

THE USES OF LEVELS

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Introduction.

An international meeting of professionals offers a good opportunity to ask ourselves where we stand in relation to the complex problem called housing. One can have different opinions about the question when housing as we understand it today - as a professional occupation- really began. Some may argue that it was with the passing of the first housing laws in Europe at the turn of the century. Others feel that the system only came into its own in the thirties or even only after the second world war. But it is safe to say that we can look back at at least a half century of professional effort on behalf of those in need of better shelter.

Against that background I would like to pose two questions:

First: what have we learned, in that period, about human settlement; what knowledge have we gained by research and experience that we did not have fifty years ago?

Second: How did we adapt our ways of working, our methods, to the new knowledge acquired?

If you ask me to answer these questions in a few words my response to question one would be: "very much; we now know much more about all aspects of human settlement. Compared to what we know now, the generations before the second world war seem ignorant."

But my response to question two would be: "poorly, our ways of working have responded inadequately to the new knowledge we gained. Our methods are still based on those first applied half a century ago."

Our major problem today as professionals - architects and planners, developers and engineers, involved in housing- is exactly this serious discrepancy between what we know and what we actually can handle. Like all other professions we must develop new skills and methods to meet the challenges of our times.

In my talk today I would like to discuss this gap between knowledge and capability in some depth. I also want to present to you a way of looking at the built environment, a model if you like, that may help us to bridge it.

Today we need a fresh look at what we are doing. In conferences on housing, like the one we are having here, it is customary to point out how complex the problem of housing is: how many actors are involved and how many aspects are of importance to it. We also tend to remind ourselves of the magnitude of the problem: how many millions of people are in need of better shelter. It is easy to believe the task is really too large and too complex and that therefore the results will always fall short of our expectations. We try hard, but the problem is very difficult. We all would like to contribute to the well-being of mankind. We dream of a better world. But our work falls short of our expectations: there is so much more to be desired.

In a situation like that it is often useful to step back a while and reconsider the premises from where we operate. I want to argue that our vision of the built environment is outdated and show you a new model which is presently emerging among us: a model that fits better the more sophisticated knowledge we have gained over time. This new model is the major subject of my talk.

Things we have learned.

I have composed a short list of things we have learned about the built environment and human settlement. Things that our view of the built environment must respond to if we want to act effectively. Things that today are important to keep in mind.

My list is not complete and I am sure you could add to it. You may also feel that some things are less important than others. However, I am confident that most of us will agree that the items of my list should belong on our housing agenda and that we must be able to incorporate them in our ways of working. Here we go:

1) Housing is only partially a matter of production of buildings. We have learned that in housing the issue is not just to provide a roof over people's heads but to create conditions that will, eventually, give everybody a decent house. In other words: the issue is not production of houses but the cultivation of a process. As you know, the World Bank has gone so far as not to give money any more for building projects, but only for training and organization to improve the housing process itself.

(the old model said: The primary goal is to give shelter, build as many units as you can, there is no time to waste, the need is to large. Mass production and industrialization of housing are most important.)

2) The job is not just professional. To produce cars it is best to hire the best engineers, managers, and marketing people: a professional crew. In housing this is not enough. Professionals are important and, indeed, indispensable, but they must work together with users, user groups, and those who represent them: the politicians and other elected officials. I leave aside here the very important role of bureaucracy which probably must be seen as a class apart, neither professional, nor user.

(In the old model housing was seen as a professional job: The experts had to make all decisions. The engineers and designers had to provide shelter for the masses in the most efficient and scientific way possible. User needs had to be studied but users could not be involved in the process.)

3) Change over time is important. The recognition that things change over time and must improve over time is perhaps the single most important new aspect introduced in our thinking about housing.

Housing projects and neighborhoods must grow and develop over time. There is no such thing as a instant environment. What is good today is insufficient tomorrow. Many housing projects that were built in Europe in the fifties , and were considered examples for other countries to follow, are now obsolete. They lack the amenities - central heating the kitchen and bathroom equipment - that people now expect but were not available twenty five years ago. Being built in concrete these projects are extremely expensive to be renovated or to be demolished.

(In the old model the dimension of time was not considered: "We must design the best possible houses for the people. We must design the house for the future, for the better world of tomorrow....now!")

4) Uniformity is not efficient. Uniform floorplans and uniform buildings do not guarantee industrialized building methods. On the other hand, truly industrial methods make different solutions possible. Hence there need not be a contradiction between variety and industrial production. Indeed we have now learned that the emphasis on uniform floorplans has slowed down the development of truly industrialized systems.

(In the traditional model it was believed uniformity ensured efficiency and industrialization. This is perhaps the most tenacious misunderstanding in housing and I suspect some of you may challenge my denial of this principle. I will say more about it later on.)

5) Users have different values and different needs. It is impossible to find a solution that fits everybody. A house is a personal thing and must adapt to the user. People like to share the same type of dwellings and to conform to certain lifestyles. But within that common context they want to identify themselves as different from their neighbors. The functional needs of households differ too. Individual preferences are very important and can only be taken care of on an individual basis.

(The traditional mass housing model needs the uniform floorplan and therefore can not recognize individual differences. It seeks the ideal prototype to be designed on the basis of scientific user needs surveys.)

6) local lifestyles and typology are important. Cultural values for each country and each region are important.

People want to connect to their heritage. Of course they also want modern amenities and they want to be respected in an international perspective. But these two demands must both be met.

(The old model believed in an international style and never considered different cultural values in the world.)

7) Housing projects must fit into their urban context and connect to existing urban fabrics. Context is important and can no longer be ignored.

