Building Performance Evaluation for the Retrofit of Council Housing in the UK:

A case study of a tower block in London Borough of Newham

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SDBE Sustainable Design of the Built Environment

Building Capacity for Sustainable Development of the Built Environment (Project ID: 2015EGY01)

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Outline

- Introduction
- Aims of the Project
- Methodology
- Results and Discussion
- Conclusion and Final Thoughts

Introduction

- This research focused on
  - Evaluating the building performance of a residential tower block in London Borough of Newham (LBN)
  - Investigating the occupants energy consumption behaviour and thermal comfort
- The tower block includes 108 flats
- Initial water ingress survey conducted by LBN team
  - Highlighting major damp, mould and condensation issues
  - Water penetration resulted in poor indoor condition and concerns of the occupants' regarding their health and wellbeing

Fig 1. Tower block in LBN

Aims of the Project

- Aims of the study
  - Evaluating the building performance of the tower block
  - Reducing the energy consumption and improving the thermal performance by providing tailored recommendation for energy efficient retrofit
- The Project is undertaken in two phases
  - Phase one: Investigating the building performance (focus of this paper)
  - Phase two: Building performance optimisations & methods for energy efficient retrofit

Methodology

- Assessing building performance to diagnose the possible cause of physical issues of dampness
- The process entails
  - Filed studies including semi-structured interview, questionnaire-base survey and on-site measurement of indoor air temperature and RH levels
  - Building simulation analysis to help understand and diagnose the issue within building performance as well as building performance optimisation

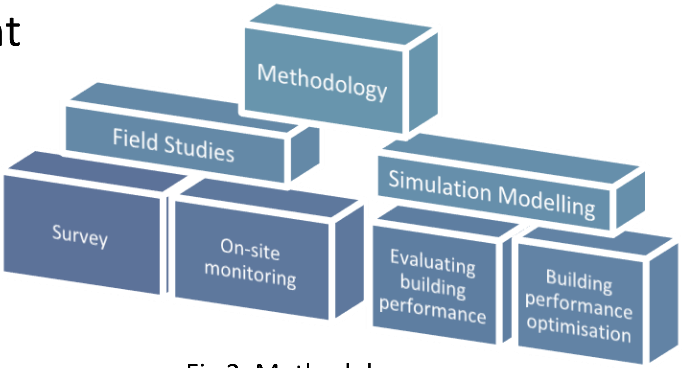

Fig 2. Methodology

Case study

- 22-storey pre-cast concrete tower block built in 1966
- The envelope is fitted with asbestos cement over-cladding panels
- Two problematic flat were selected as exploratory sample case studies focusing on bedrooms (Flats A & B)
  - Small bedroom (non-problematic room)
  - Master bedroom (problematic room)
- Both flats are located on SE in mid-floors, having similar damp and mould issues.

Water ingress and internal damp survey

- Conducting water ingress survey in the tower in 2016 by LBN .
  - 25% of the flats experience the severe damp, mould and condensation issues.
- Internal damp survey in two flats was assessed (Flats A & B) to identify the cause of penetration.
  - Jet washing the external over-cladding damage the sealing between panels causing water to penetrate

Fig 3. Dampness issues in flats A (right) and B (left)

Field Studies

- On-site measurement in small and master bedroom of flats A & B
- HOBO data loggers were fitted in the bedrooms
  - Collecting indoor air temperature and RH levels
- Measurements were carried out in cold season from 25/11/16 until 23/03/17
- Semi-structure interviewed with the occupants
  - Demonstrating the occupants have different lifestyle and energy consumption behaviour.

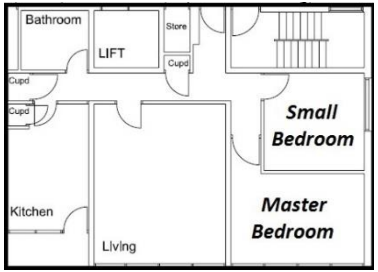

Fig 4. Case study flats

Building Simulation Modelling

- Assessing building performance of flats A & B using DesignBuilder tool
  - Possible reasons for mould and damp
  - Potential correlation with the occupants' lifestyle and energy consumption behaviour
- DB tool was validated against the monitoring results
- Incorporating outdoor weather data from MET Office and actual equipment, heating, ventilation & occupancy patterns to the simulation model
- Focused was on the coldest week

Results and Discussion

Field monitoring

- The indoor air temperatures were usually in the acceptable range in both flats
- The occupants were not satisfied from the indoor thermal condition in winter.

