Brindleyplace, Birmingham:
the UCL study of the potential of the site and the Farrell masterplan

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Summary of conclusions

- The Farrell masterplan now uses an almost optimal set of alignments to integrate the new development into the existing city centre and the light industrial and housing areas in the surrounding community;

- It takes advantage of its strategic location in Birmingham to create a new part of the street network which recognises the logic of this part of the city. By creating a focus of local integration as well as creating stong large scale alignments to the housing and light industrial areas to the south and west the development begins to reintegrate the historic city centre areas around Chamberlain Square with the more recent and isolated housing areas;

- The focus of large scale integrating spaces which meet in the central square and pass through to the towpath will be instrumental in bringing urban levels of movement to the heart of the site and in bringing informal space use and activity to the canalside;

- The scale and content of development together with the strong locally integrating spatial structure of the street grid will help make retail and ammenity land uses viable on the site. The strength of its global connections to the surrounding communities will help make sure that they are also viable at weekends, and that the area will remain inhabited at night;

- Predictions of levels of pedestrian movement in the site suggest that the open spaces of the proposed scheme will achieve good levels natural movement, that an urban mix of land uses including catering and retail will be viable and that these in turn will attract use out of work hours and at weekends, particularly from the surrounding communities and from those attending special events at the adjoining Convention Centre and Arena;

- The predictions of space use also suggest that significantly improved levels of pedestrian movement will accrue to peripheral and incident streets - Broad Street, Sheepcote Street and the western leg of Ouzells Street for instance - as a result of the development. It is likely that this will help regenerate these areas in the longer term.

Introduction

Who we are and what we do

The Unit for Architectural Studies at the Bartlett School of Architecture and Planning of University College London is a research unit that specialises in studying how urban areas and building complexes work. We try to answer the question: what is it that designers do that affects the way that people use space ? The answer our research has come up with again and again is that it is the way space is patterned and networked as a whole that most influences how people use it. We have found this out by developing a new type of of computer modelling technique we call 'space syntax' which is all about pattern analysis and which wouldn't have been possible before high speed computers because towns and cities are such complex spatial patterns (Figure 1). Space syntax techniques together with the knowledge we have developed through research and applied studies are now being used for analysis and predictive modelling for masterplanning many of the most sensitive current urban regeneration schemes including those at Kings Cross, Paternoster Square, Broadgate, Ludgate Hill, Spitalfields and the Brussels Canal Zone redevelopment.

What we offer

We use these computer modelling techniques, coupled to intensive (and rapid) observations of use and movement patterns, to analyse and explain how the patterns of existing towns and cities work (or fail to work). We then use the computer models to simulate and predict how well new masterplanning proposals will adapt, exploit and affect an existing urban pattern. By working with designers and their clients we can help develop designs that will optimise the the pattern of a new development, and its effect on the surrounding area in terms of likely space use and movement.

Why is movement so important ?

Our research shows that movement is in many ways the criticial thing in towns and cities - even that towns and cities are *about* movement and evolve naturally to optimise and exploit movement patterns and their benefits. The most important finding is that the pattern of movement in a town or city is influenced first and foremost by the pattern of urban space itself, including the overall structure of the urban grid. We call movement produced by the pattern of urban space 'natural movement' to distinguish it from flows to and from specific attractors, which is the normal way in which movement has been conceptualised in the past.

The second finding is that movement is the most important component of space use, and successful urban areas and spaces are built on good basic levels of movement. We believe we can show that historically towns and cities evolve so that the distribution of land uses - retail for example - follows the movement patterns (or lack of them) created by the pattern of space. This is one of the main reasons why if you don't design new urban developments for good levels of natural movement then you will always be struggling to make them feel alive with an economically viable mix of landuses.

The third finding follows from the very simple fact that people tend to walk in straight lines. By learning to analyse the pattern of lines of sight and access that are created by the way open space is structured through the arrangement of buildings, we can predict about 60%-7O% of pedestrian (and vehicular) movement in an existing area. With a detailed knowledge of how an urban area is working it is then possible to make good predictions about the way a new scheme is likely to be used.