(The generation of the modernist movement hated the existing cities and did not believe anything could be learned from them. The example was Le Corbusier's Plan Voisin.)

The new model.

I do not believe anything on my list is really new to you. We are all familiar with the issues raised. But to most of us the list will look unrealistic as an agenda for action. How can all these things be achieved efficiently and effectively? Of course we know that many parties, including users, are involved in the housing process. But how to organize it? Of course variety would be better than uniformity but how can you control a process with so much variety? Of course it would be good if individual user needs could be met but how can this be achieved? And so on, and so on.....

These are understandable doubts, but I suggest that they illustrate exactly the dilemma we are in. As long as we follow the ways of thinking and working we have inherited from the past we will only see problems: things remain problematic.

Therefore we need a new model in which the new agenda will fit more easily. I would like to describe to you a way of seeing the built environment in which the new issues fall into place more naturally. This new model relates to the work of many among us who have seriously tried to renew the housing process. It is currently the subject of discussion and study of a small but growing group of practitioners. It is based on a single, central concept: the idea of 'levels' in the built environment. This concept I would like to explain first. Of course, having a new model will not solve instantly all the problems we may have. But I believe it gives us a direction we must follow to be more successful.

I will first talk about the concept of levels and the model based on it. Next I will refer to work already done in practice to illustrate the new approach described by the model.

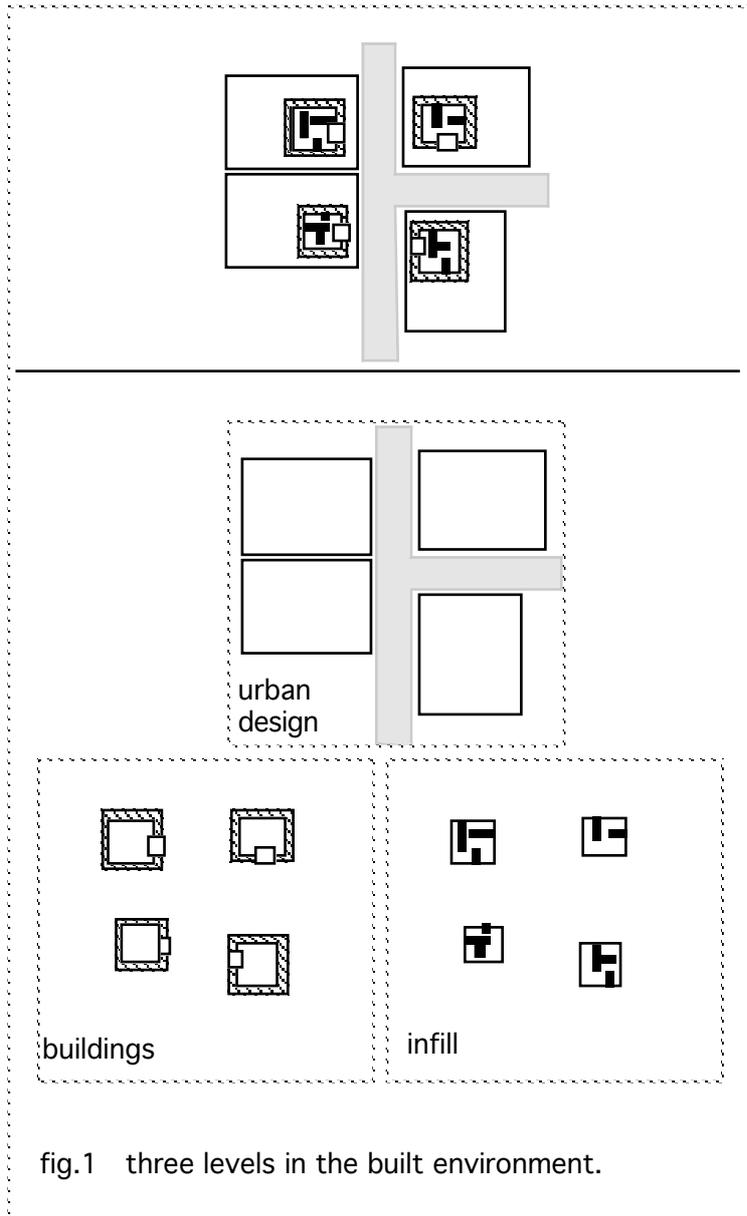


fig.1 three levels in the built environment.

Levels.

The concept of 'levels' is not really new. We already say, for instance, that the urban designer 'operates on another level' than the architect. (Fig.1) What does this mean? Apparently we understand the built environment to be divided in two groups of things. Those that are decided about by the urban designer and those that are the concern of the architect.

To understand the distinction better we must ask ourselves what happens when things change on one level or another. The architect designs a building within the context designed by the urban designer. He must respect, for instance, the layout of streets and the division of lots in the block. But within that context he is free to act. He can change the design of his building in many ways. Indeed, different architects can build different buildings in different places but will share the same street network designed by the urban designer. Although the urban design constraints their work they are free within those constraints to do their own thing.

However, when the street network must be changed the design of the buildings has to be adjusted. The urban designer can not act without affecting the designs of the architect.

Habraken, Uses of Levels

The relation, therefore, is asymmetrical. Change on the level of the building does not affect the higher level of the urban design, but change in the urban design affects the lower level of the buildings.

All this is in accordance with our everyday experience. People who own houses know they can change their houses, even tear them down to replace them with new buildings, without affecting the street layout of the neighborhood they live in. But when the street layout would be changed and the municipality would decide to cut a new street or to widen a existing one, or to rearrange a street's location, inevitably adjustments must be made on the lower level.