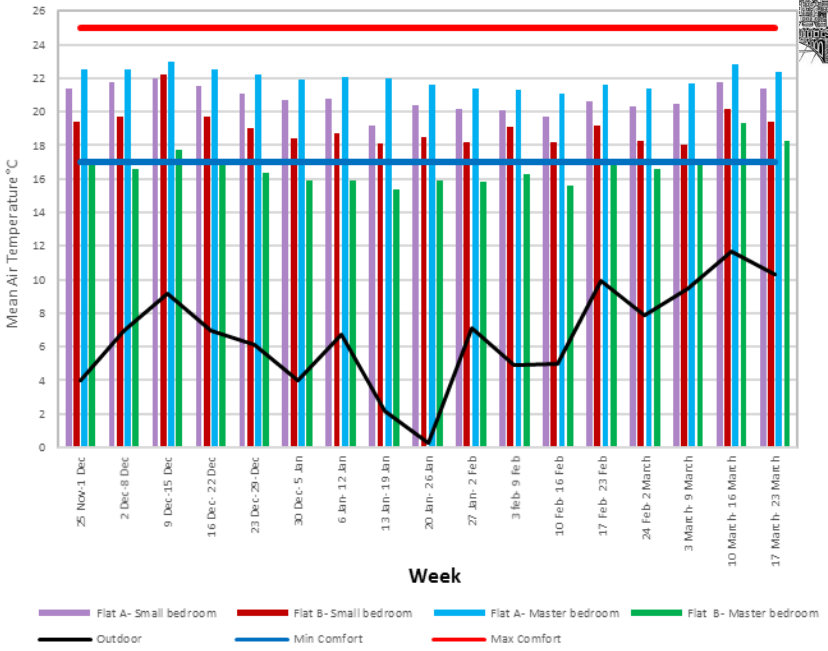

Fig 5. Weekly mean measured indoor air temperature

Results and Discussion

Field monitoring

- The weekly mean indoor RH levels were also in the acceptable range in both flats
- However, both flats have mould, damp and condensation issues in master bedroom.

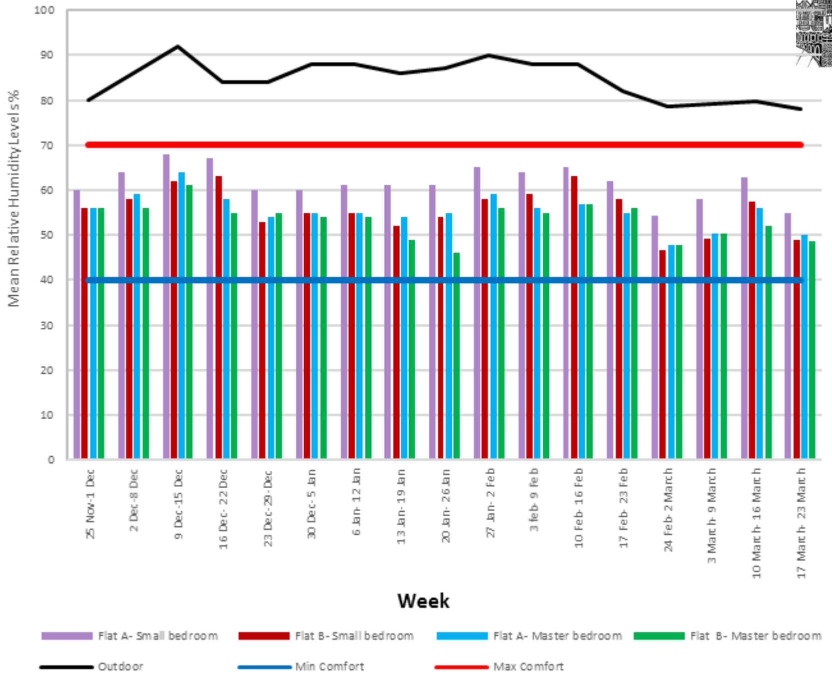

Fig 6. Weekly mean measured indoor RH%

Results and Discussion

Simulation analysis

- Acceptable correlation between measured and simulated indoor air temperature.
- Predicted material for the case study model based on 60's concrete blocks in London are acceptable.

