

TFW: Preliminary results for class 150 train, carriage one

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Key points

- We have run our seat selection code over the old building first floor layout, based on the provided CAD file.
- We achieved a maximum seat occupancy, with a 2m social distancing measure, of approximately 45% without shielding, a significant improvement on the benchmark supplied at 28%.
- We have developed a new web-based application which is specific to the Next first floor layout, available [here](#).
- We have shown our ‘greedy algorithm’ is sufficient in improving the seating arrangements in Next office buildings.

What we could do next

- Given the potential shield locations in the CAD file, we could simulate scenarios using shielding.
- We can run the code over a greater number of seat choices to try to improve our solution.

Methods and results

Following our discussions, we took the CAD file provided and reformatted the information to be compatible with our app. Running the code for one seating order, the results of which are displayed in Figure 1.

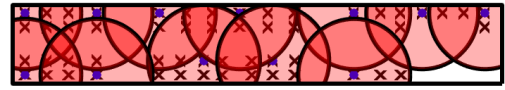
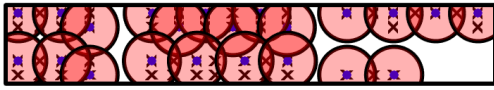
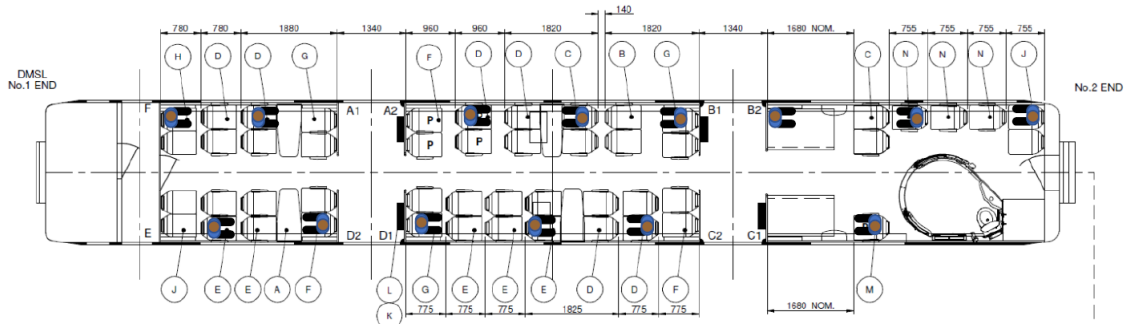
We initially ran the code under the assumption that the conference rooms could be used. We have also provided the results without the conference rooms included. Results are displayed in Table 1.

	Maximum capacity at 2m social distancing (%)
Next CAD file benchmark	27.9
Cardiff App with conference rooms	41.5
Cardiff App without conference rooms	45.2

Table 1: Comparison of the performance of the Cardiff seat finding app against the benchmark provided in the supplied CAD file.

As demonstrated in Table 1, we can very quickly achieve significantly higher occupancy rates in the office without violating social distancing measures. Given more time, we can search for even better solutions, as well as develop methods for user specification of shield locations (see first app).

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(b) A sample layout for a social distancing measure of 1 metres, which uses 201 seats.

(c) A sample layout for a social distancing measure of 2 metres, which uses 105 seats.

Figure 1: A proposed office layout given by the app for 1 and 2 metre social distancing. Seat locations are marked with crosses, available seats are marked with dots and the ‘region of safety’ is denoted by a circle around the available seats. Overlapping circles imply that certain regions are exposed to contamination from multiple sources, but no available seats are located in these regions.

Prospective developments for improving optimality

Our app always provides seating arrangements that obey social distancing measures, and provides locally optimal solutions which are already better than the given benchmarks. Returning the absolute optimum arrangement, however, is a lot more difficult because the problem is what is known as ‘NP-hard’. Simply put, the only way to guarantee you have the most possible seats used is to try every possible order of seat checking, and pick the one which has the most seats used. Actually trying out every seat ordering would take a very long time; there are more ways to order 253 seats than there are particles in the universe.

What we can do, though, is develop techniques to check our solutions and continuously improve upon them where possible. At a cost of additional time and computing power to implement, these methods would improve the likelihood we have found the best possible seating arrangement, allowing us to potentially further improve on our already powerful result.