PUBLIC TRANSIT RAIL STATION DESIGN

CASE STUDIES IN EUROPE

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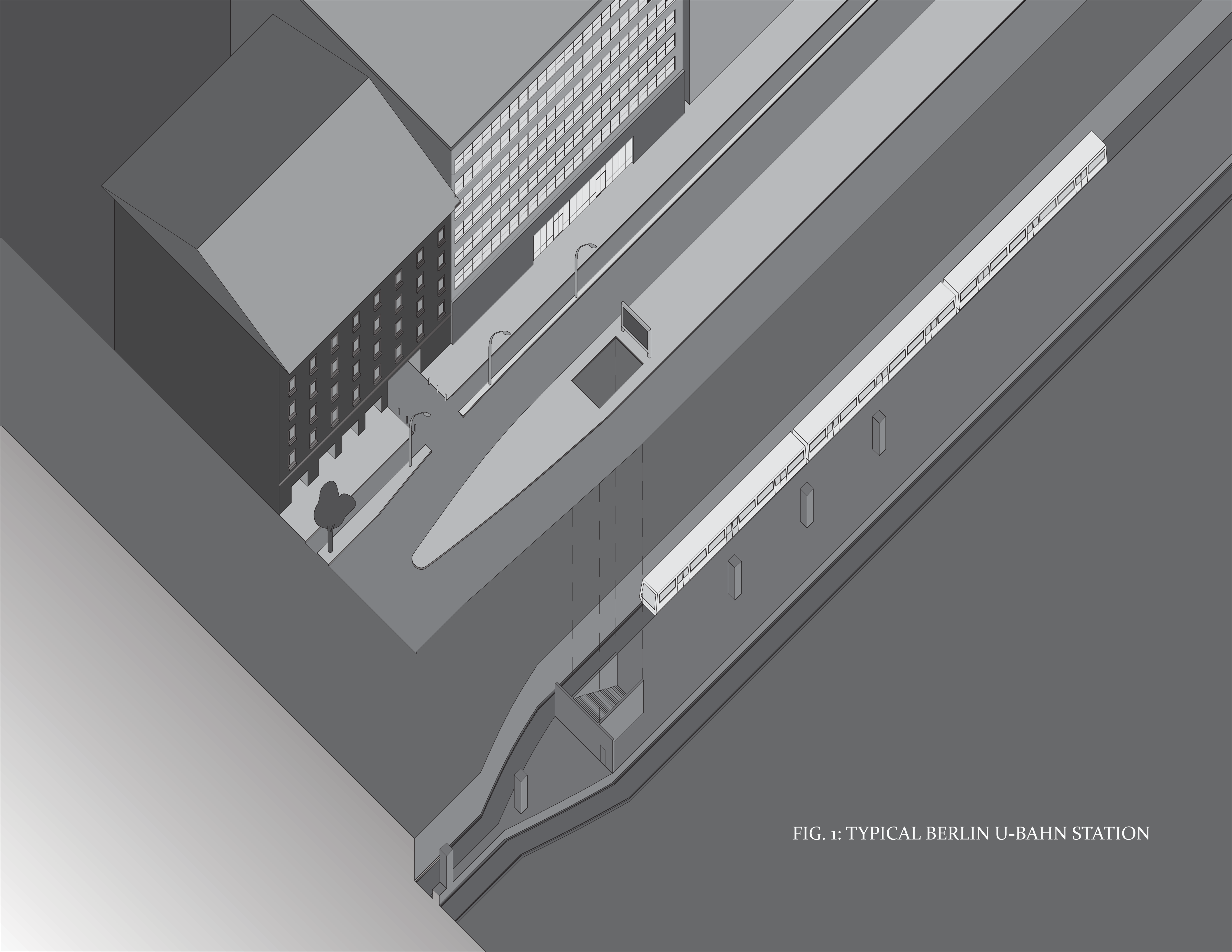


