SPATIAL PROPERTIES OF URBAN BARRIERS

Analytical Tool for a Virtual Community

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0 Abstract

Grids and trees represents two patterns of thought. In form of urban patterns their spatial properties are quite different. Neighbourhood units are mostly tree structures. Such units work as barriers in global urban nets. One intention behind unit planning is to promote local community. A different social property, virtual community, may be undermined by urban barriers. This paper presents space syntax analysis of model patterns and existing Swedish towns. It is possible to enhance vividness by de-barriering urban patterns and a technique to detect its potential is proposed.

"For the human mind, the tree is the easiest vehicle for complex thoughts. But the city is not, cannot, and must not be a tree. The city is a receptacle for life. If the receptacle severs the overlap of the strands of life within it, because it is a tree, it will be like a bowl full of razor blades on edge, ready to cut up whatever is entrusted to it. In such a receptacle life will be cut to pieces. If we make cities which are trees, they will cut our life within to pieces." (Alexander, 1965/1972:428)

1 Trees and grids

The above quote from Christopher Alexander's article, "A City Is Not a Tree", leads directly into my paper. When published in 1965 Alexander introduced two patterns of thought, tree and semi-lattice, and cogitated upon their relevance for urban design and planning.

According to Alexander the axiom of a semi-lattice is: "A collection of sets forms a semi-lattice if and only if, when two overlapping sets belong to the collection, then the set of elements common to both also belongs to the collection". The corresponding axiom of a tree is: "A collection of sets forms a tree if and only if, for any two sets that belong to the collection, either one is wholly contained in the other, or else are wholly disjoint". (Alexander 1956/1996, p. 121) It is perhaps more easy to grasp the axioms diagrammatically, see figure 1.

Alexander refers semi-lattice to what he calls "natural cities" and tree to "artificial cities". He demonstrates how the hierarchical (tree) structure of functions in planned cities is a result of mental shortcomings in the human mind. And planners are without doubt human beings.

Starting from Alexander's distinction between tree and semi-lattice the paper will compare two urban patterns: a strict orthogonal grid, see figure 2.a, and a strict tree structure, see figure 2C. These two patterns are intended to serve the same amount of buildings. The paper then calculates their spatial properties by means of space syntax analysis. In the grid example, the integration values are higher throughout

28.1

Keywords: community, barriers, grid, neighbourhood, urban

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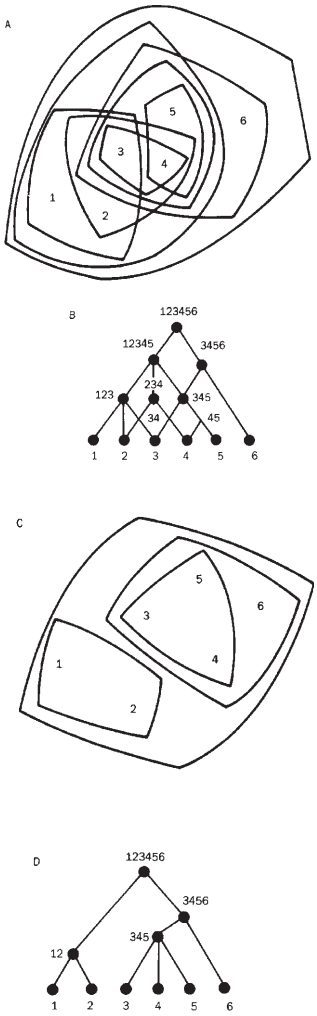

Figure 1. Two different collections of sets and their graphs; a semi-lattice (A&B) and a tree (C&D); (Alexander 1965/1996, p.122)

and consequently also the mean integration. In the tree example, values are relatively more distributed.

Next we see what happens if a slanting street is introduced onto the two patterns, see figure 2.B and D. In both cases, the mean integration is enhanced. The most remarkable effect is that max. integration rises tremendously in the grid case, and this refers to the slanting line (Cf. Broadway). We also find that such a line have less effect on the tree properties.

