

Urban Tomography: graphically exploring the urban realm – a form of augmented sectioning

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Abstract

Reading and understanding the contexts within which housing projects are designed is a crucial part of the design process. The concept of “mapping” is part of design strategies on both the level of urban planning and architecture. This paper will present and discuss a specific method and tool to explore the urban realm based on the section. The method was developed within the context of the OIKONET Threshold Matters Workspace and the Small is Power Workspace. The partners in these workspaces called this method Urban Tomography (UT). Urban Tomography is a term for imaging by architectural or urban sections or sectioning in order to conduct a mapping. Through a series of sections of a specific urban site UT is developed with the intention of contributing towards a better reading and understanding of that site. Through the use of markers specific topics, items or urgencies are graphically made visual. UT is a method of urban realm research and is a type of mapping. The output of UT is to create a high-contrast visual representation of a specific socio-spatial concept within a particular location. UT is a drawing that is created to highlight the architectural articulation of a specific concept. This diagram helps the designer to gain an insight into the specifics of a certain site. There are four components that form the UT: site, section, topic and marker. It is exactly this fourfold that sets the UT apart from the normal section and hence can be considered as an augmented section. The UT results in a high contrast image where markers are developed to visualise crucial and specific topics, items or urgencies that exist within a specific site or study area. UT is mapping derived from a combination of three techniques from three different fields: the tomography, the transect and the section. In this way, UT supports graphical investigations of different characteristics of the spaces that form the urban realm in general and housing settlements in particular.



Keywords: mapping; boundaries; urban analysis; section; urban realm, design, Urban Tomography.

1 Urban Tomography: graphically exploring the urban realm – a definition

“Space is inherent in a plan but visual in a section.” Nasrin Seraij [1].

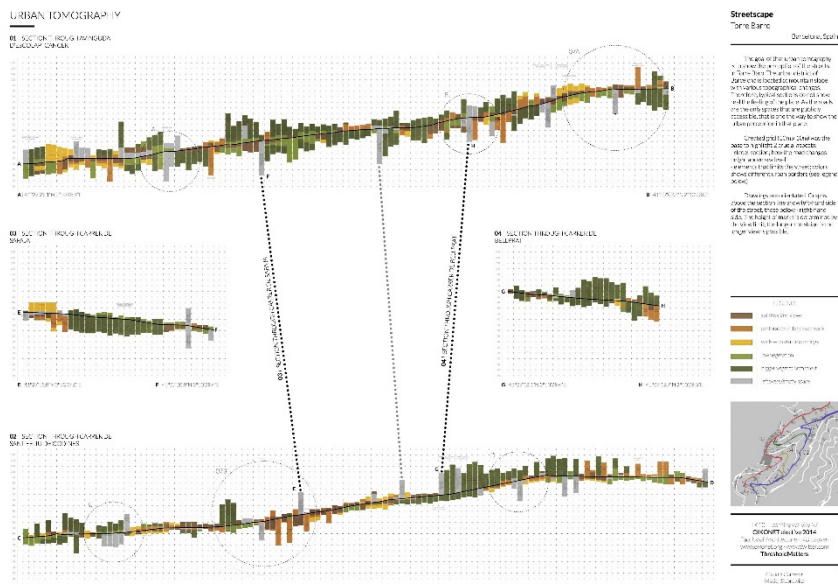


Figure 1: Urban Tomography for Avinguda d'Escolapi Càncer in Torre Barro, Barcelona. Mapping depth perceptions – an overview. (Authors: Clàudia Carreras and Maciej Sidorowicz.)

1.1 Power of the section

The section is probably the best representational tool to show spatial relations: between different spaces, between zones, between urban areas, the inside and the outside, the void and the solid. The section has the power to show spatial relations that would otherwise remain hidden. Because of these phenomena, the section has the potential to be a useful tool for mapping and spatial/design thinking. To explore this potential the section can play a role in urban research and housing design. It is with this in mind that the section became the pivotal point of an elective design seminar at the Faculty of Architecture KULeuven. A learning environment was set up that would revolve around the section as research, mapping and design apparatus for urban research and housing design. A specific

way of creating and setting up the section for mapping has been developed within this elective design seminar. This method was called Urban Tomography (UT).

This paper will give an account of the development of UT with a definition, a glossary, a protocol and some first results. This paper will also reflect on the experiences and outcomes, and will also highlight the qualities and potential of UT for the future.

1.2 Defining Urban Tomography

Urban tomography is a kind of mapping as defined by Corner [2]. In that sense, UT is a method of urban research with the goal of understanding the urban condition in the context of a design assignment. The goals of creating a UT are:

- To gain insight and create knowledge in or of a specific topic and or site;
- To map the urban condition;
- To support a design intervention via the creation of a mapping;
- To produce a beautiful and meaningful architectural drawing.