FIG. 1: TYPICAL BERLIN U-BAHN STATION

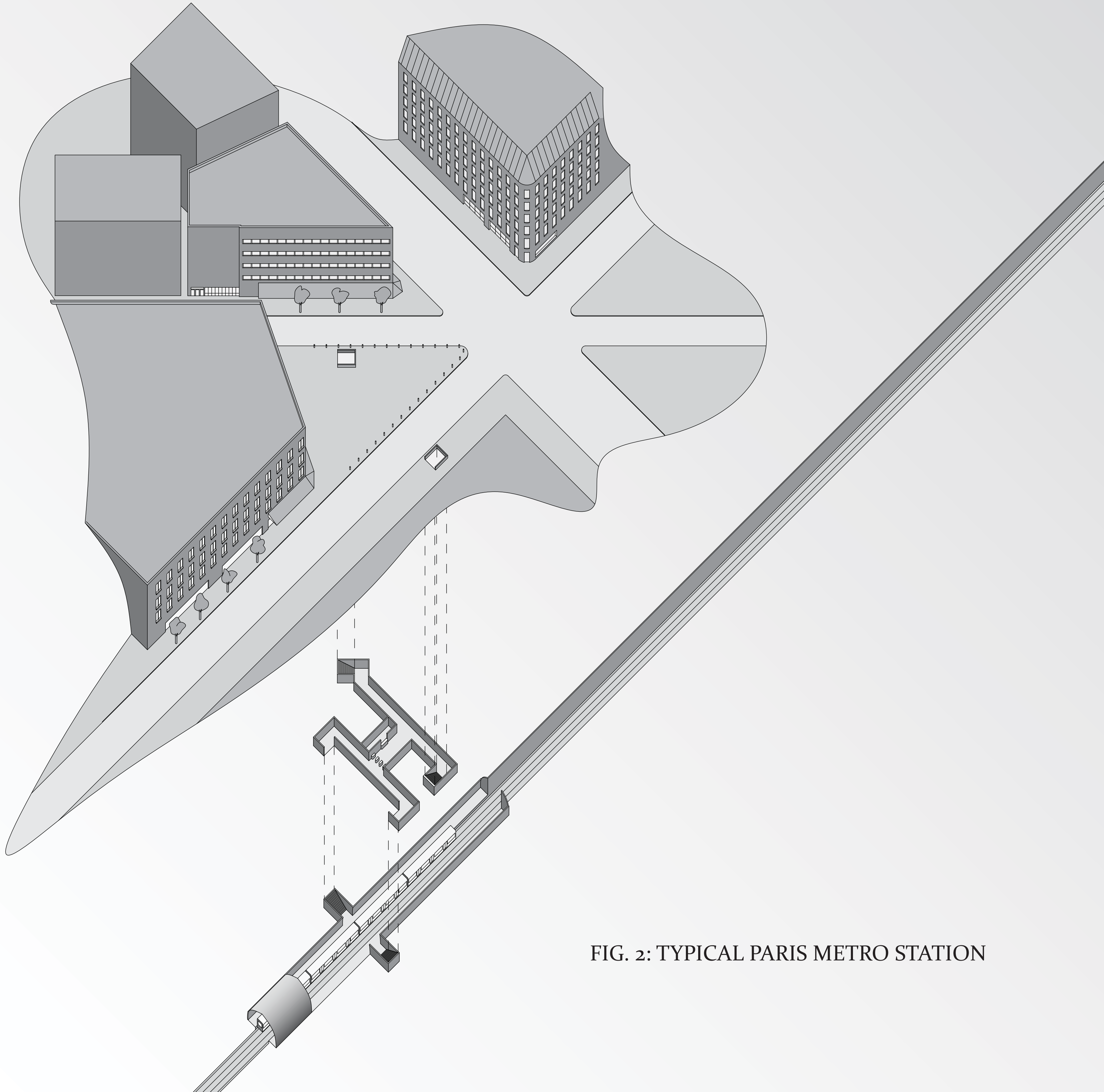


FIG. 2: TYPICAL PARIS METRO STATION

BASIC STATION FORMS

We can begin this investigation with a simple introduction to the two most basic forms of rail transit station. Diagram 1 shows a station where the rails pass between two platforms, as is common in Paris (Figure 2). This configuration has the advantage of simplifying the rail-laying process, as no extra turns are required for the track to pass the platform at an appropriate distance. This is at the expense of making the station itself more complex—there must be two separate access points with two separate circulatory paths to connect the station to the street. The station's overall width must also increase to accommodate extra circulation paths.