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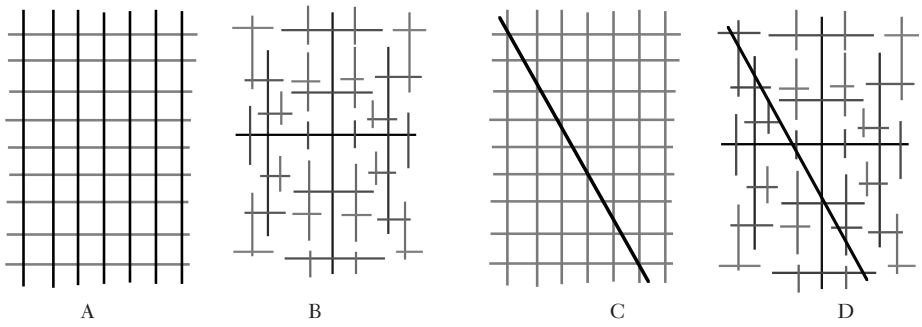

Figure 2. Two urban patterns, a grid (A) and a tree (C) and with "Broadways" introduced (B&D).

Just as a curiosity the two demo structures designed by Alexander have also been calculated, see figure 1. Also here the tree diagram shows a low mean integration value.

Do these numbers have any social relevance? Integration normally correlates to use density, so grid patterns are probably more populated than tree patterns. We can also understand why Broadway on Manhattan, N.Y. is well populated. It is not because Broadway existed before the grid pattern was laid out. This lesson tells us that space generates movement which in turn attracts shops and services (see also Klarqvist, 1997a & b).

Table 1		*max / min*	*mean*
Grid town	*fig 2A*	4.39 / 3.30	3.78
Tree town	*fig 2B*	1.92 / 0.62	0.95
Grid town/Broadwayed	*fig 2C*	29.27 / 3.36	5.63
Tree town/Broadwayed	*fig 2D*	2.21 / 0.65	1.15
Alexander/semi-lattice	*fig 1A&B*	1.73 / 0.61	1.12
Alexander/tree	*fig 1C&D*	1.38 / 0.50	0.79

Table 1. Integration values (1/RRA) of the tree and grid models.

In the final discussion the paper will return to the issue Christopher Alexander raised. However, the paper will make a detour through analysing and manipulating urban patterns, both of model towns and some existing ones. Along the way some social aspects of urban patterning will be discussed.

2 Local and virtual community

In the late 20's Perry devised the concept of neighbourhood unit and proposed a design to promote local community (Perry, 1929). A lot of housing areas have been designed according to this principle. Architects, planners, etc. incorporated the idea of being able to create or to intensify social relations by plan layout. Later, after it was merged with the Radburn principle, neighbourhood unit planning was based on seclusion, traffic separation, function hierarchies, etc. In short, local community is gained by a planned segregation. This has been the dominant idea within the planning profession all over the world since World War II., not least of all in Sweden (about this geneology see Klarqvist & Ye, pp. 167-194). In observing the difference between the social notion of "neighbourhood" and the planning notion of "neigh-

bourhood unit", planning does not necessarily mean that planners shall adopt unit planning.

Jane Jacobs paints a malicious portrait of neighbourhood unit planning in her book, The Death and Life of Great American Cities.

It is fashionable to suppose that certain touchstones of the good life will create good neighbourhoods - schools, parks, clean housing, and the like. How easy life would be if this were so! How charming to control a complicated and ornery society by bestowing upon it rather simple physical goodies (Jacobs, 1964: pp122).

Unfortunately, orthodox planning theory is deeply committed to the ideal of supposedly cozy, inward-turned city neighbourhoods. In its pure form, the ideal is a neighbourhood composed of about seven hundred persons, a unit supposedly of sufficient size to populate an elementary school and to support convenience shopping and a community centre. This unit is then further rationalized into smaller groupings of a size scaled to the play and supposed management of children and the chit-chat of housewives. Although the 'ideal' is literally reproduced, it is the point of departure for nearly all neighborhood renewal plans, for all project building, for much modern zoning, and also for practice work done by today's architectural-planning students, who will be inflicting the adaptations of it on cities tomorrow. (Jacobs, 1964: pp 124-125)

Jacobs claims that local community can exist in all types of urban patterns. Under some circumstances the traditional orthogonal grid pattern creates quite deep social relations as neighbourhood units. Based on her observations in New York and Boston the requisites for a good urban life are four generators, all of which shall be at hand simultaneously (Jacobs, 1964: pp. 162-163).