The basic idea is that through the creation of a series of augmented sections of a specific site, as will be evidenced later on, UT contributes towards a different reading and understanding of the study area.

UT exists out of four components that form a fourfold whole. The possibility landscape of that fourfold whole is represented here in this scheme (Figure 2). Each of those components will be explained further on in this paper. The main point to be made here is that the combination and interdependence of these four components are at the core of UT and make it a new kind of mapping of the built reality.

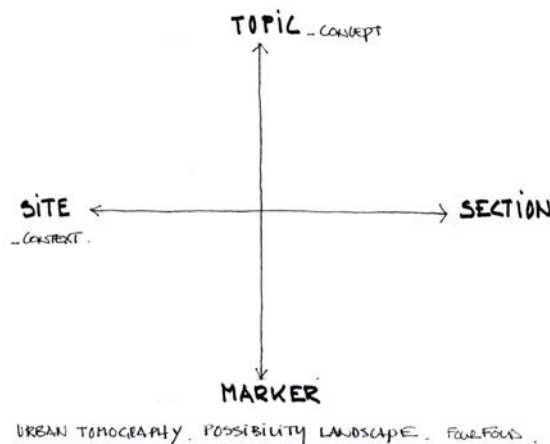


Figure 2: Sketch representing the possibility landscape and hence theoretical framework of Urban Tomography.

Urban Tomography is a mapping that graphically investigates specific aspects of the urban realm and or housing settlements. UT is a mapping method for imaging using architectural or urban sections or sectioning. Through a series of sections of a specific urban site, the UT is developed to construct a reading and understanding of that site. Through the use of markers specific topics, items or urgencies are made visual. With visual is meant that the architectural expression of certain concepts is made sharper, more apparent, perceptive, and in contrast. The final result and output of the UT is graphical. It is a mix between a diagram and a drawing that has a series of sections at its base.

The UT should lead to an understanding of how a certain concept or topic is present within a certain site in a certain spatial context.

1.3 Another kind of section: augmented

UT uses the section as a base or foundation but it is more than a section, it becomes, through the adding of the three other components an augmented section. As a consequence, it allows for modification and multiple layers and multiple reading to be present. The section itself is neither the tool nor the outcome.

UT is different from a normal section in the sense that it is not only a topographical or morphological tracing of a site. It is an augmented representation, a designed representation, a designed reflection, a mapping. It is a series of sections to which a new layer of information is added, hence augmented, to create a high contrast image that highlights a specific concept.

In a normal section the existing situation is represented on scale. UT for instance can move beyond this to create a focus reading or close reading.

The section becomes a carrier of a specific addition of information that moves beyond the mere representation of an existing topography/morphology. Another dimension is added. The section is augmented. The marker plays a crucial role in this as will be demonstrated later on.

UT is a method of graphically exploring the urban realm through the production of high contrast images for which a section was a starting point. The contrast is created through the translation of a certain concept (say the public-private dichotomy) into a graphical and visual marker that can be presented in a drawing. Scale is not important any more but proportionality is. Some of the concepts that have been explored and translated into a marker so far were: visual permeability, public-private dichotomy, time, and proximity. Often these markers become a kind of index.

1.4 Another kind of Urban Tomography

There are other ways of mapping the urban condition and that are called UT. In fact, it was Martin Krieger who coined the term Urban Tomography in his book with the same title [3]. Krieger uses videos, sound recordings and a series of photographs for creating his urban tomographies. As is described in his book: "Tomography is a method of exploring a phenomenon through a large number of examples or perspectives. In medical tomography, such as a CAT scan, two-dimensional slices or images of a three-dimensional organ are used to envision the



organ itself. Urban Tomography applies the same approach to the study of city life. To appreciate different aspects of a community, from infrastructure to work to worship, urban planning expert Martin H. Krieger scans the myriad sights and sounds of contemporary Los Angeles. He examines these slices of life in urban tomographies.”

His technique, however, is not based on the use of the section or the creation of (architectural) drawings as a research tool.

1.5 A three-fold base: a three-field base – the section (architecture), the line transects (biology) and computed tomography (medicine)

Urban Tomography is a mapping method that is derived from the combination of three techniques from three different fields: the section (architecture), the line transects (biology) and computed tomography (medicine).