Apparently the distinction that is made here is independent of the parties involved. We may talk about architects designing buildings and urban designers designing street patterns, or we may talk about home owners owning buildings and the municipality maintaining the public streets; in both cases we make the same distinction in the physical world between those parts that belong to one level (the streets) and other parts belonging to a lower level (the buildings). This distinction is so natural that its implications are understood by everybody.

Thus it seems that the built environment is organized in levels and if we look further we will find more of them. For instance we talk about urban infrastructures like highways and railroads and we understand them to be of a higher level than the streets of the neighborhood. Here again the same relationship holds. When a major traffic artery has to be cut in a existing neighborhood network the lower level of local streets must adjust. But within the given structure of highways we can change the pattern of local streets without affecting the higher level traffic pattern.

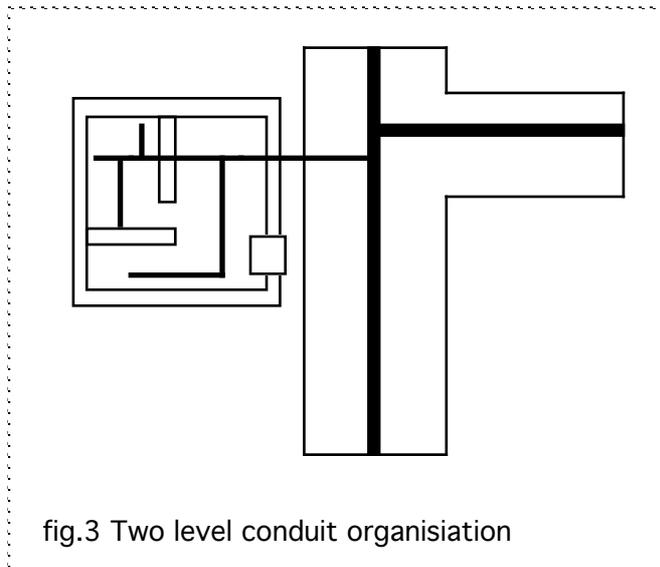
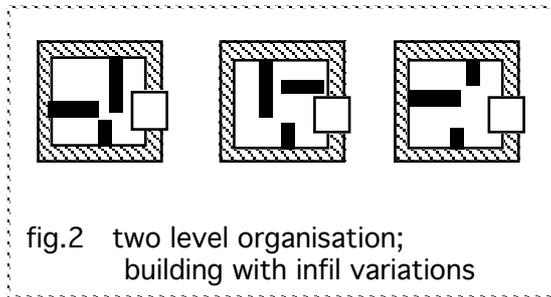
This hierarchical organization of the built environment also extends downwards. We find in many buildings how the inner partitioning can be changed without affecting the basic building structure or its shape. This we see in office buildings but also in many residential building types. Apparently we can distinguish 'infill elements' - like partition walls, but also kitchen and bathroom equipment - operating on a lower level in the built environment relative to the building. (fig.2) The same relationship as we found between buildings and local streets is found here. We can remodel the building and change the distribution of partitioning and equipment without changing the larger building structure or its external shape. But when we begin to change parts of the building and tear down load bearing walls or extend a facade to get more room inside, we expect adjustments in the infill.

(A matter of terminology comes up here. It can be argued that what we call a 'building' includes the infill as much as the load bearing structure, facades and roof. Therefore a new term must be coined for what is left when the infill is taken out. This is called 'support'. In this way we can say that a building is comprised of two levels: the support level and the infill level. In this paper I will use both the terms 'building' and 'support' for the same level.)

Once we see the concept of levels operating in the built environment we discover the same hierarchical relation in many places. So far we have been looking at environmental forms but within their technical systems we find the same subdivision in levels. Take, for instance, the window in the facade. We can replace it with another window of a different make or design but use the same opening in the facade made for the original window. In that case we do not have to change the facade wall. When we decide to change the facade wall, however, and make a different window opening, the window itself, obviously, must adjust.

In all conduit systems we find similar hierarchical organizations. (Fig.3) In the example of buildings and streets given above, the sewage system follows levels too: there is the system

in the house and there is the sewage main running in the public street. On a still higher level there will be the collector system of the city.



Model.

We have here a general principle of spatial organization that is actually operating in the built environment and we all understand it intuitively. Those who study this phenomenon believe that we can learn from it how to create and maintain complex environmental systems. I want to show you how the concept can describe things we do in practice. But to do so we must first make a more formal representation. Figure 4 shows a very simple model of five levels. The terminology may be familiar with exception, perhaps, of the word 'tissue'. The so called 'urban tissue' is the level of

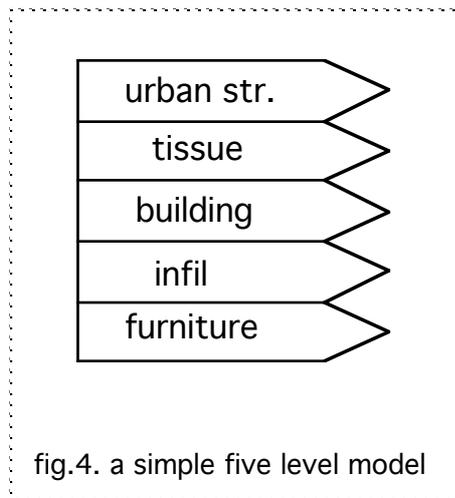


fig.4. a simple five level model

the streets and related urban elements on the scale of the neighborhood, most directly related to the building, The term is introduced to make a distinction with the 'urban structure' of major roads and other infrastructures of the city. Of course alternative terminology can be proposed, but the example of five levels will suffice to illustrate the uses of the concept

The five levels identified here are actual physical systems. We talk about walls, roads, and other physical parts. These physical systems are what we put in place when we build. They must be distinguished from the more territorial concepts we also use in design, concepts like: 'room', 'dwelling', and 'neighborhood'. The relationship between these two hierarchies is given in figure 5. What we call a 'dwelling' can be seen as the juxtaposition of building and infill, whereas the neighborhood becomes a combination of the physical levels of building and tissue.

