A Generative Methodology for the Design and Implementation of Social Distancing Measures in Public Buildings

Abstract

The research will use the diverse estate of Lancaster City Council as a test case for the development and implementation of automated wayfaring design for the post-pandemic recovery phase. As part of post-pandemic recovery planning, local government buildings that house essential services for the public will be some of the first to be re-opened *(1).* This research aims to provide a unique methodology using Rhino and Grasshopper *(2)* to automate a risk analysis of existing floor plans to identify areas of social distance non-compliance *(3)*. Using generative design methods, the work will go on to automate and implement optimised wayfinding designs to ameliorate the risk of areas identified as non-compliant.

Key Research Questions

i. Can social distancing guidance be effectively automated using generative software for building floor plans?
ii. Can automated social distancing be effectively implemented in public service buildings?
iii. How does inclusive design of signage and wayfinding impact the effectiveness of social distancing measures?
iv. What are the costs for social distancing implementation for publicly accessible buildings?

Literature Review

Extensive recent (2020-) publications have addressed the effectiveness of social distancing to reduce the rate of Covid-19 contamination. Consensus in papers refers to the World Health Organisation recommendation that 2m (6ft) is maintained between members of the public to reduce the potential of aerosol infection. *(4,5,6).* Operators of publicly accessible buildings should identify areas at risk of non-compliance social-distance recommendations, and provide suitable methods for risk reduction, through alteration or guidance on wayfinding *(7,8).*

In concluding a relatively extensive literature review (approx. 300 papers, articles and online resources) there is little to no research using illustrative or methodical case studies that descriptively test or illuminate the proposed area of study, an expected consequence of the short time since the start of the pandemic. There is currently no quantative or qualitative research completed on how automated processes may impact the design of existing or proposed public spaces in the context of social distancing measures. Of the few papers that explore architectural practice in the context of covid-19 *(9,10)* most refer to speculative guidance as opposed to means-tested outcomes. In the context of this gap in knowledge the work proposes a new methodology outlined in the next section.

Research Methods

Initially the work will be desktop based, completed from floor plans submitted by the estate and facility department of Lancaster City council, with results generated through processing by computer software including Rhino, Grasshopper and Python.

The implementation phase will then propose the creation of a 'live' wayfinding test case located in an existing Lancaster City Council publicly accessed building. This will provide data gathering for analysis and review of the success of social distancing measures. A user survey will provide qualitative data on experience and perceived operational success.

Descriptive Methodology

1) Receive building plans from Lancaster City Council.

2) *(A) Designer* builds an Analysis Surface on basis of floor plans.

3) Analysis surface inputted into master algorithm.

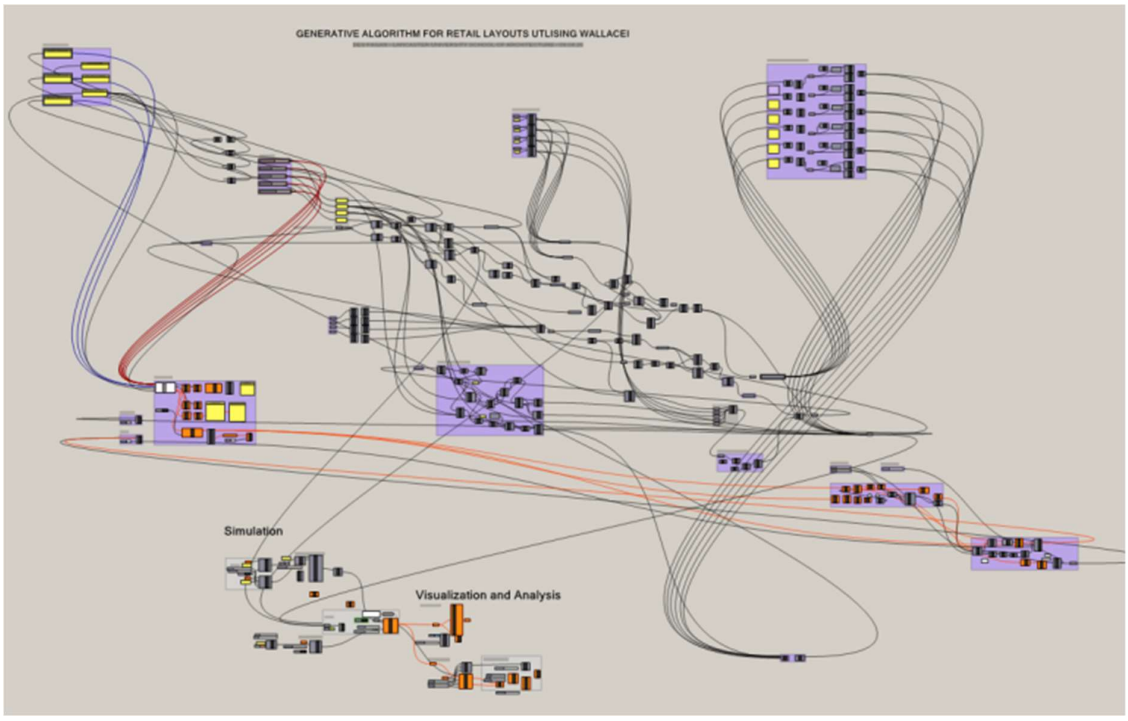

Fig 1. Example of previously authored Grasshopper definition for automated retail space (DF)

4) Algorithm charts the median route between obstructions, including aisles, places of work, places to queue, places to sit.