In medicine, tomography or computed tomography (CT) is a widespread imaging diagnostic method. It creates an image by using a series of sections/images of the human body or parts of it. In the process contrast agents or markers are being used to improve the contrast and readability of the images. These agents or markers are selected in function of what specific aspects need to be studied. In a similar way, Urban Tomography uses a series of sections with high contrasts to create an image of a specific area or site and depending on the marker is intended to highlight (the spatial expression of) a specific aspect. The goal of that image is to generate clear and structured input for the designer.

Urban Tomography is based on fieldwork. To produce UT of high quality the designer needs to gather information on site and transfer that into a drawing. This is analogous to the technique of the line transect in biotope and environmental studies. “Line transects are used when you wish to illustrate a particular gradient or linear pattern along which communities of plants and/or animals change. They provide a good way of being able to clearly visualise the changes taking place along the line. Depending on how detailed the line transect is, they can usually be accomplished fairly quickly.”

The transect proves to be a valuable method to gather the appropriate information necessary to produce the UT. In the case of UT, the relations between different aspects and how they are distributed along a cut or a path is crucial. Transects prove to be a very efficient tool and method to collect this information. In a sense this is very logical as space, architecture and the urban realm are the biotope of the human race.

The third constituting element of the UT is the architectural and urban section. As mentioned above, this core potential of the section is to show spatial relations that make it such a great instrument for research and design.

2 Urban Tomography: the components of a method – a glossary

Here we will describe more in depth the four components of the UT. Those four components are: a) site or context, b) topic or concept, c) sections and d) markers.



These four components have a specific and shifting relationship to each other, they are interdependent. Depending on the focus of the mapping they all play a different role in the sense that in some cases these individual components will be the given or the unknown, going in to the mechanism of each, the four components need to be defined.

The two most straightforward components are a) site or context and c) sections (Figure 3). Site or context: this is the physical study area or area to map. Depending on the case this can be an urban site, an area, a street, a quarter, a district, housing project, a house or even a room. The section is the base layer of the final output (drawing). It is the working backdrop, the canvas as it were. It is the architectural drawing proper and the graphical backbone of Urban Tomography.

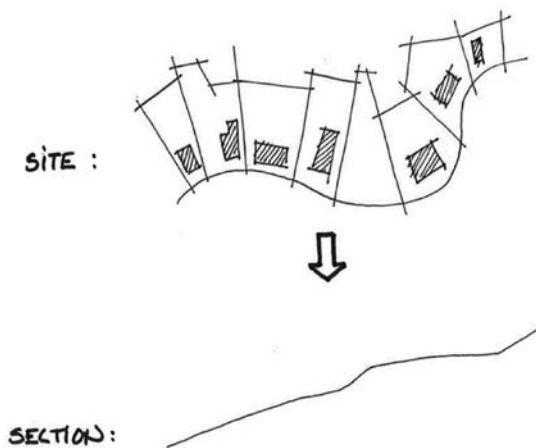


Figure 3: Diagram representing the relation between site and section – the most obvious pair of components of the UT. A section is produced on the base of the topographical and morphological information of the study area.

The two other components are less straightforward and somewhat more complex in nature (Figure 4). With topic or concept is meant a part of the complex reality. Most often in UT it is the focus of the mapping. It is the “filter” through which the researchers look at the study area. It is that critical element of which one wants to understand what role it plays in the physical reality of the study area. A goal of UT could be to highlight how this concept contributes to the (spatial) reality of the study area. Examples of topics or concepts that have been explored are: proximity, public–private, affordance, soft versus hard edges, and thresholds.

The fourth component is the marker. The marker is the graphical expression of the concept. In order for a concept to be graphically expressed, it needs to be conversed or transposed so it can be shown in a readable and understandable way on the section. This conversion/permutation can be done by quantification, proportionality, diagrammatically and pictogrammatically. Looking for the best

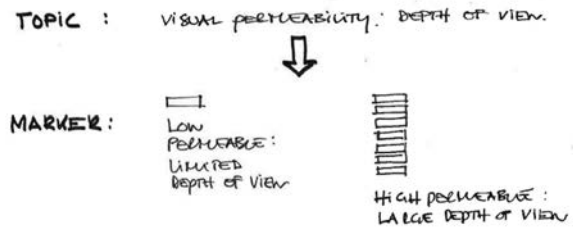


Figure 4: Diagram representing the relation between topic and concept – the most abstract pair of components of the UT. In this diagram, the topic is visual permeability: depth of field. This is translated into a graphical marker that can be added to the section. In the diagram, visual permeability is quantified through the use of blocks. A few blocks indicate low permeability, many blocks, high visual permeability.

way to graphically express the concept into a marker is a crucial operation within UT and takes the most time and experimenting in the construction of UT. The marker is decisive in creating the high contrast image that is operating as a filter of a spatial reality that UT ultimately is.