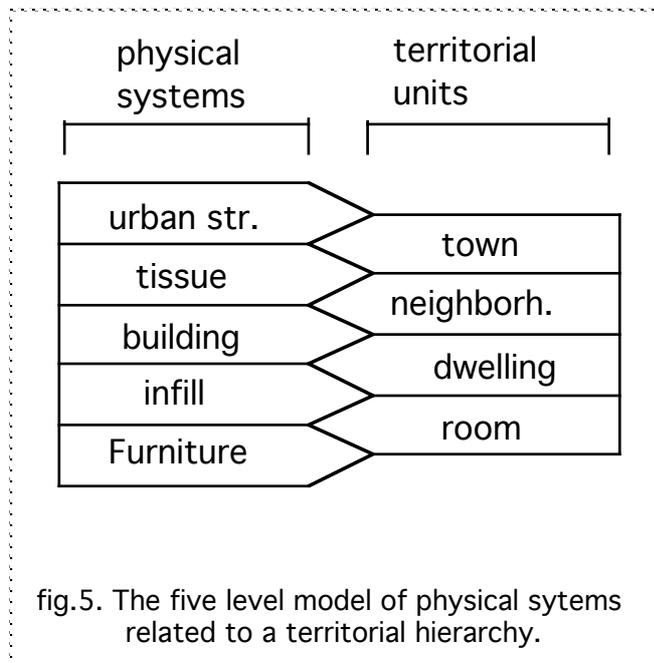


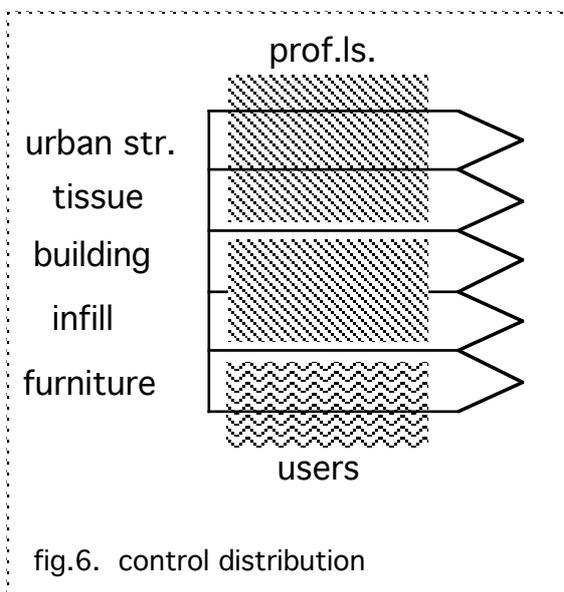
fig.5. The five level model of physical sytems related to a territorial hierarchy.

Territorial structure is an important subject in our modelling of the built environment, but will not be discussed further here. We will use the five levels of physical systems to look

at various examples of real life projects to see how the different parties involved in these projects relate to the levels.

In our little model we can identify who is in control of a certain level by means of a screen pattern. Figure 6 shows the most common distribution of control in present day housing projects. Professional responsibility encompasses all levels except the furniture that is brought in by the user. But among the professionals further distinctions can be made, of course; for instance between those responsible for the design of the buildings and their infill on the one hand and those responsible for the urban design on the other.

When we make such a control pattern in the level model we must make a distinction between design control and actual control during use. If figure 6 gives us design control we can still have different control patterns for the uses of this environment. For instance, after completion the single user still may control the furniture level only but the apartment building may be under control of either a collective of users, or a extraneous housing management. For the development of housing projects both forms of control are important, and they will require separate diagrams.

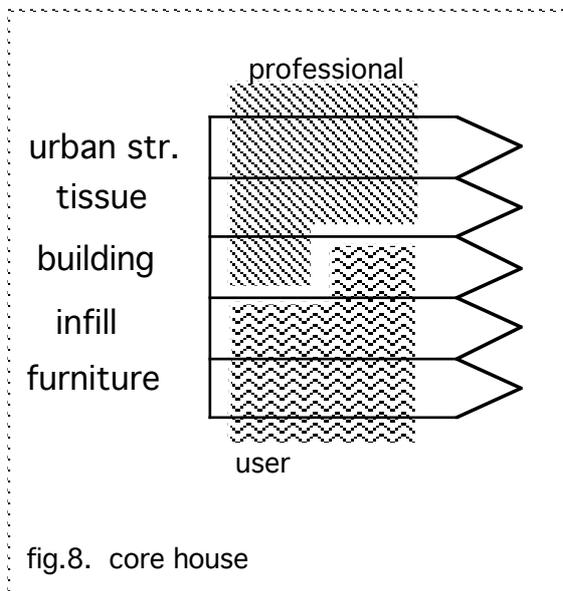
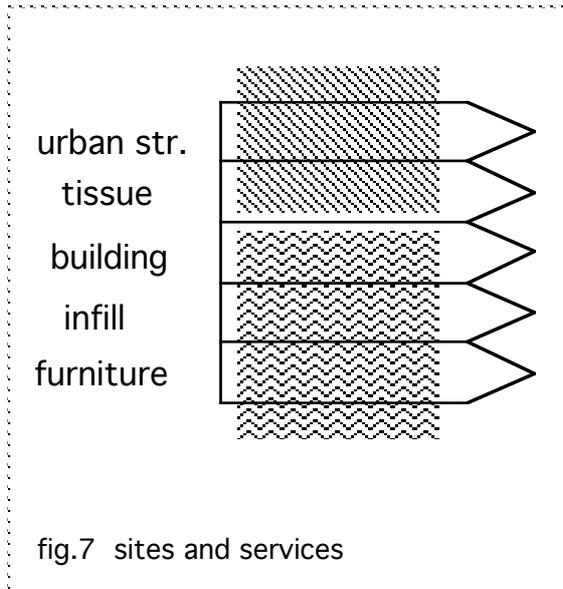


Uses of the model.