- mix of primary uses (e.g. dwellings, offices and shops);
- short blocks (not long rectangular blocks);
- aged buildings (not just new, expensive ones);
- concentration (high density of different kinds).

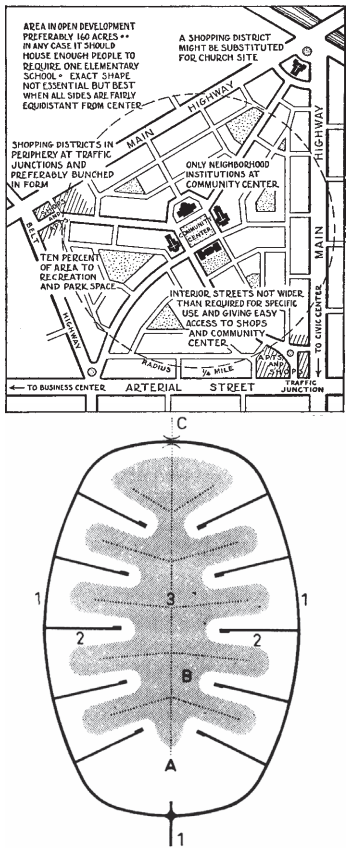

Figure 3. The neighbourhood unit plan according to Perry (1929) and to the actual Swedish standard (Bygg F, 1981).

This paper will concentrate on a specific social property termed the "virtual community". It was devised by Hanson and Hillier. The quote bellow will mediate this new concept.

... the transformation of community which results from the mere non-interactive (or pre-interactive) co-presence of people. This occurs not so much at the street interface as in the streets themselves, and in the indeterminate interface of an area of streets with the world of strangers, a form of community perpetually growing or shrinking as a function of the capacity of the pattern of space to make this community dense or sparse, structured or unstructured, continuous or sporadic. This transformation of community is of course the virtual community itself, perhaps the fundamental entity from which the other transformations are possible (Hillier ,1989: pp18).

A virtual community is the product of space and is an as yet unrealised community, that is, it has not yet become the field of encounter and interaction which most social scientists would take as the most elementary of social phenomena. Because it is prior to interaction, the virtual community falls outside what social scientists have con-

ceptualised as society. ... all of the apparent effects of architecture on social outcomes seem to pass through the relation of spatial configuration and natural co-presence. This is perhaps because movement is not simply the unintended by-product of spatial organisation but its very reason for existence. By its power to generate movement, spatial design creates a fundamental pattern of co-presence and co-awareness, and therefore potential encounter amongst people that is the most rudimentary form of our awareness of others. As we have shown, virtual communities have a certain density and structure, and are made up of probabilistic interfaces between many types of person: inhabitants and strangers, relative inhabitants and relative strangers, men and women, old and young, adults and children, and so on (Hillier 1996, pp 213).

Virtual community shall be seen as quite different from *local community.* The latter is based on the adjacency of local dwellers, sometimes including those who work in local shops, daycare centers, etc. What Jacobs favoured, at least at the metropolitan level, resembles what Hillier calls virtual community. She elects the orthogonal grid plans to support this type of community while she discredits neighbourhood unit plans.

3 Barriers and vividness

We have learnt that grids generally have a higher mean integration value. What constitutes tree patterns are the discontinuity; your nearest neighbour geographically can be far away spatially. Tree structures within the global net must be understood as urban barriers.

According to the description "virtual community" is the indeterministic interface between people in the streets and the co-awareness. I suggest that it shall be understood as a latent solidarity necessary for a socially sustainable society. What promotes this solidarity and what prevents it? It will be suggested that it has to do with the extent of barriers in the urban fabric.