When the two pairs are superimposed and combined Urban Tomography is realised (Figure 5). In the diagram the quantified visual permeability is graphically represented on the section. This creates a visual mapping highlighting the visual permeability of the study area. These diagrams are simplifications of the information processing that is part of UT but it illustrates the mechanism of UT. Further on in this paper the actual case that used this mechanism is explained. It is important to note that the mechanism is the same for all UTs so far explored but there exists a strong interdependence within the pairs of site-section and topic-marker and between the pairs themselves.

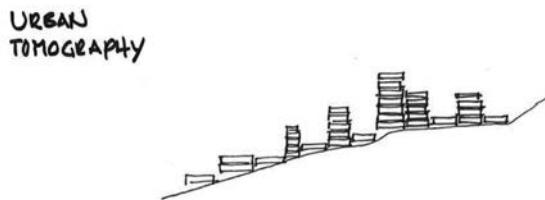


Figure 5: Diagram representing an Urban Tomography result as the fourfold of site + section + topic + marker.

3 Urban Tomography: a method and a protocol

As defined before, Urban Tomography is a mapping method for understanding the spatial expression of a specific topic or concept in a specific context or study area. The methodology of the construction of a UT requires the following of a set of

steps or protocol. As will become clear the order of the steps is alterable and often interdependent.

Urban Tomography Protocol: The different steps:

- Selection of site.
- Selection of topic.
- Building argumentation for topic.
- Loading up of an understanding and interpretation of the selected topic.
- Fieldwork.
- Building/drawing of the backbone section.
- Conversing the topic into a marker.
- Experimenting with the marker (transferring it onto the section).
- Test and feedback until a powerful/performant marker is developed.
- Apply the marker to the whole section.
- Reflect on the result/reading of the output.
- Write a legend and a short description.

3.1 Urban Tomography Protocol: a description:

Site, topic, section and marker each take up a quadrant of the UT mapping method. There are different ways to start a UT. One is to take the site as a given and to investigate the site according to a certain topic/concept. Another way would be to start from a topic/concept and to look for the presence and expression of that topic/concept over a number of different sites.

Site and section:

In most cases the site will be a given in function of a specific design assignment or research intention. A number of urban or architectural sections are then produced using the morphological-spatial and/or topological information. These sections then become the main input for the UT and will act as a canvas for the markers.

Concept:

Within the framework of a design project or an urban study the researcher reflects on a specific topic or concept he/she would like to explore in a specific study area or context. The researcher builds an argument as to why this is a relevant concept to explore. The concept then is investigated through a deepening of the understanding of it, to contextualise it through literature research and by building a collection or set of references (note: architectural projects, urban projects, but also poetry, art, and so on). This concept then becomes the base for the “marker”.

Markers:

The markers are used to frame and focus on a specific topic. Similar to their use in Computed Tomography, markers are used to enhance the contrast of a certain element of a picture and present a selected bit of information in a specific view mode. The marker acts as a filter. The marker serves to focus and to highlight certain and specific information. In doing so a lot of “noise” is left out to intensify the contrast and to focus on a specific element or topic. The technique for the conversion of a topic into a marker is highly dependent on the nature of

the concept, on the expression of the concept on the study area. The most creative and designerly part of the UT is this conversion. This is where the designer is challenged in creating a proper mapping.

The marker then becomes the element that is presumed an essential, crucial or critical element in the context of the topic one wants to research. An important part of UT is to reflect on which marker is relevant for the given site and proposed design research. Similar to Computed Tomography in medicine one sometimes needs to try different markers in order to find the best result. i.e. the best possible image of a certain concept or topic.

3.2 Interdependence and modulations

As mentioned above there is a strong interdependence between the four components of UT. The site determines the section. The choice of topic will influence the marker. The marker implies the way the sections should be produced. The relation section/marker also defines the scale, the level of detail, the position of the sections on the terrain, the number of sections, the distance between the sections, parallel projection or isometric. Depending on the specific concepts to explore, a particular series of sections could be produced.

Since UT is a method for mapping, the choice of topic and its marker is also a design choice. The choice of the marker and thus the system of marker and sections is a formative and creative act as described by James Corner in *The Agency of Mapping* [2].

Within this mapping method it is of course possible to apply different markers to the same site or to apply the same marker to different sites. These comparative studies could lead to a new understanding of a particular site. When a different set of markers is explored on a single site this is called a modulation. The same goes for the relation topic/marker: a specific topic could converse in different markers.

This interdependence and modulations are potentials of the UT method of mapping that are hinted at during the development of the UT but that needs to be further investigated.