Sites and services.

In the last decade the so called 'sites and services' approach has been applied in many parts of the world to provide shelter to people who cannot afford to rent or buy a completed dwelling. This way of working has been supported by the World Bank and other authorities as a way to make limited resources help the largest possible number of people. The sites and services idea makes a distinction between what should be done by professionals and what people can do themselves. The professional operates mainly on the level of tissue and urban structure. The users are made responsible from the level of the dwelling downwards. (Fig.7)

The distribution of responsibilities is different from the 'normal' case given in fig.6. Of course the model does not tell us what strategy is the better one. But that is exactly the point. Today there is not a single good strategy but it depends on the circumstances of a case what control distribution can best be adopted. Comparing models in a systematic way is the first step towards a more sophisticated methodology in housing.



Core houses.

It has often been pointed out that the sites and services approach makes it too difficult for people to acquire shelter. Critics say it takes a long time and too much effort before dwellers have a decent roof over their head.

Therefore other projects offer some form of primitive shelter and let people fill in the rest over time. I am sure you are familiar with the idea of the 'core house'.

With the core house approach the building level is actually distributed among two parties. The professional makes the core house, while the user, later on, will expand the building. Thus in the sites and services scheme the whole of the building level is under the responsibility of the user, while in the core house the building level is only partially given to the user. (Fig.8)

A particular interpretation of the latter form of control distribution was proposed in a scheme I was involved with in Egypt. (Fig.9) Here we designed only the surrounding walls for the dwellings, proposing that the users make the roof and fill in the volume. The rationale

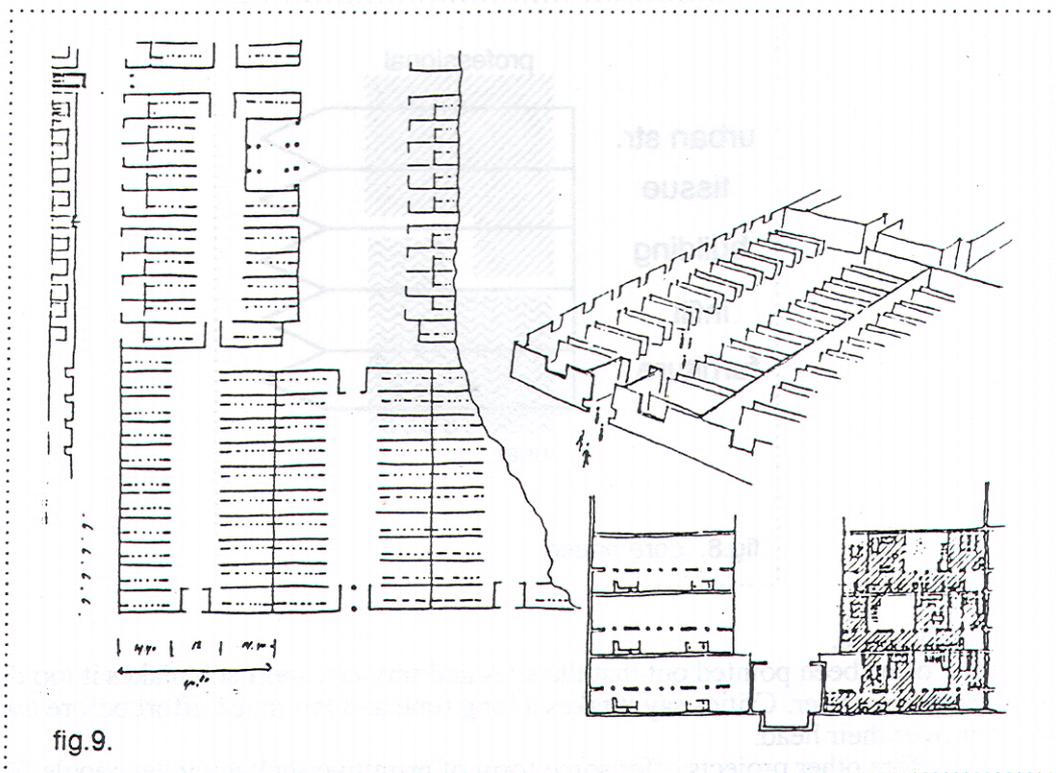
behind this solution was to protect people in the beginning as much as possible from the harsh desert winds. The walls also gave a more 'finished' look and a clear expression of the territorial organization.