Diagram 2 shows the second basic type, where the platform is central between the two rail paths. The disadvantage to this setup is the extra complication in the railroad construction necessary to create space between the tracks for the platform. The advantage lies in a simpler layout for access points. Only one is necessary, and often only a single stair with no hallways is needed to bring passengers to the street—assuming the station can be located co-linear with a boulevard (as we see in the typical Berlin U-Bahn in Figure 1).

These two basic typologies cover nearly every variation of rail transit station, both excavated and elevated. At-grade stations can be accommodated by these models simply by ignoring the access points and vertical circulation, as the platform is already at the pedestrian's feet. (Pictured right, and following page.)

DIAGRAM 1

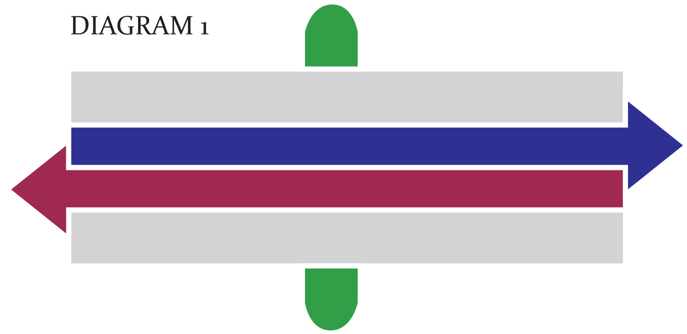


DIAGRAM 2

Elevated stops (above), street level tram stops (right, top right) and subterranean metro stops (below) all share the same flanking-platform morphology in Paris.

Veritcal circulation for an elevated station in the Paris metro.

An elevated Paris metro line crosses the Seine, sharing a bridge with street traffic.

STATION COMPLICATIONS

Of course a comprehensive transit system cannot operate without the ability to change lines. Without transfer nodes the system would not be an effective network, but rather mostly useless set of discrete paths. The plethora of possible transfer configurations have been distilled into three basic possibilities, diagrammed on this page.

The first is central platform transfer, in Diagram 3. By locating both platforms centrally, it is possible to use only one access point, and one vertical circulation path. However, this simplicity is at the cost of a complicated relationship with surface traffic. This configuration is not conducive to use with rail lines that are co-linear with surface streets, as the access point would have to be located in the center of an intersection.

The second, in Diagram 4, is where two rail lines with a two-platform layout cross each other. The obvious drawback to this situation is that it requires no less that four access points and vertical circulation paths. Its advantage is that perfectly mimics a common layout for surface street intersections, making it easy to integrate the access points into existing urban structure (one on each corner at a large intersection).

The third case is shown in Diagram 5 on the following page. In this case we have a hybrid station, where one line uses a central platform, and the other line uses flanking platforms. This case requires at least two access points and vertical circulation paths. This station is a compromise, needing more access points than Case One and being more difficult to locate than Case Two.