4 Urban Tomography: in action

4.1 Threshold matters

As mentioned in the beginning of this paper, the UT was developed within an elective design seminar at the Faculty of Architecture KULeuven during the fall semester of 2014/2015. The elective is called Threshold Matters and was set up in collaboration with Gebze Technical University, Turkey. Both electives are embedded in the pedagogical activities of the OIKONET research project (note). The research was repeated during the Small is Power elective design seminar in the fall semester of 2015/2016 [4].

The two examples of UT described below were developed within the Threshold Matters elective. The motivation to develop this elective arose from the fact that an understanding of the issue of threshold, the space between the public and private realms, is of fundamental importance to successful housing design.



Because the meaning of threshold varies between cultures, it was taken as a starting point that such collaborative projects by students and teachers from different cultures would provide new insight for all participants into this important issue. Dutch architect Herman Hertzberger once noted that “The threshold provides the key to the transition and connection between two areas with divergent territorial claims and, as a place in its own right, it constitutes essentially, the spatial condition for the meeting and dialogue between areas of different orders” [5].

Three examples of UTs that were developed within the Threshold Matters will be showcased: two for an informal area of Barcelona and one for a city block in Cureghem (Brussels). For these examples the general framework of Threshold Matters was a given. The students could propose a site and would out of a given list select one specific concept to convert into a marker and explore. For both cases the four UT components of site-section pair and topic-marker will be identified and described.

4.1.1 Depth perceptions in Torre Baró, Barcelona

The first example of UT is developed for Avinguda Escolapi Càncer, in the Torre Baró neighbourhood in Barcelona, Spain (Figures 1 and 6).

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01 | SECTION THROUGH AVINGUDA D'ESCOLAPI CÀNCER

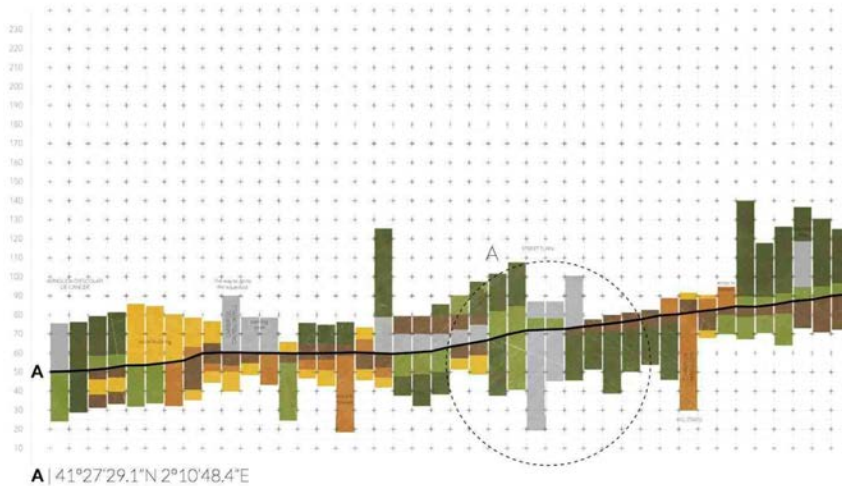


Figure 6: Urban Tomography for Avinguda Escolapi Càncer, Torre Baró neighbourhood in Barcelona. Detail showing the grid, the markers as coloured blocks mapping depth perceptions (authors: Clàudia Carreras and Maciej Sidorowicz).



Site: This urban district (informal settlement) of Barcelona is located on a mountain slope and is characterised by various topographical changes. Therefore, typical sections did not show the reality of the experience of the place. The roads are the only spaces that are publicly accessible.

Section: Because of the topography of the area a section that shows the topography was chosen as base. The section was positioned in the axis of the road.

Topic: The dwellings in the study area are built in a step-like manner up or down the slope. The roof of one house is the courtyard or entrance of the one above. Narrow stairs lead to sometimes 20 houses. None of those are visual from the street because of the slope. Sometimes the landscape behind is perceived – some long vistas over the city of Barcelona or towards the hills behind. These two observations lead to the selection of Depth Perception or Visual Permeability as a topic for further graphical investigation and mapping. Hence, UT focuses on the development of the roads and how the section and perception/perspective changes with the progression of moving along the road.

Marker: To indicate these depth perceptions and how they evolve along the length of the street every different situation is catalogued. As with the mechanism described above, the intensity of a situation is represented by a number of blocks. More blocks meaning a higher intensity – for example, a vista between two houses. On top of this a colour code was introduced to highlight different situations of urban edges (no view, stairs, vista, garden, façade). This mapping was presented on a grid of 10 m × 10 m.

