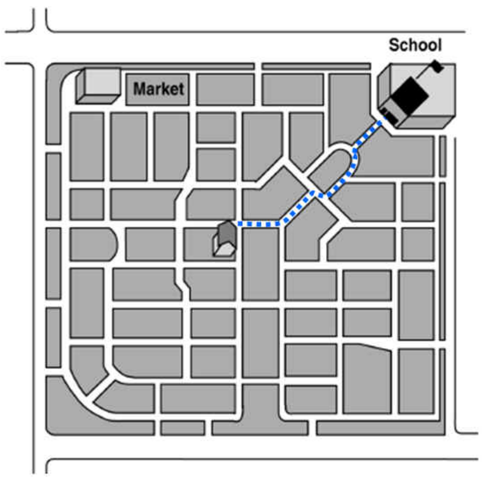
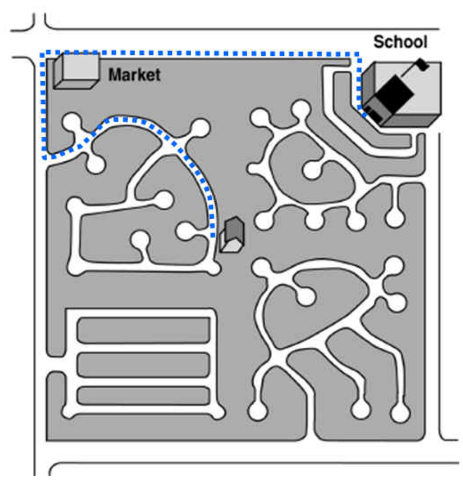
Street Connectivity
Zoning and Subdivision Model Ordinance





Prepared by
Division of Planning
Kentucky Transportation Cabinet

March 2009

Street Connectivity
Zoning and Subdivision Model Ordinance

Background & Purpose

The term "street connectivity" suggests a system of streets with multiple routes and connections serving the same origins and destinations. Connectivity not only relates to the number of intersections along a segment of street, but how an entire area is connected by the transportation system. A well-designed, highly-connected network helps reduce the volume of traffic and traffic delays on major streets (arterials and major collectors), and ultimately improves livability in communities by providing parallel routes and alternative route choices. By increasing the number of street connections or local street intersections in communities, bicycle and pedestrian travel also is enhanced A well-planned, connected network of collector roadways allows a transit system to operate more efficiently.

Over the last forty to fifty years, residential and non-residential development patterns have been created that lack internal vehicular and pedestrian connectivity. The lack of connectivity has created a physical environment that lacks mobility options and pedestrian friendly features. Development trends during the 1960s and '70s encouraged building residential communities with few street connections and numerous cul-de-sacs. It was assumed that communities built with this type of street design had less traffic and fewer traffic delays on neighborhood streets. A recent Metro Portland study found these assumptions to be false. Residential subdivisions that are dominated by cul-de-sacs provide discontinuous street networks, reduces the number of sidewalks, provides few alternate travel routes and forces all trips onto a limited number of arterial roads.

Figure 1 illustrates a more traditional, interconnected development pattern compared to a disconnected, development pattern of the late 20th century.

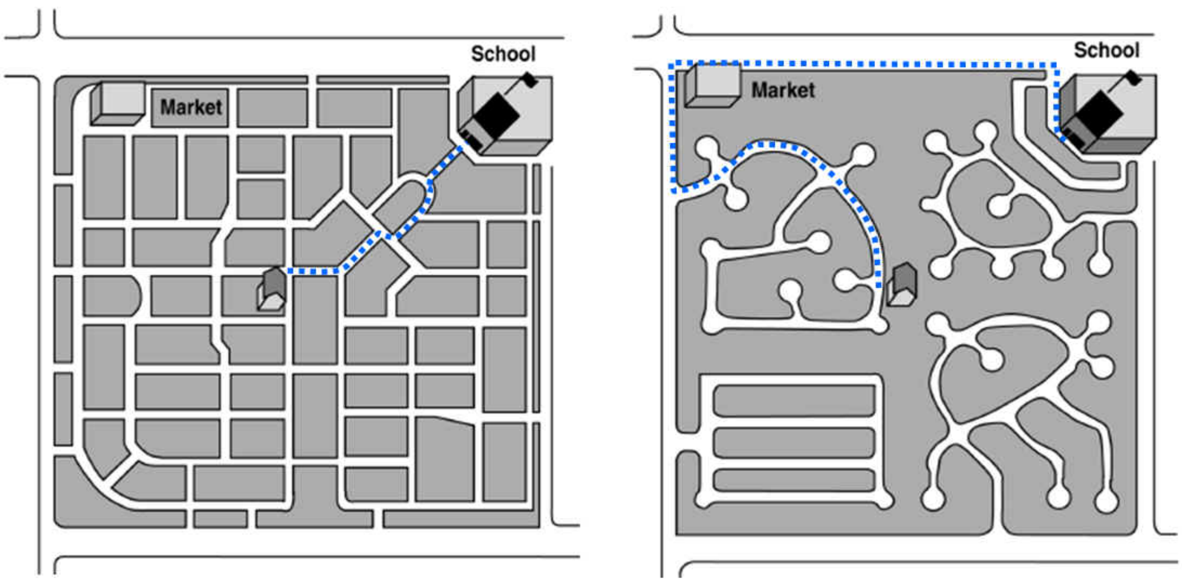


Figure 1: Shorter trip distance with connected network

The blue, dashed line represents the travel path a vehicle or pedestrian would have to take from home to school under the two different configurations. The path in the second scenario is two and a half times the length and requires travel on the major streets.