DIAGRAM 3

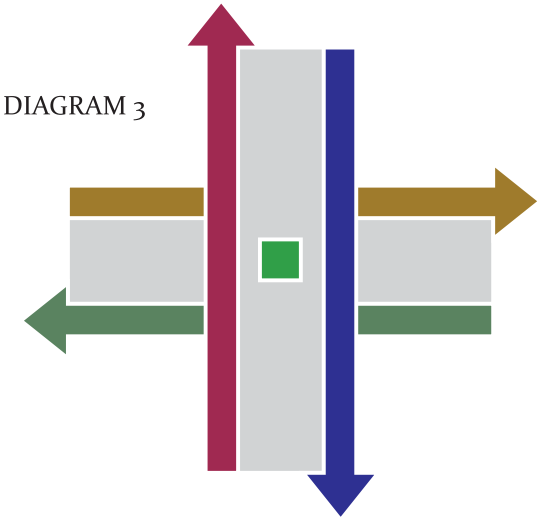
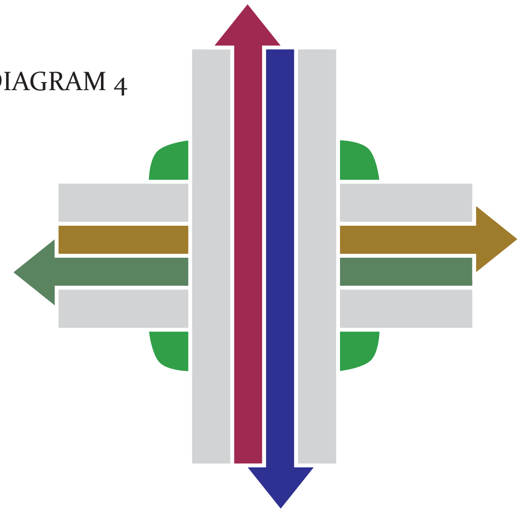


DIAGRAM 4



STATION COMPLICATIONS

Another issue to consider when discussing rail stations as transfer nodes is the sectional relationship between the rail lines. The mentioned cases assume a flat rail, where each rail line exists on a separate datum, and vertical movement is only possibly for passengers as they circulate that station. If we allow for the possibility of rail lines changing level, a slough of new station forms becomes available to the transportation planner.

There is an obvious advantage to this approach. In order for rail lines to cross each other without stoppage, a grade difference in necessary—one line must be higher than the other. To cross this grade difference, the passenger is usually required to make the effort of climbing or descending stairs. This is often aided by escalators and elevators, but instead of using these extra mechanical devices, we should be able to plan stations so that the trains themselves do most of the work required to move passengers vertically.

In some of the station types already mentioned, it is possible to change trains without using any vertical circulation: in any station with a central platform, one can easily switch to a train going the opposite direction on the same rail line. This is an uncommon activity. Shown in Diagrams 6 and 7 are ways to harness this property of the central platform to transfer passengers between lines.

Diagram 6 shows how two rail lines may approach each other, then make 90 degree turns passing a two-level central platform. Passengers wishing to make the turn can simply stay on the train. Passengers wishing to continue in the same direction can get off and cross the platform. Only passengers wishing to turn the opposite direction of their current train must use vertical circulation.