In Figure 7 the drawings are orientated in such a way that the graphs above the section line show the left-hand side of the street, those below the right-hand side. The height of the marks (coloured bars) is determined by the limit of the view from the street. The longer the bar, the longer the corresponding view.

The second example is a further development of the previous UT (Figure 8). It uses variations in markers to come to a sharper reading and understanding of the site. Through simple modification of the existing drawing and thus changing the marker some new readings were produced. Within the context of UT this is called modulation.

In Figure 9 “space flow” is shown. By selecting only the bars of low vegetation, high vegetation and leftover, one can observe how the street space is limited by urban elements. It turns out to be a characteristic element of the site that a long perspective follows when the view is strongly limited by buildings and walls this space on landscape. This kind of clustering is information that became apparent using UT. Figure 10 shows another modulation. By indicating the number of roofs (one roof equals one dwelling) per strip of 10 m (grid).

Something interesting happens when overlaying these mappings with the first UT. The UT showed that the numbers of housing units (families) are not reflecting urban perception. One of the specific spatial features of the Torre Barro is that the dwellings succeed each other in depth up- or downhill. A lot of these clusters of dwellings are served and accessible via a narrow stair. This means that the perception on the street does not reflect the density of the area. This turned out to be a key feature of understanding the Torre Barro.

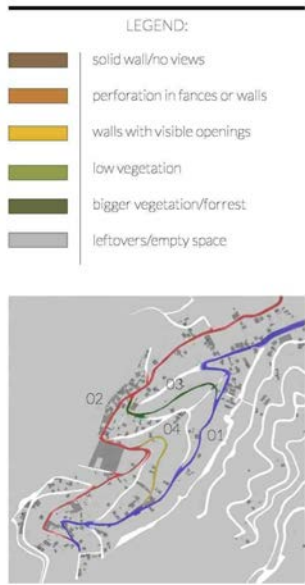


Figure 7: Urban Tomography for Avinguda d'Escolapi Cancer in Torre Barro, Barcelona. Detail showing the colour legend and site plan (authors: Clàudia Carreras and Maciej Sidorowicz).

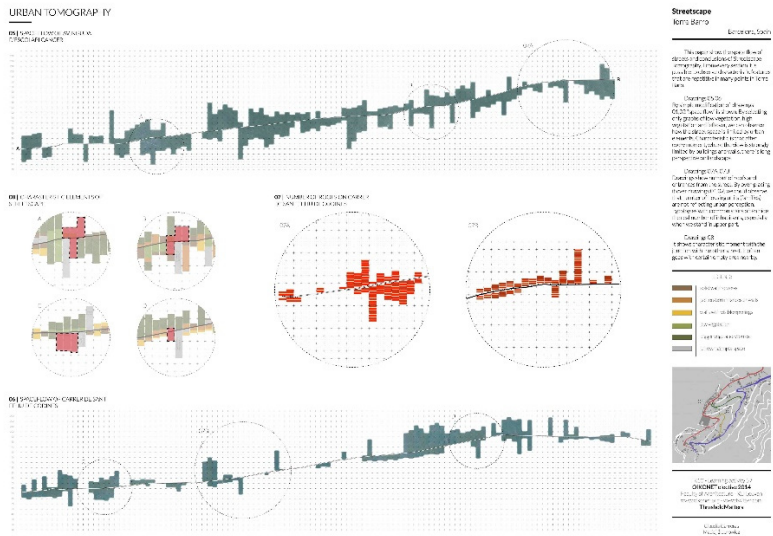


Figure 8: Urban Tomography for Avinguda d'Escolapi Cancer in Torre Barro, Barcelona. A modulation of UT depth perceptions – mapping space flow – (authors: Clàudia Carreras and Maciej Sidorowicz).

