CONGRESS FOR THE NEW URBANISM

Network Preamble: CNU Statement of Principles on Transportation Networks

Cities and their surrounding regions are the social, cultural, and economic drivers of human civilization. Of especial importance is the design and composition of transportation networks, which not only enable the movement of people and goods within and between cities and regions, but which provide the physical foundation on which human settlements are based.

While a great deal of attention is currently directed towards the design and operation of the individual components of a region’s transportation system, comparatively little attention is given to the design and development of the transportation networks which these facilities comprise. This has resulted in the creation of transportation systems that are fragmented, disconnected, and inefficient from a transportation perspective, and that do not effectively address the social, environmental, or economic aspirations of the communities they serve. The United States now has the world’s highest level of VMT per capita, while simultaneously experiencing the highest traffic fatality rates of any developed nation. Per capita traffic delay has more than doubled in the United States since 1982.3 This deterioration in transportation system performance has occurred in spite of an ongoing public investment of more than $200 billion per year in transportation infrastructure.

Network theory can also help identify effective alternatives to current US road design policy, which is commonly referred to as the Functional Classification System. The Functional Classification System, developed in the 20th Century, is focused on vehicle movement or throughput. Functional Classification ignores the complex purposes urban thoroughfares have served since the emergence of human settlement; namely that urban streets not only facilitate vehicle movement, but also provide the setting for valuable commerce and social interaction. Network design takes a more comprehensive view of how streets interact with each other and their surrounding context.

Given these trends, there is a clear need to rethink the design and operation of regional transportation infrastructure, moving beyond a focus on the individual components of the system, and towards a more comprehensive, network-level approach. A network-level approach to transportation planning and design recognizes that a transportation system's primary purpose is to connect people, places, and activities with each other and with the social and economic activities of the larger community and region, and that there are multiple strategies available to do so.

Attention to the design and configuration of transportation networks improves the transportation system in four key ways:

1. Enhancing Accessibility for Persons of All Ages and Abilities. Much of conventional transportation practice focuses on enhancing mobility, as measured in terms of either speed or travel delay, and which are embedded in contemporary level-of-service measures. While such measures are invaluable for addressing freight movement and interregional transport, they fail to address transportation needs within a metropolitan region, where destination accessibility – or the ability to quickly and conveniently access desired travel objectives – is what matters.

A network-level approach to transportation systems planning and design focuses on a transportation network's ability to enable travelers to access their destinations in a timely and efficient manner. Such a perspective recognizes that travel objectives may be accommodated using a variety of modes – including motor vehicles, transit, walking, and bicycling – and that such demands may be addressed through land use planning and community design.

A key concept in addressing intraregional accessibility is street network connectivity, or the connectedness of the street network. Street networks with higher levels of connectivity shorten trip distances by permitting more direct trip routing, making destinations more accessible by walking5 and increasing the capture area surrounding transit stations. Street networks with higher levels of connectivity have further been shown to reduce vehicle miles traveled, as well as reduced traffic congestion and vehicle delay by permitting traffic to diffuse across the larger street network, and by providing alternate routes to absorb excess demand on any individual route.

Beyond enhancing the performance and viability of each of the primary modes of travel, well-connected networks ensure that all persons – regardless of their age or driving ability – are able to independently accomplish their travel objectives in a safe and efficient manner, thereby providing a key means for addressing the challenges of addressing personal transportation in an aging society.

2. Addressing the challenges of global climate change.
The transportation sector is responsible for almost one-third of the carbon dioxide (C02) emissions in the United States.8 While improvements in fuel economy and clean emissions technologies may help offset the transportation-related production of C02, the design and configuration of community and regional transportation networks can aid in these goals by reducing vehicle miles traveled and encouraging shifts to cleaner modes of transportation, such as walking, bicycling, and transit.