DIAGRAM 5

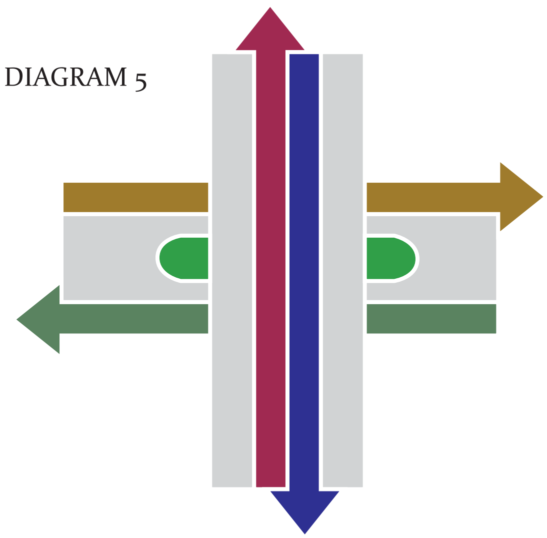
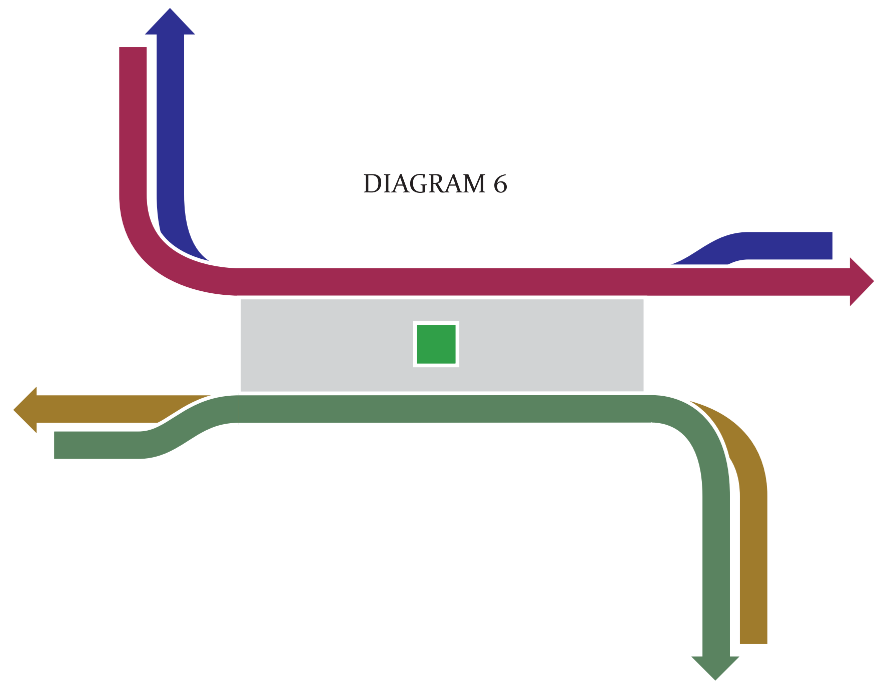


DIAGRAM 6



STATION COMPLICATIONS / CULTURAL EXPECTATIONS

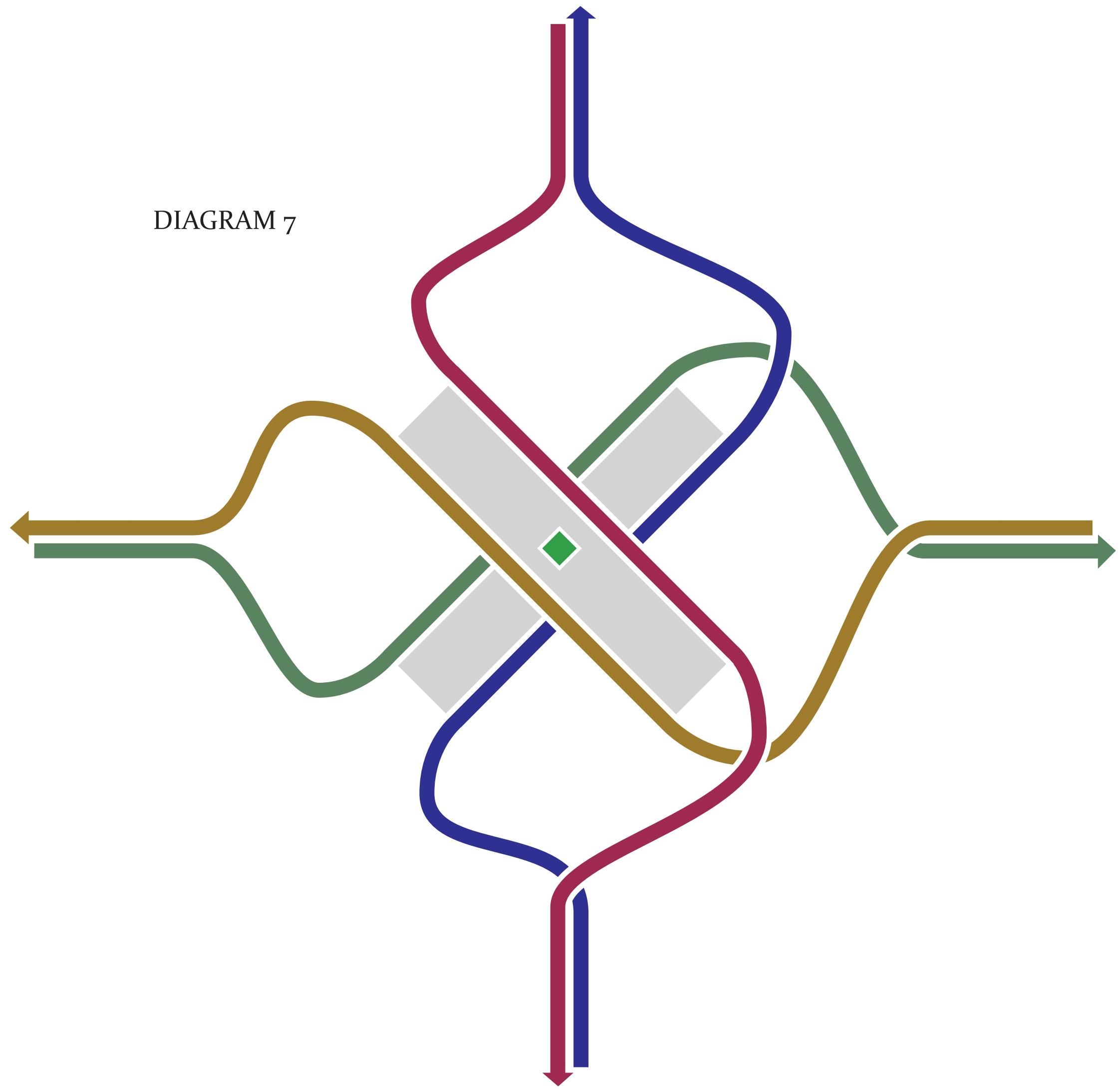
Diagram 7 shows a similar situation, except the rail lines continue through the station on their original trajectory. This makes the station a bit simpler for travelers, since they can continue straight through without changing trains, or make a "left turn" by crossing the platform. The "right turn" requires vertical circulation.

