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The Impact of Urban Planning on the Design and Operation of Stations and Interchange Hubs

Modern cities present urban planners with a challenge in that they have to understand the urban metabolism. Without fully comprehending what makes cities exist as well as the processes that support them, planning for the future is futile. What further complicates matters is that in the opinion of the authors the urban metabolism cannot be understood unless the underground metabolism is taken to be part of it. Once this is achieved, underground developments can be planned in a way that they are integrated into the urban fabric. To achieve this integration underground space needs to be unveiled to the city by designing in such a way that rather than being invisible, underground stations and transportation hubs become visible. They are integrated into the urban fabric in such a way that they enhance it and contribute to making the city more sustainable, resilient, inclusive and above all liveable.

1 Urban planning

To define urban planning is a dangerous task. Engineers are used to precise descriptions to make rational decisions. Urban planners have to work from a certain logic, but they have to use their knowledge and skills to understand the dynamics of the urban environment. As Dassen and Hajer [1] wrote: "The urban metabolism is hidden. If we could unveil the urban metabolism, it would become clear what contemporary urban life consists of, and we would get an idea of what disconnect requires". It is this understanding of the urban metabolism that is key to developing our cities of the future. If a definition needs to be given we can best look at the international guidance that has been developed by UN Habitat [2]: "Urban and territorial planning is more than a technical tool, it is an integrative and participatory decision-making process that addresses competing interests and is linked to a shared vision, an overall development strategy and national, regional and local urban policies."

But it is not just urban planning that shapes the city. Where urban planning is concerned with understanding the urban metabolism, urban designers are shaping the public spaces and architects help develop the city fabric through the design of buildings. Dassen and Hajer are writing about the Smart Cities of the Future. Their concern is not just that the urban metabo-

Einfluss der Stadtplanung auf den Entwurf und den Betrieb von Haltestellen und Verkehrsknotenpunkten

Moderne Städte stellen Stadtplaner vor die Herausforderung, den urbanen Metabolismus ihrer Stadt verstehen zu müssen. Ohne umfassendes Verständnis der Grundlagen der Existenz von Städten und der wirkenden Prozesse ist Zukunftsplanung vergebliche Mühe. Verkompliziert wird die Aufgabe dadurch, dass nach Ansicht der Autoren der urbane Metabolismus nur verstanden werden kann, wenn auch der städtische Untergrund als Teil des urbanen Metabolismus erfasst wird. Sobald dies erreicht ist, können Tiefbauprojekte so geplant werden, dass sie sich in die urbane Struktur integrieren und einfügen. Damit diese Integration gelingt, darf der unterirdische Raum für die Stadt nicht verborgen bleiben, sondern die Entwurfsplanung muss darauf zielen, Untergrundbahnhöfe und Verkehrsknotenpunkte sichtbar zu machen. Sie werden so in das urbane Gefüge eingebunden, damit sie dieses verstärken und zu mehr Nachhaltigkeit, Resilienz und Inklusion beitragen und vor allem die Stadt lebenswerter machen.

lism needs to be uncovered and understood to create these cities. Their concern is also that the biophysical and social domains need to be reconnected. As part of humanity's struggle with mitigating and adapting to climate change, we need to uncouple from carbon based energy. What we argue in this context is that the subsurface plays a significant role in all this. The urban metabolism can no longer be understood without also understanding the underground metabolism. Even if only looking at the subsurface as a provider of renewable energy, this cannot be done from a planner's perspective without considering underground space.

In this paper, we explore how urban planning and the development of underground mass rapid transport systems, and particularly their stations, influence each other but also strengthen each other for the benefit of our cities of the future. When it comes to underground stations for our transport systems, we can



Figure 1 Hector Guimard's original Art Nouveau entrance of the Paris Métro in Abbesses station (image by Steve Cadman) [11]

characterise them from a historical perspective as "floating in underground space" connected to an underground network of pipelines serving as a transport medium. They are hidden from view, are disconnected from the urban fabric, and that, to all intents and purposes, was seen as the beauty of these systems. As such they were hidden from the urban planners, urban designers and architects. The shape of the stations is most likely determined by the efforts of the engineer and established engineering practice to create their shape and configuration. In describing his entry for the design competition for Les Halles in Paris, France, the architect Rem Koolhaas wrote: "The project consists therefore of a group of buildings that are in part structures that emerge from the underground and in part penetrations into the ground from the surface with the hope that this concept will once and for all do away with the schizophrenia that exists in Les Halles between the underground and the surface" [4]. It is our contention that this schizophrenia between underground and surface dictates how our underground stations are formed in general. They only connect with the surface through narrow entries, created either

by copying a historical tradition or through lack of surface space, brought about by the total disconnect between the unplanned development below the surface and the planned development above (Figure 1).