Research suggests that urban barriers can be sorted into six classes; one "natural" and five man-made:

- Impediments; rivers, canyons, steep slopes, lakes, etc.
- Traffic structures, incl. safety zones; railways, urban highways, etc.
- Large constructions; shopping malls, big industries, etc.
- Large enclaves; housing estates, industrial areas, etc. (often tree patterns)
- Restricted zones; airfields, military camps, shooting range, etc.
- Green areas; parks, farming land, SLOAP, etc.

It is possible, of course, through some of these barriers (sometimes they are even intended to serve as connections) but they normally carry very few people. Barriers are designed mostly with good intentions and may have some good effects on human life. However, there are also some negative effects, especially when aggregated on a global scale. These effects are mostly unintended and unexpected.

Previous research using space syntax analysis has provided evidence that the spatial properties are related to social facts. However, it may not be so when applied to the scale of global urban patterns, but for the sake of discussion let us take it for granted.

The global static measure, integration, seems in most cases to have a positive correlation to use density of spaces. Let us assume that if manipulations result in a raise of the overall (mean) integration there is also a rise of the use density. I call this measure an indicator of vividness.

A slightly more complex pattern than in section 1 will now be manipulated to see what happens to the indicator of vividness. This model town might resemble a contemporary Swedish urban structure, see figure 4.a. Think of an original grid pattern cut through by a railway and/or a highway in the middle and enclaves added to the periphery defined by separating green areas. To this pattern a few connections are 're-introduced' over, under or through the barriers, see figures 4.b and 4.c. From table 2 you can see that the spatial properties indicate enhanced virtual community.

Also the tree structure has been tangentially connected on the periphery, but it has only a minor influence on the mean integration value.

4 The Alingsås case

We have just learnt that it might be possible to raise the vividness of an urban pattern by de-barriering it. Let us now climb to the next level and test it on a real town. A small town Swedish, Alingsås, has been chosen. It has about 25,000 inhabitants within its agglomerated area. The town was founded in 1619 and its centre is based on an orthogonal grid, like many other towns in Sweden. It is situated on the highway between Stockholm and Göteborg, about 45 kilometres from the latter. Alingsås received the Europa Nostra diploma in 1984 for good conservation of its wooden house city centre. This is not the reason it has been selected here. It is rather because of its handy size and that it is characteristic of many other Swedish towns with regards to barriers. Alingsås is situated between two lakes and by a small river. It is divided by highways and a railway line. It contains modern planned neighbourhood units on the outskirts and the city centre is surrounded by a traditional peripheral road. Large green areas penetrate radially far into the town. In this sense it is a model town.

The first step was to make a space syntax analysis of the existing plan pattern. The result of this may be understood from the integration map, see figure 6 and table 3. The city centre is well integrated with rest of the town. The "integration core" (the most integrated lines of the urban pattern) covers the city centre and runs along with the highway and the county roads thus relating the edge to the centre.

The next step was to survey the urban plan of what could be considered barriers and how these are structured. Of course, this is a rather subjective ocular analysis. Here the existence of barriers created by tree-structured neighbourhood units has not taken into consideration. A comprehensive study of this phenomenon is required to develop a more reliable and relevant method. Anyhow, the map illustrates well a general split-up of the urban structure.

There is hardly no tangential connections in the periphery which means that the nearest neighbour is almost as remote as somebody living in the opposite direction of the town. All the existing barriers must have some negative influence on movement, especially for pedestrians.

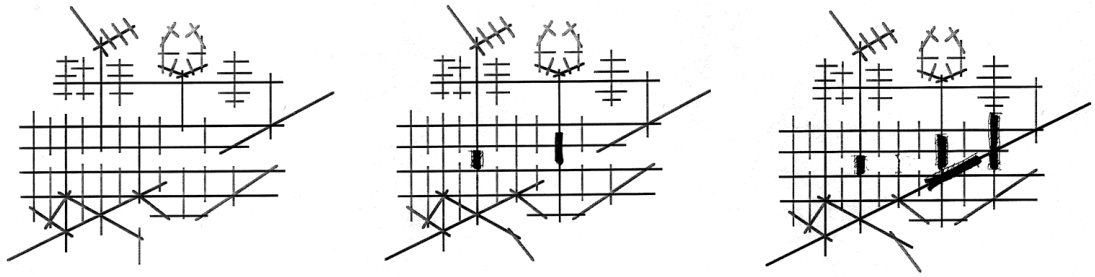

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Figure 4. A simplified urban pattern resembling a Swedish small town (A) and de-barriered in two levels (B&C).