URBAN TOMOGRAPHY

05 | SPACE FLOW OF AVINGUDA D'ESCOLAPI CANCER

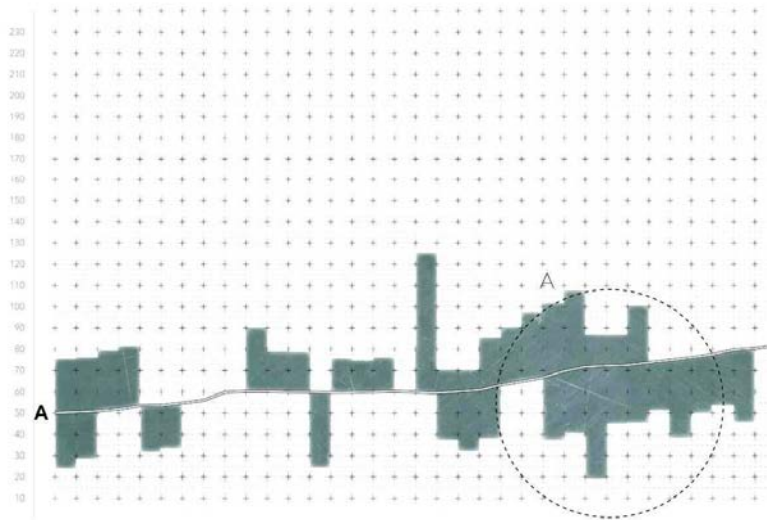


Figure 9: Urban Tomography for Avinguda d'Escolapi Cancer in Torre Barro, Barcelona. A modulation of UT depth perceptions – mapping space flow – detail (authors: Clàudia Carreras and Maciej Sidorowicz).

07 | NUMBER OF ROOFS ON CARRER DE SANT FELIU DE CODINES

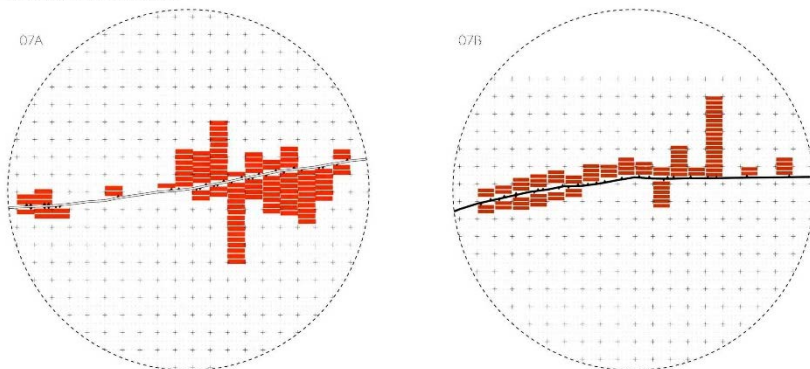


Figure 10: Urban Tomography for Avinguda d'Escolapi Cancer in Torre Barro, Barcelona. A modulation of UT depth perceptions – mapping space flow – detail (authors: Clàudia Carreras and Maciej Sidorowicz).

The UT highlighted another characteristic of Torre Barro. Figure 11 is a detail where the UT focuses on the areas in the vicinity of street junctions. The UT shows that in a lot of cases when a street junction appears it is paired with a nearby empty area. This again is one of the spatial building blocks or unwritten rules of the informal settlement of Torre Barro that is identified and mapped through the method of UT.

08 | CHARACTERISTIC ELEMENTS OF STREETScape

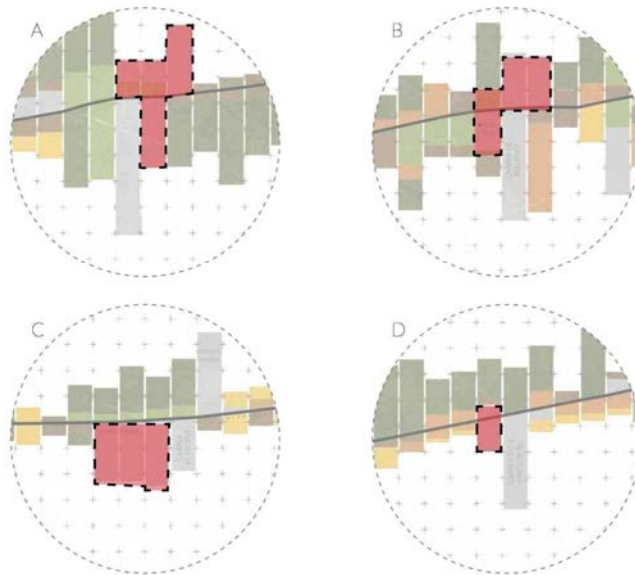


Figure 11: Urban Tomography for Avinguda d'Escolapi Cancer in Torre Barro, Barcelona. A modulation of the UT depth perceptions – reading and understanding the study area (authors: Clàudia Carreras and Maciej Sidorowicz).

4.1.2 Public and private in Cureghem

The third example of a UT is one developed for a site in Cureghem, Anderlecht, Brussels (BE) (Figure 12).

Site: The site is a hybrid open city block that contains some housing, a school and a football field.

Section: The sections are made every 45 meters and are presented in an isometric perspective. The buildings are represented schematically as closed volumes. The football field is drawn in plan to act as an orientation device.

Topic: This hybrid open city block is characterised by unclear distinctions and edges. This is reflected in the fuzzy public–private gradient or spectrum. This UT aims at mapping and understanding how that gradient is distributed over this open and hybrid city block.