Regarding operation of our modern mass rapid transport systems, pressure is growing to operate them in safe and secure ways. Just like other infrastructure, they need to be sustainable and resilient. They need to provide customers with an experience rather than just being a convenience. Three examples from around the world will illustrate this. These cases examine the issue of private versus public space, of opening up making underground space visible and of integrating surface and subsurface into the urban fabric.

2 Underground stations

2.1 Jubilee Line London – Canary Wharf station

Canary Wharf station on the Jubilee Line in London, UK, was designed by architect Lord Norman Foster and is exemplary in that it at least partially does away with the schizophrenia identified by Koolhaas. Consisting of two identical glass domes with a public park between them, the entrance to the underground can be seen from afar and invites the public to descend below the surface. Conversely, travellers leaving the underground for the surface do so by using a bank of escalators with the glass dome giving them a sensational view of the surrounding Canary Wharf skyscrapers. The changing skies provide a dramatic and dynamic backdrop that continuously changes the scene the traveller looks at (Figure 2).

Exemplary as it is, the Canary Wharf is also a poignant example of an issue that puzzles urban planners. It is not just the disconnect between surface and subsurface; it is also the disconnect between public space and private space. As the public descends with the escalators to the ticket hall below, they are met by ticket barriers requiring a valid ticket to pass through and to access the platforms below to catch the trains entering the station. The ticket gates serve as a physical barrier keeping out those who have no intention to travel on the underground. As



Figure 2 Canary Wharf Jubilee Line station [12], [13]

such they segregate public space from private space. "Although it is a public company that owns the actual space, it has the appearance of private space. The fact that London Underground staff is in charge of the station clearly illustrates this. Policing is done not by the Metropolitan Police but by the British Transport Police; a police force funded by the train operating companies, Network Rail, and the London Underground – part of Transport for London. Cameras that observe passengers inside the station are operated and monitored by London Underground staff from Transport for London's central control room. The main characteristic that turns the underground space into a private space is the plain fact of non-accessibility for the public during times the underground line is not in operation. Outside operational hours there is no public access to the facility." [4]

The disconnect between public and private space matters a great deal. As William Whyte observes: "A good space beckons people in, and the progression from street to interior is critical in this respect. Ideally, the transition should be such that it's hard to tell where one ends and the other begins. You shouldn't have to make a considered decision to enter; it should be almost instinctive" [5]. It is these "good spaces" that contribute to the urban fabric in a way that makes it liveable and loveable for its citizens. The cities of the future should not be anonymous in that they are purposefully and efficient, they must be inclusive and vibrant.

When underground stations become more than just a sub-surface facility for getting on and off trains when ticket halls become more than just a barrier through which travellers pass, then the underground station transforms into a vibrant transportation hub offering more than just the ability to catch a train. But for this transformation to truly contribute to the urban fabric first the underground must become visible from the surface in more ways than just marking the entrance with the iconic letter "M" or "U" and we need to find a way to make the station part of public space, creating a "good space" that enhances and contributes to city life.

2.2 Underground urbanism in Paris, France

Just as was the case in London, the Paris metro is shaped by history. There is, however, a difference in that Paris has always been a city that was planned, including up to a point its underground space. Gandy [6] quotes Baron Hausmann, Prefect of the Seine Region from 1857–1870, on the merits of the Paris sewer system: "These underground galleries would be the organs of the metropolis and function like those of the human body without ever seeing the light of day. Pure and fresh water, along with light and heat, would circulate like the diverse fluids whose movement and replenishment sustain life itself. These liquids would work unseen and maintain public health without disrupting the smooth running of the city and without spoiling its exterior beauty." The importance of this quote lies in the fact that his vision was later caught on by the first underground urbanists, notably Édouard Utrifan, who, in the first years of their thinking, gave rise to the idea of the subsurface as the urban service layer. The concept of hiding beneath the surface that what we do not want to see, hear or smell in our cities, stems from this period. In fairness, we have to say that Utrifan in later life came around to a new way of thinking. It was yet another Prefect, this time Maurice Doublet, Prefect of the Parisian region who in 1970 said: "The immense contribution of underground urban development is that it allows a separation of offices and bus-



Figure 3 Artist's impression of an opened-up underground station for the Paris Metro [14]

nesses. Service and administrative offices can thus be placed underground, restoring the surface to its original state of equilibrium and "joie de vivre." Underground urban development restores a hierarchy of urban functions by articulating the notion of what one will do with mankind" [7].