Table 2

	max/min	*mean*
Model town	2.05 / 0.66	1.15
Model town/2 joints added	2.61 / 0.72	1.37
Model town/4 joints added	2.63 / 0.71	1.51

Table 2. Integration values (1/RRA) of the model town.

In step three the existing street pattern has been de-barriered . At the first stage, the old connections south of the city centre were reintroduced. When calculated the enhancement of "virtual community" indicators were significant. Adding peripheral connections in stage two did not add very much to it, though overall it is still noticeable.

Remember that relatively small additions have been made to the pattern, especially compared to the model towns in previous sections. The following table shows the results: integration, integration(3) - a more local property taking only three steps into account - and two different types of correlations both of which can be understood as legibility.

According to the rise in the space syntax indicators vividness and legibility this pilot study gives evidence to the possibility of intentionally raising the virtual community by de-barriering urban patterns.

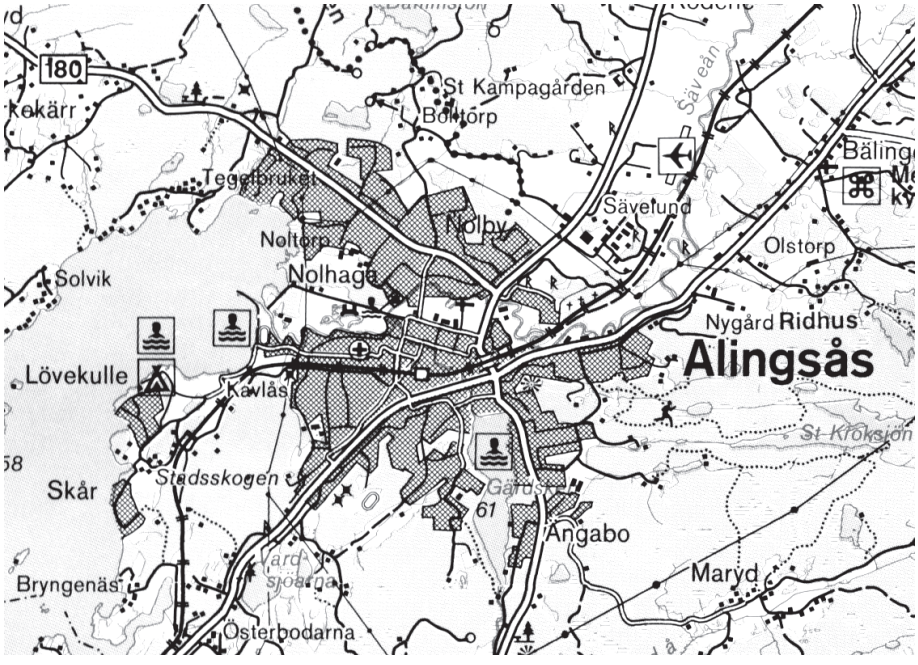

Figure 5. Alingsås and its immediate surroundings (detail from tourist map).

Figure 6. Integration (1/RRA) map of the existing plan pattern in Alingsås.

5 The de-barriering potential

When first invited to present this paper the goal was to develop a new technique to detect urban barriers as a part of ongoing research. Methods for detecting sub-areas within existing urban grids has been developed by others. One study intended to develop a method to adequately delimit urban system for space syntax analyses by gradually extending the area of analysis and observing changes of the spatial properties (Hillier et al., 1989). Another one was applying choice core decomposition to detect different neighbourhoods by their spatial properties (Peponis et al., 1989). The goal of this paper was rather to detect the discontinuities so frequent in modern urban areas. The approach was to super-impose a grid upon the existing urban net and to calculate the differential between the same axial lines, with and without the relief grid.

Figure 7. Barrier map of Alingsås 1996. The built areas in white and the barriers in black.