What have we done in the Birmingham study

There are three main stages in the study we have carried out for Farrell's and their clients. First we have analysed the spatial pattern of a large part of Birmingham - approximately 16 square km around the Brindleyplace site, as far afield as Spring Vale, Winson Green and Edgbaston (Figure 2). We have to work at this scale initially because movement patterns are as sensitive to the large scale spatial pattern as the more localised. Analysing Birmingham at this scale has given us some suggestions about the urban structure which you may find interesting in themselves as well as for their relevance for the Brindleyplace site.

Second we have observed pedestrian movement intensively within the catchment area of the site. 160 street segments were observed at all times of the working day and a more limited sample in the evenings, at night and at weekends. Again you may find our results interesting in themselves. We have then correlated the spatial analysis with the observations to show how spatial configuration produces space use in this particular case. The strong correlations we have obtained effectively verify our model of Birmingham, and allow us to add new design proposals to the model and to simulate and predict their effects with reasonable confidence. Fourth, therefore, we have worked with the designers and their clients to explore possible design ideas, and to evaluate and fine tune the masterplan.

What does the computer model actually do?

Space Syntax® computer models represent the spatial configuration of the street grid in terms of the lines of sight and access which people actually use to move around an urban area. (Figure 3). This is a complex pattern, and this is the reason that computers are used. The techniques allow us to see how a street grid can actually appear different from different points of view. From some spaces - for example the court in the Bull Ring (Figure 4) - the rest of Birmingham is many changes of direction away. From others - say, the line that crosses Chamberlain Square diagonally (Figure 5) - the area of town within a few changes of direction is far larger. We have found a numerical index which we call 'integration' that expresses what you see in these figures. Roughly, the integration value of a line is its 'depth' from all other lines in the system. This measures the average complexity of routes to that line from all other lines since moving from one line to another in the map involves a change of direction. It turns out that this index, which is arrived at from a purely mathematical analysis of the overall pattern, is a very good predictor of the levels of pedestrian movement along each line: the more 'integrated' a space (shallower, less complex routes with respect to the rest of the system), the better used, the more segregated the emptier.

The 'radius' of this index (that is the number of steps from each line that we count) can be varied to explore the structure of an urban pattern. For example, we find that a radius of 3 steps (red and orange in the Bull Ring and Chamberlain Square illustrations) gives a very good picture of how integrated a line or space is in a relatively localised area, in contrast with radius-n (unrestricted radius) which gives a picture of its importance in the large scale 'global' system.

The structure of Birmingham

With these indices we can discover some important features of the spatial pattern of Birmingham, in that the radius-3 and radius-n indices of integration in Birmingham show a strikingly different pattern. The pattern of lines usable by pedestrians as a whole analysed in terms of these indices is coloured up with deep red for most integrated (and therefore 'hot' in terms of natural movement) and deep blue for least integrated (and therefore 'cold' in terms of natural movement) in Figures 6 and 7. Remarkably for a purely spatial analysis, New Street is the most locally integrated line at radius-3 (Figures 6 and 8), while the section of Broad Street adjacent to the Brindleyplace site is the most globally integrated at radius-n (Figures 7 and 9). A key feature of the underlying structure of Birmingham follows from this. The downtown area around New Street, and focussing on Victoria and Chamberlain Squares is highly

locally integrating, and shows up as the major red focus on this index, with the main lines of Broad Street leading to Five Ways only of second order (orange and yellow) strength. However the position is reversed when the global or radius-n index of integration is taken. In this Five Ways and Broad Street are the main focusses of integration (red) whilst the cluster of lines in the New Street area are only of second order. This means that whilst Broad Street and Five Ways are important in connecting up Birmingham at the largest scale, they do not have an equivalent importance in their local connections (obviously because the type of development that has taken place in that part of the city is predominately relatively isolated housing estates and light industry). The Chamberlain Square-New Street complex, however, whilst singularly well integrated into the inner area has been partially isolated from the larger scale city (again, obviously, by the effect of traffic routes on pedestrian movement). It is also possible, however, to see how the recent changes to the Paradise Forum-Centenary Square link are begining to successfully reintegrate this side of the city into the larger scale context.

This analysis shows that the Brindleyplace site offers an important strategic opportunity both to create a new local focus to bring life to the run down area around Broad Street - one of the reasons for its present state is undoubtedly its loss of local integration - and also to help re-integrate the fragmented urban structure of Birmingham as a whole.