3. Increasing Health and Safety.
The design of transportation networks can have a profound effect on health and safety. The design of transportation networks has a profound effect on physical inactivity and traffic fatalities, two of the leading causes of preventable death in the United States.10 In the case of physical activity, street networks designed and configured to support travel by active modes – such as walking and bicycling – have been shown to increase physical activity and to reduce the incidence of overweight and obesity.11 In the case of traffic safety, street networks can be designed and configured to moderate the behaviors that result in traffic crashes, thereby reducing the incidence of traffic-related death and injury.

4. Ensuring the Responsible Stewardship of Limited Fiscal Resources.
There is currently a crisis in transportation finance. While the gas tax has remained legislatively fixed since the early 1990s,13 increased global demand for transportation-related materials, such as concrete, steel, and asphalt, have caused construction and maintenance costs to skyrocket in recent years. The result is that many transportation agencies are hard pressed to fund basic system preservation and maintenance, let alone the construction of new capital facilities.

A focus on the design and configuration of transportation networks, rather than single-use facilities, can provide low-cost opportunities for enhancing transportation system performance. Well-connected street networks permit traffic to diffuse over larger geographic areas, dispersing traffic and providing alternate transportation routes that relieve congestion at bottleneck locations. Because street connectivity requirements can be incorporated as part of local development codes, the transportation benefits associated with increasing network connectivity can be realized at little or no cost to the public sector during the development review process.

Network Design Principles

Transportation networks can create great places and support high-quality living and working environments. Widely admired urban transportation networks throughout the world come in many configurations, but they share a number of design patterns and elements. These can serve as guiding principles for developing and modifying networks to improve their performance in providing transportation choices and supporting quality places.

Six essential principles for good urban transportation networks are:

- **A Network Supporting Places**: A network of urban streets should support urban places — and vice-versa
- **Diversity of Streets:** Networks should consist of a diverse set of urban street types serving diverse transportation modes and urban settings
- **Highly Connected Network**: Create street networks with abundant connections internally and to adjacent places.
- **Human Scale Network**: Create a dense pattern of streets, blocks and frequent intersections
- **Integration with Blocks and Buildings**: Neighborhood and city scale street networks must also integrate with a supportive context of blocks and building to create a truly pedestrian supportive environment
- **Links to Regional and National Networks:** Neighborhood and city scale street networks must link with regional and national scaled transportation systems, including streets, transit, rail, shipping, and airports.

These principles underlie the world's most successful urban street networks, including the medieval patterns of Prague and Florence, the organic networks of Boston and London, the planned grids of Washington, D.C., and Savannah, Georgia, and the simple interconnected streets of many classic streetcar suburbs. Given the wide variation in successful street network patterns, and the scales at which transportation networks must function, it is hard to be prescriptive about the form and configuration of the network. But these design principles provide the basis for developing existing and future transportation networks to be sound and sustainable.

A Network Supporting Place

The most important function of a good street network is that it forms an effective and flexible framework for building a community. The network should provide opportunities for bustling activity in mixed use urban cores as well as opportunities for quiet living in lower intensity neighborhoods, with a host of variations in between, along the urban transect. The network must be scaled and have urban design and transportation characteristics that complement and support the places it is linking together. This includes "Districts" which often have a primary use and an internal circulation pattern whether their purpose is government center, religious facility, university, hospital, military base, power plant, or airport. A few districts require —or even benefit from— limited or controlled access. Yet no district exists independently from the network; every district has an impact on the network that connects it with the wider community.

The streets in the network should be designed to accommodate this range of desirable and livable places. The design characteristics of each network segment should result from the intensity and character of activity along it, and its location in the region, community, and transect.

Diversity of Streets

Successful transportation networks are made up of all types of streets. These streets vary not only in vehicular traffic capacity and function, but also in the variety of travel modes they accommodate. Some streets should be designed to attract traffic of all types, including vehicles, transit, bicycles, and pedestrians, while others should be designed to be quiet and only see the occasional vehicle or pedestrian. This range is achieved by having variations both in the design of the network and the design of the streets themselves. However, all streets in an urban network should have an urban character that caters to the pedestrian and accommodates urban land use patterns and their change over time.