The paper has attempted to do this however, several problems emerged due to the lack of proper software and the need to develop new software for the purposes of the study. Laborious semi-manual analysis was conducted and found that it might be possible to make interesting findings, though not the intended ones at the outset of the study. It did not detect the barriers perhaps, because the approach is not relevant or because several more experiments are required. It might be worth a second try later with more appropriate software.

Table 3

Measure		Existing	Level 1	Level 2
Integration.	*max.*	0.81	0.95	0.97
	min.	0.29	0.29	0.29
	mean	0.50	0.56	0.60
Integration(3)	*max.*	5.41	5.16	5.00
	min.	0.21	0.21	0.21
	mean	1.56	1.59	1.63
Correlation	*conn:int*	0.17	0.20	0.20
	int(3):int	0.26	0.30	0.31

Table 3. Spatial properties of Alingsås, the existing plan pattern and de-barriered in two levels.

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Figure 8. Integration map of Alingsås with the two levels of jointing added.

As a by-product of this study it has been found that by superimposing a grid upon an existing urban pattern it is possible to show its potential to obtain a higher level of vividness, and consequently of virtual community. The paper will now present the results of a quick and dirty grid tool implementation on four urban patterns, representing a sample of small Swedish towns. An orthogonal grid was introduced one square kilometer at a time.

In all cases the mean integration value increased considerably. It seems to be of great importance how you design the analytical grid. Though this has not been tested yet. However, one conclusion is that there seems to be some negative correlation between the barrierness and vividness.

6 Conclusions and discussion

What is interesting to research is the urban fabric and its implications to social life. It is a scientific problem to describe and explain the relation between space and life. It is a professional problem how to design the urban fabric to attain social and other goals in society. If the urban fabric promotes social and other types of sustainability or not is a relevant problem in the society.

In the previous sections a possible way to analyse urban patterns has been demonstrated and to see the effects of making adjustments of these patterns. This can be taken as a point of departure for discussions about urban planning. Utilisation of space has flavour of efficient use. Investments in space should be well used by people. If we, for example invest money and space in playgrounds they should be well used for the intended purpose or for something else. Deserted spaces seldom contribute in an efficient way to the urban life. If *mean integration* is an indicator of vividness the planners should learn how to obtain it through means of planning. It has been suggested that it might be obtained by de-barriering urban patterns and few tests have been made.

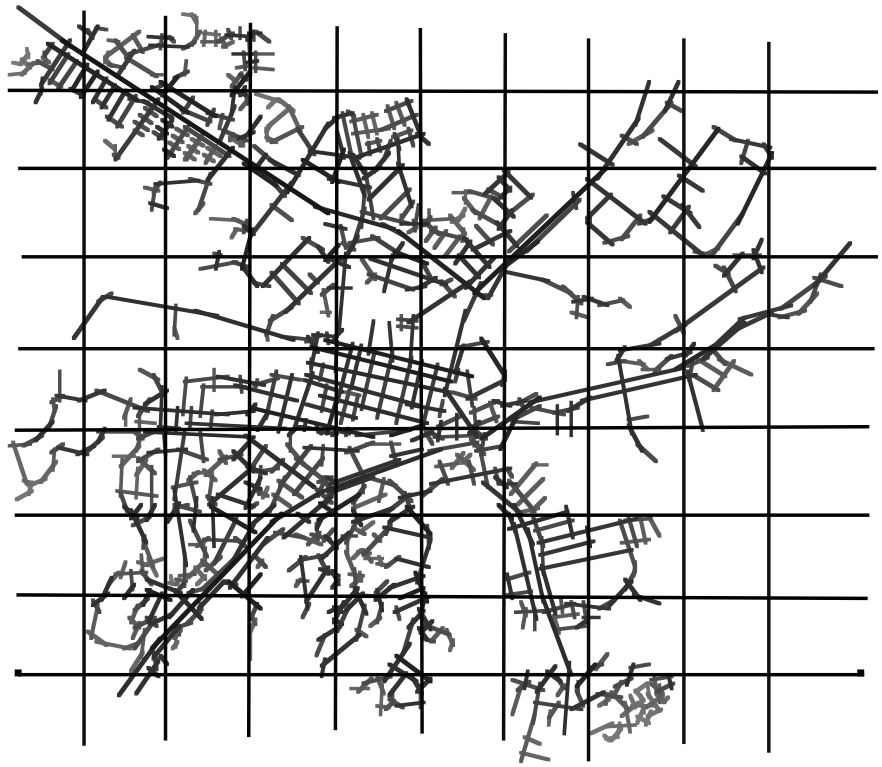

Figure 9. Axial map of Alingsås with the analytical grid net superimposed.

