Optimisation of car-park designs

Plans for new urban developments (blocks of flats, offices etc.) very often include integrated basement car parks. The value of each car-parking is space very high indeed — perhaps £100k in central London, although a more typical figure across the UK is £15k. In consequence, there is high value in trying to maximise the number of spaces within a given car park, with the constraint that some level of usability (size of spaces, limitations on vehicle manoeuvrability) must be respected. At present, the layout of car parks is designed by an architect with CAD tools, and the results may be extremely complicated (see Figure 1) — yet there is no guarantee that the architect has achieved the maximum possible number of spaces.

We seek automatic algorithms which will either replace the role of the architect (or more realistically, act as a decision support tool to him/her). When provided with a given floor shape (and locations of entrances / exits), the algorithms should seek ways of populating it with the maximum possible number of usable car-parking spaces. There are design standards\(^1\) for spaces — 4.8m × 2.5m is considered to be the smallest that is feasible — although the space must be longer than this if it is in a ‘parallel park’ configuration. Local authorities also maintain design standards about the widths of aisles and so on — see Figure 2. But these need not need to be respected in a private car-park — so a fundamental encoding of constraints in terms of turning circles, swept areas etc. might allow for more inventive solutions and a better utilisation of space, than adherence to the design standards’ rules of thumb.

Finally — in practice, the car parking area is impeded by structural pillars whose positions one might assume (for simplicity) are fixed. However, it would be useful if the algorithms and procedures could incorporate a sensitivity analysis — e.g., to indicate that an extra space would be possible if a pillar is moved a small distance.

\(^1\)Car Park Designers’ Handbook, by J.D. Hill at al, Thomas Telford Ltd.