5) A 2m exclusion zone between two passing users is tracked onto the plans and an area (shown in Fig.2 in red below) is highlighted at risk of non-compliance for social distancing.

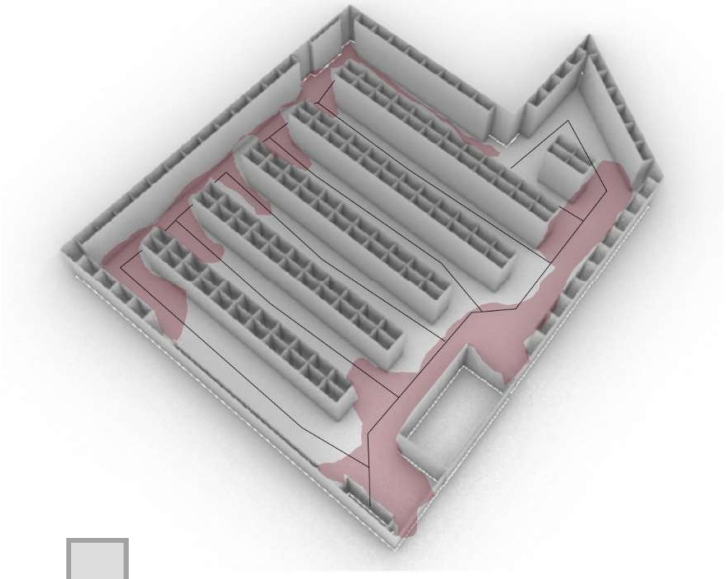

Fig 2. Example plan indicating median line and social distancing non-compliance (red)

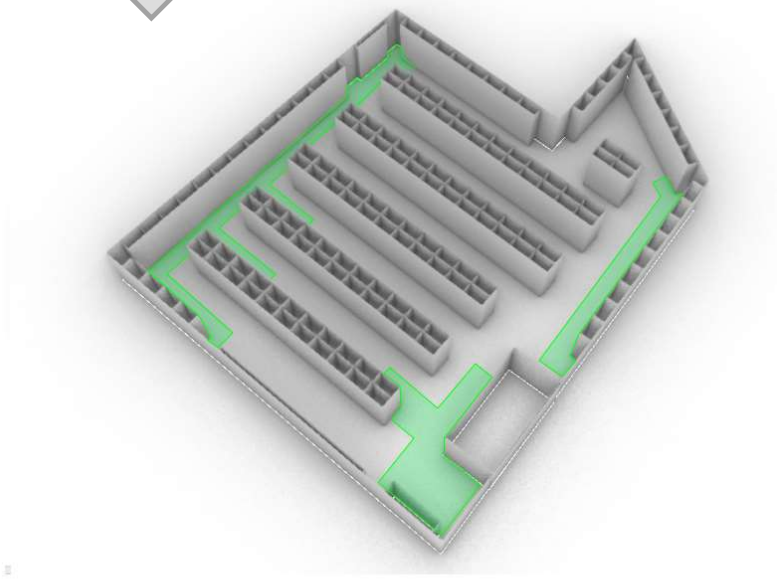

Fig 3. Perimeter indicates zone for wayfinding signage automation (green)

6) The algorithm generates an optimised layout for wayfinding and floor signage/graphics based on minimum distances between furniture and walls (the extent of which is identified as the outlined green colour on Fig.2). This is checked and evaluated by the (A) Designer.

7. Design of branded floor signage and post / wall signage by (A) Designer is produced as a cohesive package of information for communication to users and reviewed against inclusivity criteria.

8. A test case is identified from the estate of Lancaster City Council, and signage and wayfinding physically incorporated in the space prior to opening.

9. On opening, evaluation through observation of users and staff, including person to person questionnaires and timing of pedestrian movement by (A) Designer.

Analysis

Based on analysis of outcomes for the live test case, the algorithm and methodology are revised to provide improved accuracy. The automated analysis of floor plan risk and proposed wayfinding can be completed for the estate of buildings as a package of work. Analysis and observations can be made on the scalability and applicability of the methodology to the diversity of case uses within the estate.

Research Limitations

i. Ethical approval required re: pandemic and interaction with public – a possible means to remove risk is to bring project to conceptual stage only, not implementation.
ii. Speculative new research with minimal precedent on existing models for distancing.

Proposed Timescale

Steps 1-2 = 2 weeks
Steps 3-6 = 3 weeks
Steps 7-9 = 4 weeks
Analysis, conclusion, further work & paper = 3 weeks

Total length = **12 weeks** to completion

Further Funding by scaling:

- *UKRI open call for research and innovation ideas to address COVID-19*
- *ISCF Healthy Ageing Social, Behavioural & Design Research Programme*
- *Strategic Priorities Fund*

References

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