In May 2010, the Paris transport authority RATP announced the exposition of the results of the "Osiose" design competition for the metro station of the 21st century at the Cité de l'Architecture et du Patrimoine [8]. One of the entries was by the then Foreign Office Architects, headed by architect Farshid Moussavi. Moussavi presented a radically new view of the metro station of the future. Her idea was to open up the underground space and by doing so integrate surface and subsurface in a new way. Her radical departure from the common notion is visualised in Figure 3. It incorporates all those aspects that make a city vibrant. It does away with the segregation between public and private space in that the entrances to the underground station become one big open public space, only transitioning to private areas where people enter shops or the trains.

How this concept could work in practice was brought to light by the design and implementation of the transformation of the Les Halles forum and underground metro hub. As we can see from Figures 4 and 5, the transformation of this underground complex, consisting of shops, cinema, a swimming pool and metro platforms, was successfully inaugurated in 2016. French architect David Mangin's design consisted of transforming Les Halles into a large open public space, bringing back a green landscape with a central boulevard. The site of the Forum Les Halles and the transportation hub is opened up to reveal the negative volume as Utrifan characterised it and is covered by a large canopy, designed by architects Patrick Berger and Jacques Anziutti, hovering 9 m above the surface. Criticised by a few, this transformation of Les Halles is exemplary in that it demonstrates how opening up underground space can contribute to integrating subsurface development and surface development. It does away with the schizophrenia that too often exists between the two and enhances the urban fabric with its stunning design. It also has its own internal architectural quality that surprises, appeals and provides an experience to those passing by or using its services.



Figure 4 The Les Halles underground transportation hub opened up and covered by the canopy



Figure 5 Interior of the Forum Les Halles showing its architectural quality

2.3 San Francisco Transbay Transit Centre

It was Jane Jacobs [9] who famously wrote: "Think of a city and what comes to mind? Its streets. If a city's streets look interesting, the city looks interesting; if they look dull, the city looks dull." When looking at the original, functional design of the Transbay Terminal in San Francisco, USA, stemming from the 1930s, Jacob's observation could well apply. As Figure 6 illustrates, the terminal building is "(...) outdated and has a poor relationship to the street" [10]. It is a far reach from the vision for 2030 that planners foresee for the district in which it is situated: "Radiating from the Transbay Transit Center is a network of public spaces that provides both inspiring and functional support for an incredible concentration of activity—people working in, living in, and visiting the area, as well as people simply passing through via the major transit systems that serve the whole city and region. Equally, most find the district an enjoyable and humane place to spend time, not necessarily conscious that the district is an exemplar of comprehensive environmental sustainability benefitting the entire region" [10].

In 2007, Pell Clarke Pell Architects were chosen to design the new Transbay Transportation Center. Their design was seen to be outstanding in that it took full advantage of the space available and integrated both subsurface and surface use in a novel way, including a green public open space on its roof. The

integration was carried out by creating six different levels, four above ground and two below ground, for the transportation hub (Figure 7).

"What makes the design and operation of the Transbay Transit Center even more remarkable is the way sustainability principles have driven it. The publicly accessible park is aimed at reducing the city heat island effect and contains efficient irrigation and drainage systems. Natural daylight is taken advantage of reducing the need for electric lighting of the internal areas using the Light Column feature that also provides natural ventilation. The project required the demolition of the existing terminal which created enough concrete waste to fill 28 Olympic size swimming pools. This will all be recycled. The project also reduces storm water runoff through the use of grey water storage tanks. In all the potable water use of the new building will be reduced by 50% in comparison with the current situation" [4]. The sustainable design concept is shown in Figure 8 and was developed by Except Integrated Sustainability, based in Utrecht, The Netherlands.

The San Francisco Transbay Transit Center is exemplary in that it shows how urban planning can influence the design and operation of transportation hubs and underground stations. It also indicates that transport infrastructure can be so much more than invisible objects hidden in underground space.