The downside to this arrangement, obviously, is the complexity of the track layout. The station has a large footprint, and tracks must cross each other in four different locations, unless the tradition of right-hand "drive" is eschewed.

This convoluted track layout may completely offset any advantage this station may provide in the way of decreased vertical movement of passengers. Passengers will be more likely to become confused by the layout, given the grotto-like construction of most stations—many passengers may fail to visualize the station layout correctly, and choose the wrong train. Continuous mass-confusion could easily offset any benefit, by increasing navigation errors and making the system less efficient.

When designing transit stations, it is more important to make the layout logical and simple to understand within the passenger's frame of reference. Our cultural background predisposes us to certain assumptions about the flow of traffic. For example, in America and continental Europe, it is generally accepted that traffic flows on the right. This is legislated for automobile traffic, but often carries over to behavior on the sidewalk, the grocery store aisle, et cetera.

DIAGRAM 7



CULTURAL EXPECTATIONS

If people have expectations about traffic flow in the grocery store, they certainly have expectations about traffic flow in public transit systems. Thus it makes sense for planners to mimic existing traffic patterns as closely as possible when designing station or network master plans.

Likewise, consistency within the system can also improve efficiency and ease of use. Most transit systems grow with their cities, built by many different designers over the course of decades. Complete homogeneity is thus rendered impossible. However, consistent circulation patterns are not such a lofty goal. Even in a system as complex and varied as Paris', there is still standard circulation pattern in the preponderance of stations. Newer stations have faster, more comfortable trains, escalators, elevators—all the modern conveniences. But they still use the flanking platform station layout almost universally—from elevated stations on M6, to tram stops on T3, to the oldest subterranean stations from the turn of the century.

Paris is not free of problems, though. Incongruity in the system causes issues when older lines are crossed by newer ones, and when lines encounter unusual terrain. Some stations appear as nodes on the system map, but in actuality are sprawling networks of underground tunnels completely dependent on signage to be navigable by pedestrians. Good examples of this are Saint Lazare and Montparnasse stations. At these stations, three or more lines come in close proximity of each other, but for whatever reason do not connect in a logical way. Further, the rail lines do not follow the layout of surface streets. This makes it nearly impossible to discern one's location upon first entrance, since the above-ground frame of reference that a traveler develops does not carry through to the underground system.