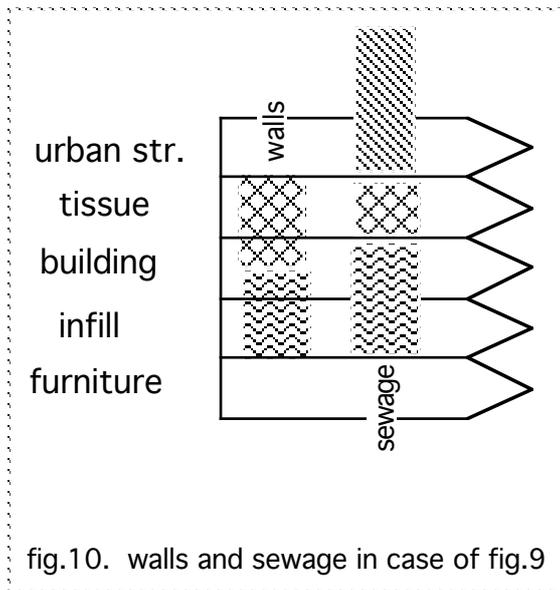
Let me stress again, at this point, that I do not advocate any particular solution, but want to give you examples of different strategies that all can be explained and compared by means of the concept of levels. In this way one can study alternative approaches to find the best possible solution in each case.

Systems and levels.

The last example is also interesting from a methodological point of view for another reason. We see that walls are also designed to protect and define the separate compounds in the neighborhood and that, finally, the whole neighborhood had its own wall with gates. Thus, in the first stage, walls were designed on three levels. Use-control will be distributed among two parties: the individual users will bear responsibility for walls on the building and infill levels, but the building walls they share with neighbors as well as the walls delineating the compounds are a collective responsibility. (Fig.10)

Here we see how a specific technical system - in this case the configurations of walls - can be operating across different levels and be controlled by different parties on each level. We already saw the distribution of a single technical system across levels in figure 3. In figure 10 we also find the distribution of the sewage system as it could be in the example of the Egyptian compound project. Again we see control by, respectively, the individual users, the collective of users, and the municipality. This distribution pattern is not the same as with the walls. Each system can have its





own control distribution. It is of course possible to have different ways of assigning control to a system across the levels, using in the same design. For instance: in figure 10 the collective control of the sewage on the tissue level can be replaced by control from the municipality.

Support /infill approach

So far we have looked at examples of control distribution for projects for the lowest income groups. A very different case is taken from the European housing situation. As some of you may know, I have advocated for many years, the distinction between 'support' and 'infill'. This idea came from the necessity to build large apartment buildings for relatively high density situations. The 'support' is what I have so far called 'building level' in the model. As observed before, we have here a question of terminology. Some people argue that infill is also part of 'building'. In that case the higher level needs a new name: hence 'support'. Infill comprises partitioning walls, kitchen and bathroom equipment and all the conduits for electricity, heating, water, and gas, needed to operate the equipment.

A clear distinction between support and infill was proposed to offer the users of the housing units the freedom to determine their own floor plan. The support could be built in rigorous repetition as a single project. But on the level of the infill each unit can be different. And the responsibility lies mainly by the user. Figure 11 gives a example of a floor plan of a support project that was built already ten years ago in the Netherlands. It was designed by architect Frans van der Werf. It is easy to see that all infill plans are different but that the support is fairly repetitive. The diagram of this way of working is given in figure 12. We see that the support level is under professional responsibility but that the user decides about the infill

I mentioned earlier that the control pattern can be about design control or about use control. If we switch to the latter in figure 12 we can see the management of the housing estate controlling the tissue and support level while the users remain in control of their infill level, being able at any time to change and improve. But we can also think of a scenario where the collective of users manages the building as may be the case when it would be a condominium. In that situation fig. 13 would apply.

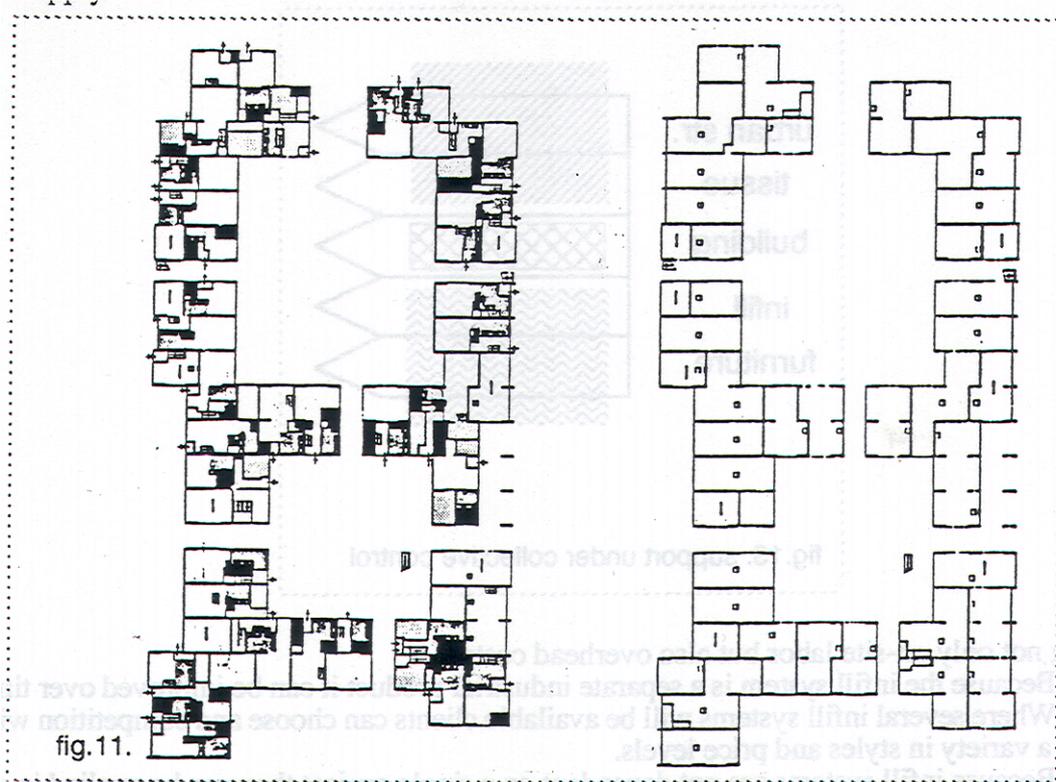


fig.11.