Existing patterns of movement

Figure 10 shows the whole day average flows for the existing pattern of movement at the 160 locations observed in areas around the site in people per minute. The figures above the arrows indicate two way movement along that line through an imaginary 'gate' at the centre of the arrow. Similar maps have been made for each two hour period through the working day (8-10am; 10-12; 12-2pm; 2-4pm; 4-6 pm) as well as for two evening periods (6-8 pm and 8-10 pm) for a resricted set of 'gates', and two Saturday periods (10-12 noon and 12-2 pm), and all are included in the Technical Appendix. The maps show that Five Ways, Broad Street and the Chamberlain Square-New Street area are the main focusses of movement, and each holds up well into the later evening and at the weekend. The overall average for the whole area is 3.123 (moving people per minute).

There is, however, a remarkable contrast between the 'urban side' and the housing and light industry side of the site. The urban side has a mean movement rate of 6 people per minute - the rate at

which an area begins to feel urban - while the housing and light industry side manages only .608 - a whole order of magnitude less. The Five Ways area produces 3.02, half way between the two, but with virtually all the movement concentrated around the shopping centre and the pedestrian interchange in the centre of Five Ways. These very substantial differences must be taken into account in the design of the masterplan, in that it ought both to extend the urban area to the west but also ought to draw out of the housing and light industrial areas the movement that Five Ways shows is potentially available. The figures, however, also offer a warning: that housing and light industry alone do not generate the kind of urban life one is looking for in an area, though they may generate small localised pockets, but city workers do. They move about, use the facilities, make purchases and in general are predisposed to enjoy what is on offer and can help make retail and amenity land uses economically viable.

How the space pattern leads to the movement pattern

How this might be achieved begins to suggest itself as we examine the relationship between the spatial pattern of the city and the movement patterns we have observed. We must here make use of a favourite tool of statisticians: the scattergram. This is important, though tedious, and we must explain what it is and how it can give us confidence that our models are giving us a true working picture of Birmingham, and a reliable basis for prediction.

Figure 11 is a 'scattergram' of all the 'gate' observations. Each gate is one point on the scatter, located on the horizontal axis according to the global integration value of the line on which it sits, and on the vertical axis according to the number of people per minute passing through that 'gate'. There is also a line on the scattergram passing through the points called the regression line which is a kind of moving average indicating how much more movement you get on average for how much more integration.[1] Now, if you think about it, a perfect relationship between integration and movement would mean that all the points would lie exactly on the regression line. The degree to which the gates cluster close to the regression line therefore indicates the degree of 'correlation' (a number between 0 and 1) between the two, and therefore the degree to which, other things being equal, you can predict movement from spatial integration. We normally expect a correlation of about .78, meaning that we have 'explained' about 60+% of the total movement.

In this case, we get a much messier scatter than usual and therefore a much less good correlation. However, this is because we have combined the urban side of the city with the housing and light

industry side, where very different conditions of built density prevail. This can be seen on Figure 12 which maps the overall average plot ratios for urban blocks as a whole, including any open areas found within the blocks. The map thus indicates the general level of development in the blocks. Now although the specific plot ratios adjacent to obverved gates do not have much effect on movement rates (as you would expect since most movement is passing through space rather than arriving at or leaving destinations on that line), the general level of density in the area does. If we then make a broad separation of our data into two areas corresponding to the urban side and the housing side (including the Five Ways area), then we find two very powerful correlations as shown in Figure 13, and therefore good predictive ability. We may if we wish also separate out the rather special Five Ways area and get Figure 14, again showing a very powerful correlation.

There is one important difference, however. The best prediction of movement on the urban side comes from the local integration index; that on the housing and light industry side from the global index. These differences reflect the distinctive feature of the spatial pattern of Birmingham, that its local and global integration patterns prioritise different parts of the city. These scatters do however show how powerfully the movement pattern in the city is influenced by the purely spatial structure of the street grid modified by the general degree of development in an area. Our models have thus been verified for Birmingham and can provide a useful tool for design evaluation and fine tuning.