A good example of a station hindered by terrain is Abesses, where the tracks run underneath a hill, so deep underground that a spiral stair with at least ten flights is needed to connect the platforms to the street above. The station is retrofitted with elevators, but the way in which two platforms converge to a single exit is still quite confusing, even before walking in a circle ten times.

It may seem simple to learn these quirks. Anyone who travels on the Paris metro should habitually pick up the routes within a few weeks and stop making mistakes. But this may be more difficult than it appears. Psychological studies have shown that people are very sensitive to their frame of reference when performing spatial memory tasks. Mou and MacNamara* have done several experiments testing accuracy of spatial memory in consistent frames of reference versus variable ones. The experiments used a set of reference objects and target objects. Subjects asked to remember the locations and detect changes in the target objects performed better when the reference objects were arranged with consistent alignment. When the reference objects were placed haphazardly, subjects performed worse. There is no reason this notion cannot be applied to human behavior in traffic. Passengers will circulate faster in stations, and lose their way less often, if the internal frame of reference for the transit network matches, as closely as possible, the urban framework from which a pedestrian derives their frame of reference. This suggests that unusual station layouts hinder not only the passenger's ability to find a good route, but also their ability to remember it the next time around.

* *W. Mou et al. Congnition 108 (2008) 136-154* and *W. Mou et al. Journal of Experimental Psychology: Learning, Memory, and Cognition (2004) v.30 n.1 142-157.*

Further, a large percentage of transit customers in Paris are from out of town—while the native may know the route like the back of their hand, they will still be slowed by confused tourists blocking their path. Tourist access can be streamlined in other ways as well, from multi-language or symbolic signage, to fare structures that cater to short term visitors. This consideration is not confined to Paris, any city large enough support a sizeable public transit network will likely also support a significant tourism industry.

The essence of all these observations is that transit station design must be highly contextual, more so than most other categories of architecture. Context is extremely important not only in logistics planning, as we have already seen, but also in style. It is important to give passengers a strong sense of place so they can navigate through the system. This sense of place is strongly influenced by the construction and decoration of the space. For example, the Louvre station in Paris is decorated with museum exhibits integrated into the walls. This immediately cues passengers to their location, and more importantly gives them a hint of what to expect when they exit to the surface.

Stylistic context is not as important when designing at-grade or elevated stations. Since the passengers can just peek out the window to see where they are going, hints are not necessary. The concept of revealing the outside world to passengers on the train is important. It is the single easiest way to connect the system to the city in a logical, easy to understand manner. The entire system is visible from the cityscape, and the cityscape is visible from the system. Passengers on the S-Bahn, or the elevated lines in Paris, or the trams in Amsterdam all get a sense of the city as they travel through it—they can discern their location with landmarks, static points of reference. Try as we may to build underground systems with a consistent frame of reference, it is far easier to skip the translation and simply put the system above ground, inserted into the existing frame of reference.

A grand avenue in Paris is remiss not to have trains following its traffic pattern, either above or below.

CONCLUSIONS

Of course it is easy to speak in ideals, and to draw diagrams of ideal situations. When confronted with reality, however, some of these apparent axioms of transit station design will fall to the budget, or the building code, or the zoning regulations, or the peculiarities of the site. Cities are dynamic and layered, and nothing if not inconsistent. Further, the conclusions reached in this study would never have formed without the existence of countless mistakes to note and avoid. Good design cannot be applied retroactively, so any attempt to “fix” the transit network in a city is a decades-long proposition—and may do more harm than good.

This happens to be an apropos moment in history for this discussion. As we face a tightening of petroleum resources, the next thirty years will hopefully bring about a massive expansion of the rail-based public transit systems in the United States. We can take lessons from European systems, which by and large outdo ours, and avoid making the same mistakes.