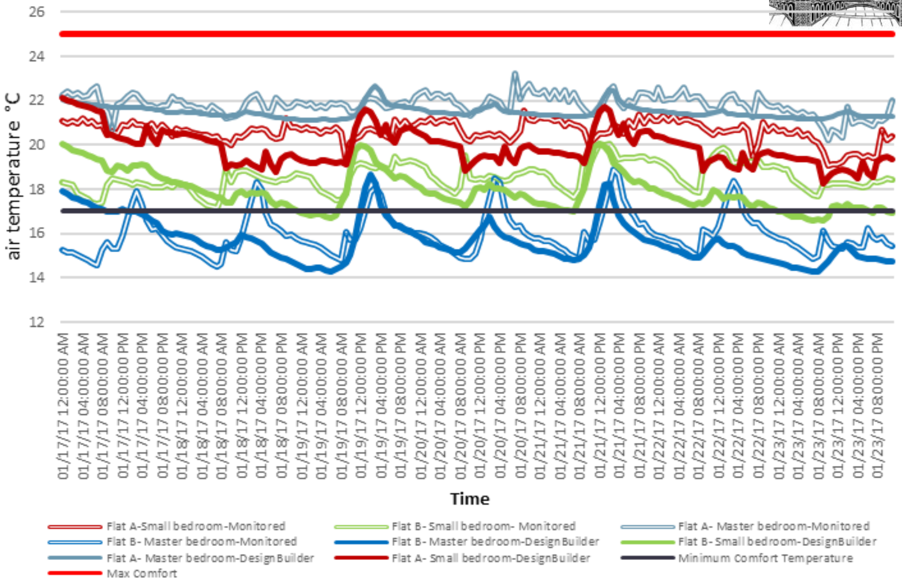

Fig 7. Monitored air temperature against the simulation results

Results and Discussion

Simulation analysis

- Measured indoor RH levels were generally higher than the simulation results.
- Water ingress issues might be a reason
- Software and data loggers accuracy might be another reason

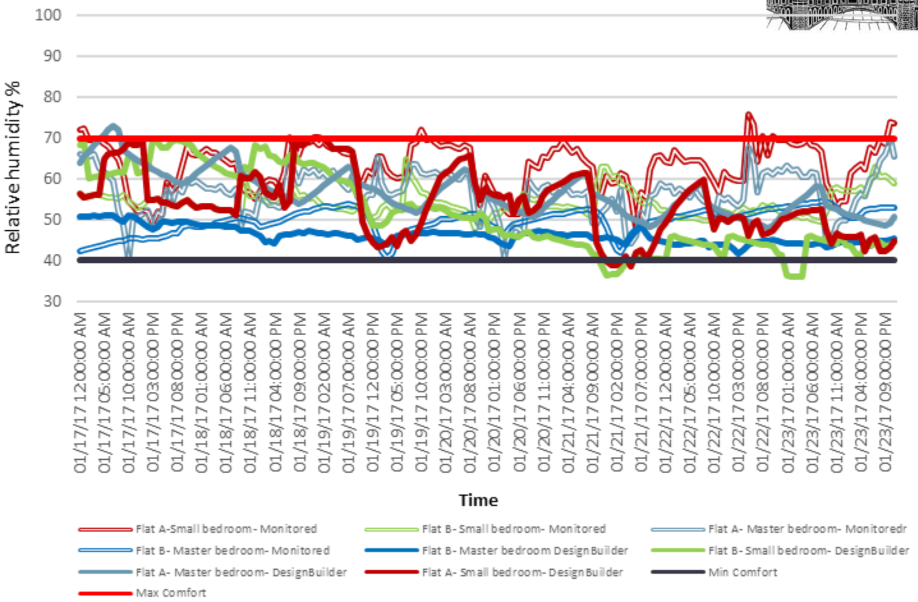

Fig 8. Monitored RH% against the simulation results

Results and Discussion

- The water can be entrapped in the building materials and the indoor moisture can be appeared on the building fabric behind the insulation during the cold period as the building is internally insulated
- The occupants' lifestyle also has a significant impact on this issue.
- Although the bedrooms in Flat A are ventilated for one hour every day, the relative humidity levels are higher than Flat B
    - Flat A is occupied by a young family of five but Flat B has only one occupant.

Results and Discussion

kWh	Flat A		Flat B	
	Small Bedroom	Master Bedroom	Small Bedroom	Master Bedroom
Average heating load	4	10	0	0
External Infiltration	1.7	0.8	0.6	1.1

Flat A

- Heating energy consumption in the master bedroom is higher to reduce the level of damp and condensation.
- As the area of the problematic room is higher than non-problematic room, it uses more energy for heating to keep the indoor air temperature in an acceptable range.

Conclusion

- Both flats have the water ingress issue in the same corners of the flats which is significant in the master bedrooms.
- The results support the argument that the dampness issues may be caused by the poor construction materials of external walls.
- This is further clarified as both indoor air temperature and RH levels in both flats were usually in the acceptable range.
- Raising awareness of occupants concerning energy consumption behaviour can reduce some of the issues experienced.
- The long-term solution is the energy efficient retrofit (second phase of the project).

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Key Dates

Abstract submission deadline:	15th July 2017
Notification of acceptance:	30th July 2017
Full paper submission deadline:	15th Sept. 2017
Notification of acceptance:	30th Sept. 2017
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Thank you for your listening…!

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