Discussion of the masterplan and how it will work

In the light of these findings, let us first look at how the masterplan will work, bearing in mind of course that the proposed street layout has already been modified and developed in response to this study, and using the knowledge from previous research on which it is based. The masterplan is now very much concerned with route continuity within and around the site, through strong alignments of lines of sight and movement, and the location of open spaces on focusses of strong lines. In particular the study of the contextual area has allowed priorities to be developed within the site in terms of the key alignments with respect to the surrounding area. For instance the important alignment from the western leg of Ouzells Street into the site through the square and to the tow path now plays a strategic role in integrating the housing areas to the south west of the site. Although the levels of movement in this area are generally low at present, the consistent levels of space use observed at Five Ways, even late at night, suggest that large scale integration in this area will attract not insignificant levels of through movement out of

office hours and at weekends.

A slightly different more southerly alignment leads up to the Five Ways complex via Broad Street and links directly through the site to the square and the towpath. From the east the lines of Berkley Street and Granville Street link directly into the site, with Berkley Street passing right across to the western island, and potentially to the Arena towpath leaving only one or two further steps to the proposed Vincent Street Centro station. This alignment will also form an important access to the site and areas beyond from the proposed Broad Street Metro station. The directness of these connections and their importance both locally and in the larger scale structure of the area can be seen on Figures 16 and 17 which show their integration values in the highest order red and orange range for the global integration index, and in the high order oranges and yellows for local integration.

Connections from the city centre to the east via the link through the Convention Centre mall across the canal and to the square will be visually direct but need to negotiate changes of level and possibly of direction in order to maintain local connections to the canal towpath. In view of this, and the possible effects of deterence on free movement that future security regimes might impose at the Convention Centre, the alignment to Broad Street at the north east corner of the site past the Brasshouse is of considerable importance in maintaining adequate movement into and through the site. The concentration of retail in this location, and its relationship to the canalside as well as to Broad Street will allow the minimum visual obstruction on the alignment to the central square.

An important element of the masterplanning principles for the scheme has been to ensure that people moving through the area will be aware both of the local definition of the urban space they are in, and of the more global connections of these spaces to the urban grid at the larger scale. In previous research this factor has been found of particular importance in attaining urban levels of informal space use - people just sitting and watching the world go by tend to locate themselves just off the main lines of sight that carry larger scale movement. The scale of a piece of open urban space depends it seems not only on the relationship between its width and the height of buildings, but also on the scale of the lines of sight that lead into it and knit it into the urban fabric. Larger spaces need buildings in scale and more strategic visual connections to the larger scale fabric if they are to attract informal space use in proportion to their size, and so feel occupied. Figure 16 shows how the pattern of strong global integration in Birmingham with the current masterplan

inserted creates a new focus of strongly integrating lines at the main square, in a way that is manifestly comparable to the Victoria-Chamberlain Square complex. The close diagonal link between the square and the towpath level plaza on the canalside mirrors the relationship between Victoria Square, as the gatherer of a series of highly strategic lines, and Chamberlain Square which is slightly set back and the focus of informal space use. In this case the scale of the canalside space has the added large scale visual connections provided by the canal complex itself, which are of a scale in proportion to the size of the effective open space bounded by the Arena, the Kingston site, the eastern corner of the island and the two commercial buildings on either side of the plaza itself. We believe that the strength of the global integration gathered in the central square will provide the people, and the scale of the canalside plaza with its visual connections and canal activity will mean that they want to spend time there in informal space use.

There is a difference between Brindleyplace Square square and Chamberlain Square however. In terms of the local pattern of the street grid, the advantages of the Chamberlain Square location give it stronger local integration. In terms of global integration, however, the new square has the edge, reflecting its globally more strategic location in the city at the larger scale.

This will have important effects in meeting the twin objectives of the masterplan: to make a new local focus and to improve the integration and movement opportunities of the surrounding community areas. It means that during the week, when the presence of office workers predominates a new natural urban focus will be created in and around the main square of the development and the canalside. But it also suggests that at weekends when the office workers are no longer there, the integration of the site into the surroundings will mean that movement and space use will be attracted from the residential areas providing a good base on which to develop the out-of-working hours leisure and informal activities and facilities. Take for example the extension of the western leg of Ouzells Street through the edge of the square diretly to the canalside, and also linking directly thorugh to the retail area and the Covnetion centre bridge. This line will attract fairly low levels of movement from the residential and light industrial areas adjacent because these generate little movement during the working day. However the line is spatially very integrating and creates powerful links to a host of potential desitniations near and beyond the canal side. These will be exploited at the weekends since they are available through the natural movement opporuntities created by the development. As the area around the site begins to regenerate, and

the community schemes in the vicinity are realised, the important resources offered by the Brindleyplace site in terms of its strategic location and its largescale integrating structure will begin to show in terms of additional levels of space use and through movement.