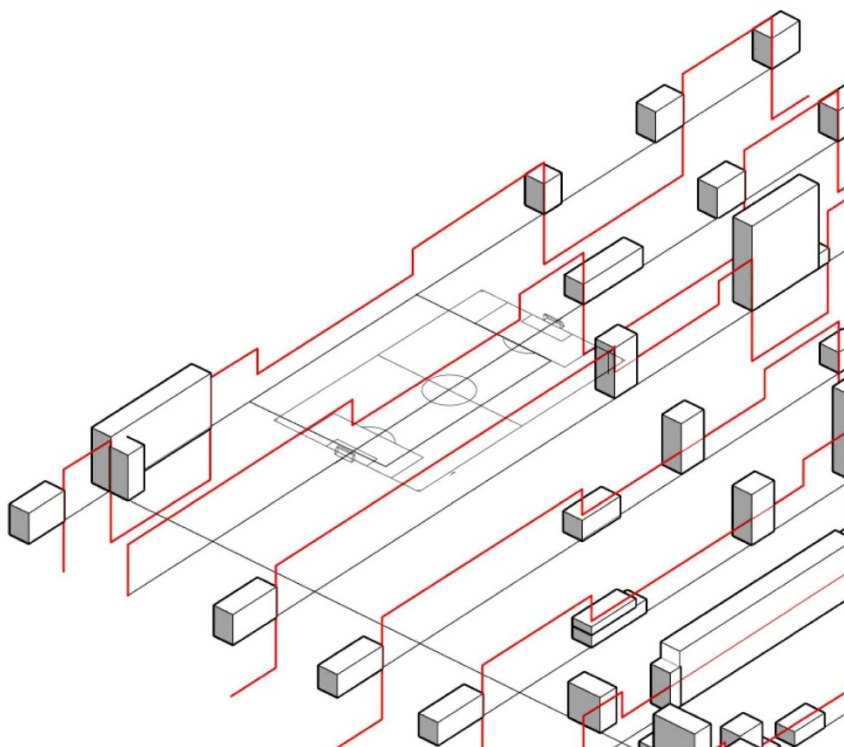


Figure 13: Urban Tomography for a site in Cureghem, Anderlecht, Brussels – mapping public–private spectrum – detail (authors: Joachim Bekkers, Kwinten Delvaux, Olivier De Greef, Andrei Vasilief).

spatial relations. The UT produces images where specific information is shown. These are useful for a profound reading using a classical architectural tool, the section, now introduced as a new method. In this sense, the UT is also an architectural diagram.

In the three cases described above the students used the result of the UT as a key development in their master dissertation. The highly-contrasted images support the designer in creating a reading and mapping of a specific situation within the specific context of a design assignment. The UT enabled the designers to visualise, highlight and support the designer in identifying (architectural) characteristics of the study area.

During the development and production of the UT the question arose as to whether the UT as a method could be utilised as a projecting tool in the design process. The UT creates a mapping of an existing situation. The question is: can it also produce a projection of a desired situation? This would mean that the modulations act as a projection. By tweaking and tuning the drawing, the UT could become a design proposal, a drawing that proposes a concept, an architectural intervention or strategy.

The next step for the development of Urban Tomography which could be as an instrument to graphically explore the urban realm is ahead of us.

6 Conclusions

Two action points for the future are apparent. The first one is to thoroughly and exhaustively explore the potentials that the Urban Tomography method of mapping has. As mentioned before the interdependence of the four components and the possibility of modulations are potentials of the UT method of mapping that are hinted at during the development of the UT but that need to be further investigated. The same goes for all the different tracks that are theoretically possible namely taking the different components as a given or starting point.

As mentioned above, putting the UT forward as design and projection tool to create, suggest and visualise spatial strategies has not been tested yet. The UT method has high but at the moment unexplored potential to become a tool for exploring possible interventions and to project a future situation. In this sense, it can become a part of the research by design paradigm and find its way to the practice.

Another element that needs to be researched is whether the UT is dependent on scale. Is it possible to apply the method of the augmented sectioning to all scales? What needs to be modified is would one like to apply the UT to a public interior?

Now and in the near future reflecting on living in high-density contexts is paramount to the design process. The way our dwelling will link to each other and the public realm is a key-component of housing design. This link is a spatial relation between the inside and the outside, between the private sphere and the public realm. As a form of augmented sectioning the UT is designed to graphically explore the urban realm and its link with the edifices it is described by.

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If there is any motivation for teaching and researching, it is the students. Their inquiring spirit and energy moved the elective and the Urban Tomography forward. Without them there would be no results.



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