According to the Lexicon of the New Urbanism, acceptable street types in a good urban street network include: Boulevards, Avenues, Streets, Drives, Alleys, Lanes, Mews, Passages and Paths[1]. These streets are listed roughly in order of decrease in the desirable traffic volume. The volume that is desirable will also depend upon the context of the street. For instance, an avenue in an urban core likely should be congested with the high-levels of activity there, while an avenue through a single family neighborhood may be best designed for lower traffic volumes. These streets should vary in cross-section design, with boulevards occupying

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[1] The Sustainable Network recognizes the existence and current function of freeways and expressways, and this is discussed as part of the Link with Regional and National Scaled Transportation Systems

the widest right of way with multiple traffic lanes, medians and wide sidewalks, and paths typically being the narrowest consisting of a walk, landscape, and other hardscape.

However, these streets should also vary in terms of their configuration in the network. The configuration of street networks should support speed management goals across the entire range of the street types. The network's configuration should balance the need for continuous routes and connectivity for all modes of travel with the need to self-reinforce vehicle speeds through use of strategies such as T-intersections, sinuous street alignments, and narrow street cross sections and lanes.

Boulevards and Avenues should be designed to connect multiple neighborhoods and, as such, should be continuous across large sections of a city, with relatively little break in continuity. Streets and Drives should generally be less continuous than Boulevards and Avenues, in order to control speeds and traffic volumes. This lesser continuity can be achieved by a number of design variations in the network pattern including the use of t-intersections for terminating a street segment, the use of offset intersections, or incorporating kinks or deflection in the alignment. Examples, of such variations are illustrated in the figures below, which show street networks in Savannah, Georgia and Prenzlauerberg, Berlin, Germany .

A network should offer its users a choice among a range of ways to travel, including walking, bicycling, riding transit, and driving or riding in an auto. Like with the range of street types, appropriate transportation modes vary depending on the scale and character of the community being served. Each of these modes should be integrated, as appropriate, within each street. Different transportation modes have different relationships with specific street types.

A complete transportation network also offers a choice of route and of the environment within which to travel. For instance, some may be enticed to ride a bicycle if they can take direct routes to their destinations, while others will only consider this mode of transportation if the route traverses through calm residential neighborhoods or park-like settings, even at the cost of a longer travel time.

Transit in the network should largely be confined to Boulevards and Avenues and to a lesser extent Streets and Drives, while in denser areas subways can be appropriate and regional transit may have dedicated right-of-way. Alleys and Lanes generally provide service access to buildings and are even less continuous than Streets and Drives, but the same design variations are used to achieve their lower level of continuity. Mews do not have through traffic and are designed to have the least amount of traffic in the network. Passages and Paths are designed for non-motorized travel only.

Highly Connected Network

Good street networks are highly connected. The amount and types of connections in the street network are key factors in determining both how the community functions and the character of the individual streets themselves. A high level of connectivity provides an efficient method for dispersing traffic, facilitating route choice and creating more comfortable conditions for travel by foot, bike or transit.

Connectivity can be measured in a number of ways. At a basic level, most streets in a good street network should connect to other streets at both of their ends. Other, more technical measures help us understand the level of a network's connectivity. The *link to node ratio,* for example, is the ratio of the number of street segments to the number of intersections. Generally a link to node ratio of 1.4 or greater is considered to indicate a well-connected network.

However, it is not just the number of connections that are important to the function of the network but also the patterns and type of these connections. Good networks should connect all types of streets to one another. One flaw of contemporary network practice is a strict hierarchy where arterials only connect to collectors and, in turn, local streets typically only connect to collectors. These restrictions create highly specialized streets facilitating high volumes and high speeds on the arterial system and correspondingly low volumes (but not necessarily low speeds) on the local streets. In good urban networks, however, connections are allowed between Boulevards and Mews, and between Avenues and Alleys, and between all other possible combinations. The results are individual streets that are less specialized, with generally lower speed, but a network that is much more efficient.