Predictions of likely patterns and levels of pedestrian movement

If a development is inserted in a more or less homogeneous area - say the City of London - and no major new attractors or traffic interchanges are proposed, then the regression equation of the scattergram of the existing area is sufficient to predict future movement rates in a development since any new development will give rise to both changes in the values of existing lines and give integration values to new lines. In the case of Brindleyplace, however, there are a number of special features: the site sits between two areas which are radically different in their density and type of development; major new attractor facilities are proposed; and two new stations are expected to open before the development is complete.

Because of the great differences in density on the two sides of the site, and the fact that the central area of the city is best predicted by the local integration index whilst the housing and light industrial areas, including Five Ways, are best predicted by the global integration index, it was necessary to find a combined measure of local and global integration that could sucessfully predict existing flows on comparable spaces in both types of area. This could then be used in the detailed prediction of the effects of the development on existing peripheral lines and the new lines within the site itself. The simplest combined measure was obtained by multiplying the local integration index by the global integration index. This single measure was then found to give very good predictions of the observed levels of space use in the main lines of movement at Five Ways, on Broad Street and in the New Street area. Figure 18 therefore gives the predicted all day average movement potentials on the main lines in and around the site. These predictions are intended to show the underlying potential of the main alignments in relation to the existing pedestrian movement network, and do not take specific account of special attractors or peak traffic flows due to one off events at the Arena or Convention Centre. Any or all could be substantially affected by fine tuning decisions, including detailed modifications of alignments, as for example, on the Convention Centre bridge. Also, the natural potential of the lines to the west and north west will only be realised in the longer term as the area develops. In the short term, they can be expected to be considerably lower.

These predictions also take no account ofpossible flows due to the proposed Vincent Street Centro station or the Broad Street Metro. Clearly, if these proposals were to go ahead significant levels of space use could be expected to accrue to strategic movement lines within the site, especially to the extended line of Berkley Street into the square and then to the north east connection to Broad Street, the towpath and possibly to Sheepcote Street, with am and pm peaks giving the highest levels. However, whether or not these interchanges are built the fundamental alignments of the scheme would seem almost optimally to reintegrate the surrounding area and to provide for good urban levels of space use.

Looking to the future

These predictions are based on the levels and types of development around the site at present, coupled to the proposed levels of development within the scheme itself. The impact of the development in the longer term, however, will be to help regenerate what is currently a run down area. By creating a focus within the site of both locally integrating (Figure 17) and globally integrating alignments (Figure 16), the development will complement the structure of local and global integration found in Birmingham at present in which the down town area is characterised by the locally integrated focus at Victoria Square (red in Figures 6 and 8), and a larger scale focus of integration is at Broad Street and Five Ways (red in Figures 7 and 9). This will create a development with an urban character all of its own, but one which is derived from the present spatial logic of Birmingham and the strategic location of the site within it.

Figure 1 The open space structure of the area immediately surrounding the Brindley Place site. The complex geometry of the 'black' open space requires new computer techniques to represent it and to analyse its potential for pedestrian movement.

Figure 2 About 16 square kilometres of central Birmingham were analysed in three areas of increasing radius around the Brindley Place site. The innermost area with all the main catchment areas for the site was intensively observed. The second larger area is the catchment area for these observation areas and so formed the main modelling area for analysis and prediction studies. The analysis of the largest area allows us to check that the spatial properties are robust and are not just a factor of where we have chosen to draw the boundary, and to draw various conclusions about the spatial structure of the whole of central Birmingham.

Figure 3 The space syntax computer model is based on a representation of the spatial configuration of all space open to pedestrian movement. The space is represented in terms of longest lines of sight and access that pass through all the open space structure of the city. Each of these lines is then represented in the computer in terms of a matrix of the lines that it crosses, and this allows calculations to be made not only of the local relationships between linear spaces (how manny spaces they connect to for instance), but also of their more global relationships to all other spaces in the city.