Efficiency.

For a long time it was argued that the support/infill distinction might perhaps be very desirable, but that it was not efficient. You may be interested to know that at this moment the opinion among many professionals in the Netherlands has changed. It was found that, if one studies the technology seriously, the separation of the infill level offers better efficiency.

There is no time to go into this question in great detail but the major arguments are as follows:

- Clear separation of the infill level makes it possible to design and produce infill systems that are independent from individual projects. Their components can be produced industrially in large numbers.

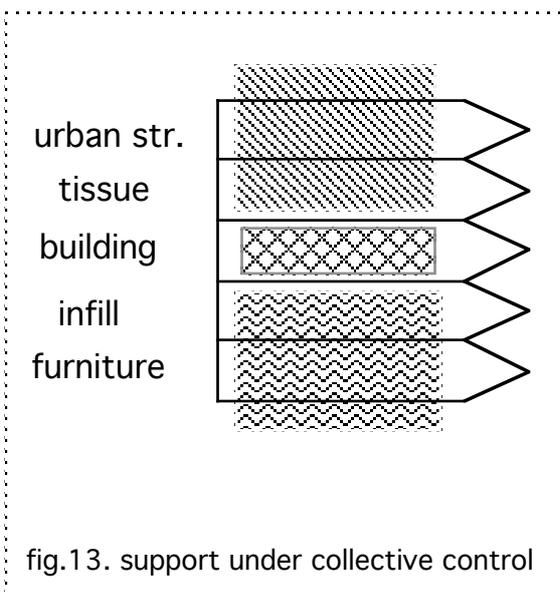
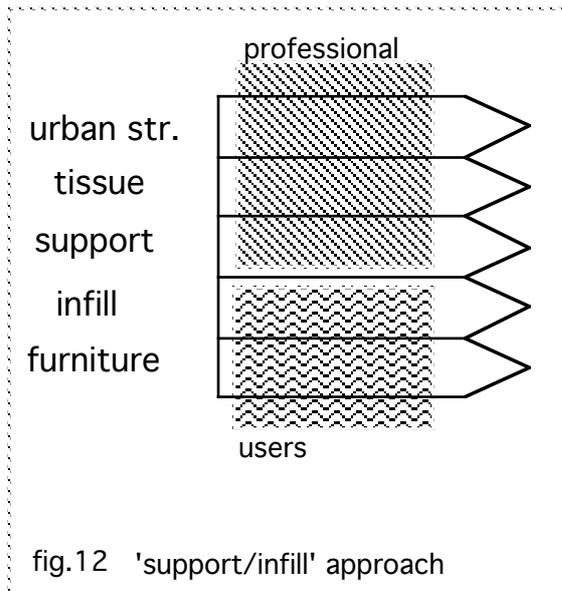


fig.13. support under collective control



- Installation of separate infill systems saves much time and labor on the site, therefore reducing not only on-site labor but also overhead costs.
- Because the infill system is a separate industrial product it can be improved over time.
- Where several infill systems will be available clients can choose and competition will produce a variety in styles and price levels.
- Because infill systems are not dependent on a single project they can be applied in a wide area. This is particularly interesting with a more united Europe in 1992.
- Because the installation of a infill system goes per unit it is not important that floorplans are the same; they can all be different.
- Individual units can be changed and improved over time to meet individual users needs.

You see that in this case the initial motivation is technical and economical but that, at the same time, we can respond to several of the 'idealistic' points on the wish list I gave earlier.

At this moment in the Netherlands there is a organization called 'Open Building'. It has more than a hundred members among whom we find not only architects and engineers, but also contractors, manufacturers, and experts in public housing management. They are convinced that the clear distinction of levels in housing production and design is the way of the future. They are not necessarily all that interested in the freedom of the user to change his own infill system, but they regard the support/infill distinction as a good base for improved industrialization leading to a better product for less money.

It would be a mistake to believe that the support/infill distinction is only for rich countries like the Netherlands. The distinction of levels allows us to organize our work better and offers greater flexibility and efficiency independent of the available material resources. Professor Bao Jia Sheng from Nanjing university, who is present at this conference, has successfully applied the support/infill distinction in a housing project in Wuxi City, China, with a very different budget compared to that available to his colleagues in the Netherlands. I assume he will report on that project himself. A few weeks before this meeting I was informed that the support/infill approach is also applied in Egypt by the ministry of reconstruction. There professors Nasamat Abdelkader and Sayed Ettouney have developed a standard support system that can be applied in different sites around the country. The infill of the units will be left to the users who will apply traditional materials.

Final remarks.

To end my talk I would like to make a few final remarks.

I set out to propose a model that allows us to describe different control situations in different projects. But by now you will have discovered that this model actually implies a methodological principle. The distinction of levels, as they operate in the real world, allows us to organize our work in a more sophisticated way. We no longer need to seek a similar solution for all purposes, but we can find the best approach in each case. In each project we can ask ourselves how responsibility will be distributed across the various levels to get the best results in the most efficient way.

The concept of levels therefore provides a planning tool that we can use to deal with the growing complexity of our task.

When we organize our work in this more sophisticated way important methodological questions arise. For instance, how will the distinction between the two levels be made clear? How do we decide exactly what belongs to one level and what to another? How do we define the subsystems to be found on a single level? How do parties, operating on different levels, coordinate their work?. You will agree that such questions are not particularly new. Issues of control distribution and coordination between parties always have been very important in planning and design and engineering. In the course of time we have researched and developed numerous additional tools to help us organize the division of design control better.

