE				

## Lessons for reversible building design in UK

- Building designed with true flexibility in mind remain in the minority
- Some existing homes have some flexible principles despite not necessarily having been designed with these principles in mind
- Increasingly on the agenda, especially with the rise of MMC

## Next steps

- Development of reversible building design tools
  - Reuse potential
  - Transformation capacity
- Building Information Model (BIM)





## References

- [www.adaptablefutures.com](http://www.adaptablefutures.com)
- Adapted from Schneider, T., & Till, J. (2007). *Flexible housing*. Architectural press.
- Durmisevic, E. (2006). *Transformable building structures: design for disassembly as a way to introduce sustainable engineering to building design & construction*. TU Delft, Delft University of Technology.
- NHBC Foundation (2015) *Homes through the decades: The making of modern housing*.