Figure 6 Transbay Terminal as it was in its former days (Source: Transit Centre District Plan, San Francisco Planning Department)



Figure 7 Artist impression showing a sectional view of the Transbay Transit Center design [15]

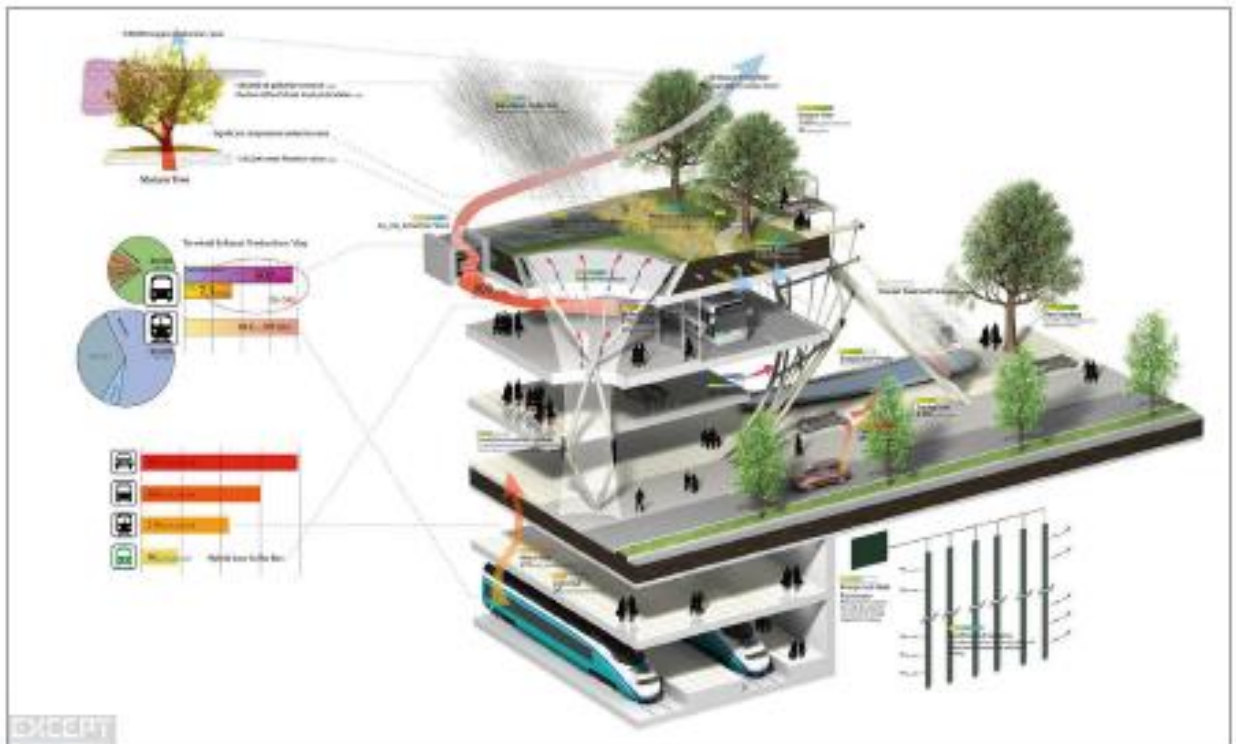


Figure 8 Schematic showing the sustainable design concept of the Transbay Center [16]

3 Discussion

Underground urbanism can contribute positively to the cities of the future if it is approached as part of the urban fabric. To do so, it needs to become part of urban and territorial planning. The biggest challenge urban planners face is that they must understand the urban metabolism, including the underground metabolism. In order to do so, interdisciplinary collaboration is required. It is, however, this collaboration that can give rise to new designs that embrace the opportunities underground space has to offer.

Embracing these opportunities requires doing away once and for all with the schizophrenia that exists between surface and subsurface. Rather than developing a segregated underground tissue, we must integrate surface and subsurface and so incorporate underground space into the urban fabric. In that way, it becomes a logical part of the city, enhancing its uses to the benefit of its citizens.

4 Conclusions

As we have seen, the impact of urban planning on the development of underground stations and transport hubs can be enormous. The absence of urban planning leads to a use of the subsurface that in the end can only result in chaos. By planning in the real sense of the word, the use of the subsurface can be developed in a way that not only creates synergy between the various uses, e.g. transportation and energy, but also ensures that underground space becomes visible and part of the urban metabolism. This is not a far-fetched vision, but a basic necessity as we must also acknowledge that life on the surface very much depends on the ecosystem services delivered by the subsurface.

If disciplines can come together across policy silos, this will result in projects that provide more than just a transport solution. Transformation, integration and synergy all aim at delivering cities that develop sustainably, are resilient, inclusive and above all liveable for their citizens. This notion equally applies to surface and subsurface development. The transportation hubs and stations of the future are required to be more than a means of getting on and off trains. They need to have a service role that goes beyond mass rapid transport.

Underground stations and transport hubs should enhance the urban fabric in a new way as shown by the cases we dis-

cussed. In the cities of the future, we must develop infrastructures that are multi-use, that contribute to the climate change challenge, and that provide benefits to the neighbourhoods they are situated in.

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