Examples of such tools are for instance a better understanding of modular coordination: not for the standardization of components, but for the coordination of design among different parties. In the same way we have experience with the uses of formal zoning systems as design tools to coordinate work on different levels.

When we operate on a particular level we must, in this new way of working, be able to judge what freedom we offer to the party on the lower level. When, for instance, a urban designer makes streets and house lots, as we discussed in a earlier example, he wants to make sure that the house lots can contain the kind of houses he has in mind. He will analyze the size and shape of the lots to make sure the houses he has in mind will fit. This kind of investigation to check what can be done on a lower level, can be formalized in what we call a 'capacity analysis'. Such a analysis can be done on all levels of the built environment. For instance , when we design a support system we want to understand its capacity to hold the right kind of infill plans. Or when we make a core house we want to find out in what ways the user can expand and improve it.

I mention these few examples of formal operations to show that a specific methodology is involved than cannot be explained here. Much remains to be done but we know enough to be confident that the levels approach for open building is very promising. To use this new approach, however, new skills and methods must be applied.

Let me return briefly to a topic we discussed earlier: the issue of variety versus uniformity. You may have noticed that I stressed method and the distribution of responsibility in a scientific and flexible way. In each example we found, however, that the result is greater variety and flexibility. In the sites and services example we can be sure that each house will be different and that houses will adapt over time to the needs of their users. The same is true in the support infill examples. Here again the result can be that each unit is different and adaptable over time.

But you also will have noticed that this rich variety was not he goal but he result of a more efficient and sophisticated approach. The idea that variety can be the result of efficiency is hard to accept for many among us. Even among members of the Open Building organization

in the Netherlands I found that people said: I know now that variety and efficiency are not in conflict with each other, but I still find it difficult to believe. This is understandable because we have been trained for generations with the idea that rigid standardization of floorplans is necessary to be efficient. In the next decade this old fashioned idea will disappear.

I assumed, in my models, that the user can be regarded as a responsible party as much as the professional. Some of you may have their doubts about this assumption. But you also will have noted that the models of control distribution are different from what is usually called 'articulatory design' I firmly believe that those who want to participate must be willing to carry responsibility. Moreover, responsibility must be clearly defined. Only when these conditions are met, the users rule can be helpful.

I do not share the concern of some of my colleagues who fear that when the user participates, the professional role is somehow discounted or degraded. I believe the opposite is true. To organize and steer the processes we have seen in the various models, professional skill is more needed than ever before. As experts we are responsible for the management of the process and our expertise must lie in our understanding of the control distribution patterns and the skillful organization of the different parties involved.

This new expertise must be developed. As I have said before, I believe much can be done here. A new level of sophistication can be reached. When the concept of levels is not properly understood, or when the control distribution is not properly studied and when the coordination between the parties on different levels is not skillfully organized, problems will arise, no matter how much or how little money is available for your project. Those who want to take full advantage of the understanding of levels and control distribution must study it carefully and be aware of the methodological requirements to be met. To deal with the more complex world that we live in, and to replace our outmoded methods for better ones will take much effort. In the field of architecture we tend to look at the quick fix: another style, a new type to copy. This will not work when we are serious about the housing problem. To change or methods is hard work.

To end this paper we now may come back to the seven points I brought up in the beginning of my talk. Let us see what levels mean to them.

- 1) The levels concept allows us to choose the right process: we consider the different parties involved and can decide what their responsibilities must be. We also see how different projects can be structured differently with their own control distribution pattern. As such it is a planning tool.
- 2) In this model both professionals and non professionals can have a place. The need to arrive at the most effective solution with the best possible use of resources will determine the control distribution. In some cases users can do the job better, in others professionals must do it. The most important point is that on each level, for each subsystem, the responsible party is identified.
- 3) Change over time can be related to levels. Change on a lower level is easier and can have a faster frequency than change on a higher level. Clearly defined levels with systems assigned to each, make change over time easier to be organized.
- 4) Uniformity can be efficient when one party has to do many things. To build a support, for instance, repetition of the same bays is more efficient. But when systems operate on their own level, different parties can use the same system simultaneously and work parallel. We see this with the infill systems in the support project or with

the building of individual houses in the sites and services project. In those cases variety is not the purpose but the result.

- 5) Separation of the lower level systems from the higher level allows for their change without disturbing the higher level. If that condition is fulfilled, adaptation to individual needs on the lower level is easy and efficient.
 - 6) The building level can be designed to respond to local lifestyles and cultural values. This is what determines the quality of the urban environment. This level can also respond to specific housing types that people prefer. The lower infill level provides the modern amenities that have become international preferences, good bathrooms and kitchens, electricity, telephone and television. Adaptation to a higher standard is possible over time.
 - 7) To fit a housing project in the local urban context is always the responsibility of the professional urban designers and architects. Their expertise should particularly be occupied with this question, leaving the lower level decisions to those who live in the projects.
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Some further reading:

For a theory of the built environment based on physical levels and territorial hierarchies see: N. John Habraken, Edited by J.L. Teicher: The Structure of the Ordinary, MIT Press.

For the application of the levels concept in general design education see: n. John Habraken, The `Control of Complexity. In: "Places", volume 4, no2, 1987, MIT Press.

Furthermore: N..John Habraken : Towards a new Professional Role, in: "Design Studies". Vol. 7, no3. 1986, Butterworth, London.

N. John Habraken: Control Hierarchies in Complex Artifacts, Proceedings, Conference on Planning and Design in Architecture, Protzen, Editor, Boston, 1987, International Conference on Planning and Design Theory.