A technique to analyse the potential to de-barrier urban patterns has been introduced and examples shown how to insert joints. This type of manipulation does not tell if it is technically, socially, and economically sound to de-barrier an urban system. We have also to develop means to design connections that might contribute to this goal without eliminating already achieved goals, like for instance safety. It is a long way to develop techniques and methods of de-barriering.

Well-located new connections introduced into an existing urban pattern will perhaps attract enterprises, a lesson we have learnt from the Broadway example. This is an indirect way of densifying an urban structure. If we connect streets through, for example safety zones and green areas we can design building lots more actively along the connecting line. In this case we act according to what space is, a generator and moderator of movement.

The theory of virtual community must be critically discussed and tested. We have either to add behaviour observations when great changes of barrierness occur in towns or to compare different existing urban patterns and try measure the virtual community or perhaps vividness of each town. These social notions are difficult to handle because they are related on the same level as macro sociology. However, this does not exclude the need to include this social aspect in planning.

Table 4

Town	*Existing*	*Gridded*
Alingsås	0.81	1.34
Jönköping	0.76	1.85
Linköping	1.00	1.60
Ulricehamn	0.75	1.50

Table 4. Mean integration of a sample of Swedish towns, the existing pattern and with 1 x 1 km2 orthogonal grid superimposed

The neighbourhood unit planning has also been discussed. There seems to be a dangerous gap between detail and the global levels in planning. The modernist idea of a scientific dealing with urban issues has perhaps contributed to this gap. To be able to

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Figure 10 Integration maps of a sample of Swedish small towns: Jönköping (A), Linköping(B), and (C)Ulricehamn.

handle all the complex aspects involved planners have reduced the complexity by introducing units that are more or less repeated. Each unit may be optimised, but units aggregated to an entire town may be disastrous. What task does this set to urban designers and planners and scholars related to it? A quote from another article by Christopher Alexander, 'The city as a mechanism for sustaining human contact' offers some guidance:

The configuration must be thought of simply as a partial specification of what a city has to be to function as a mechanism for sustaining human contact. It is inevitable that urban concentrations create stress. Our first reaction to this urban stress is to move away from it; to turn our backs on it; to try to escape it. This is very natural. Yet the remedy is worse than the disease. ... If urban society is to survive, we must overcome this over-reaction. If people do not expose themselves, if they do not make themselves vulnerable, life will become more and more intolerable, and we shall see more and more of the signs of dissociation which are already far too evident (Alexander, 1972: pp 431).

This sets out for discussion the relation between the global town plan pattern and its social aspects. The articles by Alexander quoted are deeply concerned with design problems of modern urban structures. The solutions and proposals he presents maybe questioned, but he singles out important questions.

Sustainability is one important goal in world society of today. The UNCED conference in Rio de Janeiro 1992 put it on the agenda and the concept is now discussed and promoted world-wide. When talking about sustainability people usually mean just the ecological aspect of it. It should however stand for economic and social sustainability as well. Social sustainability can be seen as the continuity of social and cultural relations between human beings. Also, we should observe that sustainability does not mean conservation and status quo. It is rather a continuous development and changes in social relations, but only as long as the society still exists as a society.

There are many threats against social sustainability. Examples are economic, social, ethnic, etc. differences per se, and their reproduction in space, segregation. You can even claim that social sustainability in society tends to decline. Not intentionally perhaps, but as unexpected effects of changes of different kinds, for instance of the information technology and in the economic and democratic systems. The greatest threat is however the prevailing patterns of thought among professional planners, and in the common sense. Jacobs, Alexander and Hillier have drawn attention to virtual community, a notion that is difficult to grasp, and the paper has tried to develop an analytical technique to enhance it through urban planning

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