Streets designed to carry higher volumes of motorized traffic and transit, such as Boulevards and Avenues, should be spaced properly. Spacing these large streets too far apart often forces them to contain too many lanes, thus decreasing their pedestrian and bicycle accommodation and severely eroding their place-making capacity. Inadequate spacing may also cause motorized traffic to encroach on Drives and Streets designed to serve only lighter traffic volumes associated with neighborhoods and districts. Where transit lines are closely aligned with Boulevards and Avenues, the spacing of these streets will also affect the efficiency and accessibility of transit service.

The pattern of connections is also important in determining whether or not a city functions as a coherent whole or as a collection of islands bridged by a few streets. In order to achieve a coherent citywide pattern, a full range of connections should be made not just within a given neighborhood, but also between surrounding neighborhoods and mixed use employment and shopping districts.

Human Scale Network

Good street networks need to be attractive, comfortable and convenient to pedestrians, bicyclists, and transit riders and serve as a good template for development. A fine grain of pathways and connections in the network can achieve this goal; particularly if the streets that make up the network are human scaled in their urban design. American street networks typically range from as little as 60 (one example is the street network in downtown Salt Lake City) to more than 500 intersections per square mile (such as the network in downtown Portland, Oregon). Smaller blocks (or more intersections per square mile) are typically much more comfortable for pedestrians, providing more direct paths to destinations and generally creating a more human scale environment. There is a growing body of research showing that in places with a more fine-grained network more people walk, bike and use transit. This research has also shown that these more human scale networks are much safer for all users of the road. In particular, accident severity is drastically reduced, suggesting that such fine-grained networks promote lower vehicular speeds. On the basis of the available evidence, it is recommended that street networks should be as fine grained as practicable but at least 200 intersections per square miles.

Integrate the Network with the Context of Blocks and Buildings

Streets in a successful transportation network must also relate to their surrounding urban context of blocks and buildings. The previous principle begins to integrate the land use context of cities with the street network by defining a human-scaled pattern of blocks. This process of integration is taken further with the relating of the blocks themselves to the street network.

There is a reciprocal relationship between the block and its network: each informs the other and, together, blocks and their network create a viable pattern that links place to place. A mutually supportive relationship between the street and its context is necessary for a high-performing street network.

This relationship must balance mobility and access, or “travel along the network” and “arriving/leaving a place.” This relationship also helps create places. Integrating the buildings and open spaces within the blocks with the adjacent streets provides a public and interactive face to the street. The urban network cannot achieve its full potential for place-making and providing for transportation choice without this relationship with the uses along the street. The design of the public realm of streets, primarily the sidewalk and landscaped “public realm” adjacent to the roadway must in turn be supportive of the uses and activities within the block.

Link with Regional and National Scaled Transportation Systems

A high-performing street network also needs to be well connected with the transportation systems that link it to the surrounding region, the state, nation, and the rest of the globe. These connections, via rail, ship, and air, are necessary to provide longer-range social and economic connections enabling a vibrant and sustainable economic and social community. Our society has long been over-dependent on freeways for longer distance truck and auto transport, and also overly reliant on air travel for connections to relatively nearby cities. A successful and sustainable larger scaled transportation network needs further investment in more sustainable rail technologies. The careful integration of these systems into downtowns, cities, and the countryside is an important new challenge to address.

At these larger scales it is also important that land use patterns and the regional transportation network are coordinated so that centers of mixed use employment and commercial activity are well connected with each other and with the surrounding context of neighborhoods, districts, and smaller centers. This requires the proper spacing of regional transportation facilities and the availability of appropriate transportation choices. The combination of all these travel choices and linkages across all scales create the full range of opportunities to improve the experience of travel, reduce vehicle miles traveled, and reduce greenhouse gas emissions.

Conclusion

These Network Design Principles, related to the full range of scales of the Charter for the New Urbanism, are a starting point for defining a street and broader transportation network that is a necessary framework for a sustainable future.

The Portland Transportation Summit provides the opportunity to work together to refine these principles and expand this conclusion to set a course for further development of the practices, policies, and evaluation tools and methods for creating a more sustainable network.