Local street connectivity provides for both intra- and inter-neighborhood connections to knit developments together, rather than forming barriers between them. The street configuration within each parcel must contribute to the street system of the neighborhood.

Research has shown that high roadway connectivity can result in:

- Reduction in travel distance (VMT) for drivers
- Reduction in travel times for drivers;
- Better and redundant emergency vehicle access;
- More efficient public services access (mail, garbage, transit)
- Improved bicycle and pedestrian routes and accessibility.
- Higher percentage mode share for transit, bicycling an walking
- Safer roads

A 2008 study of California cities compared “safe” road networks (fatal/severe rates less than 1/3 state average) to “less safe” networks (fatal/severe crash rates close to the state average). The results, shown in Table 1, demonstrate that with a higher intersection density i.e., higher connectivity, mode share for transit and non-motorized modes is higher while the fatality rate due to automobile crashes is much lower.

	Less safe	Safe
Average intersection density (#/square mile)	63	106
Walking/bicycling/transit mode share (%)	4	16
Fatality rate per 100,000 population	10.5	3.2

Table 1

In addition to the following connectivity ordinance, it is recommended that cities and counties plan their transportation network to have an acceptable roadway (arterials, collectors and sub-collectors) network density. It is recommended that through streets be spaced no more than ½ mile apart, although spacing of sub-collectors (through-streets that feed collectors typically with volumes less than 500 vehicles per day) at ¼ mile spacing is even better (Figure 2). Lower densities result in a higher strain on the existing highway system, often resulting in needed capacity improvements and inefficient operations.

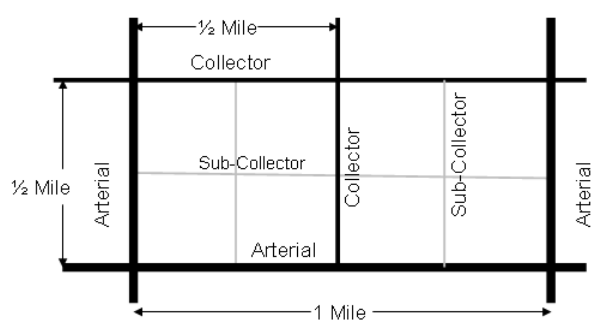


Figure 2: Arterial & collector road density

Connectivity Model Ordinance

The following model ordinance may be adopted in whole or amended to fit local conditions by a planning commission or local government. It consists of two primary components: the internal and external connectivity requirements. Both are critical to ensuring an efficient roadway system.

Purpose

The *[elected body]* hereby finds and determines that an interconnected street system is necessary in order to protect the public health, safety, and welfare in order to ensure that streets will function in an interdependent manner, to provide adequate access for emergency and service vehicles, to connect neighborhoods, to promote walking and biking, to reduce miles of travel that result in lower air emissions and wear on the roadway, and to provide continuous and comprehensible traffic routes.

General Standards

1. A proposed development shall provide multiple direct connections in its local street system to and between local destinations, such as parks, schools, and shopping, without requiring the use of arterial streets.

2. Each development shall incorporate and continue all collector or local streets stubbed to the boundary of the development plan by previously approved but unbuilt development or existing development.

Connectivity Index (Internal)

1. To provide adequate internal connectivity within a subdivision or planned development, the street network shall have a minimum connectivity index of *[1.40]*. The desired minimum connectivity index is *[1.60]*. The connectivity index is defined as the number of street links divided by the number of nodes and link ends (including cul-de-sacs and sharp curves with 15 mph design speed or lower).

Commentary: The higher the connectivity index, the more connected the road network. A connectivity index of 1.40 is a reasonable standard to ensure a connected roadway network; however, there are some cities that require a smaller index, sometimes as low as 1.20. Figures 3 and 4 demonstrate how to calculate the connectivity index.

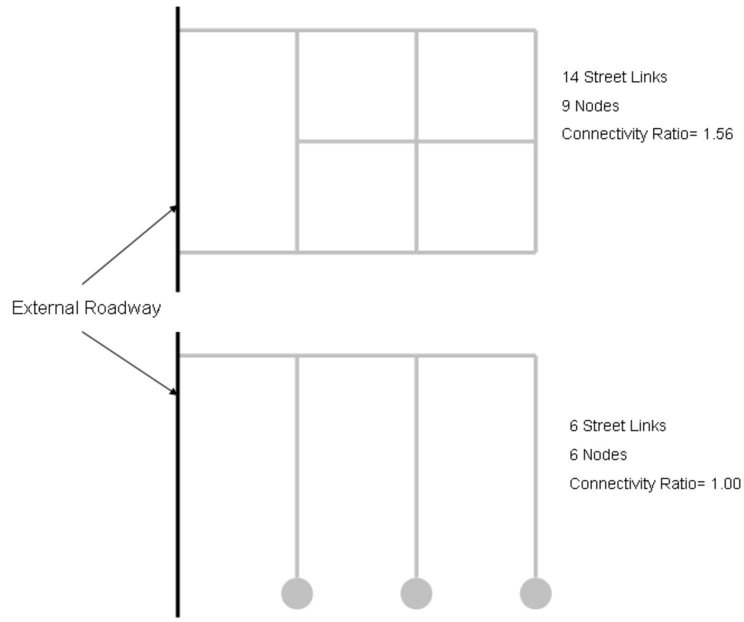


Figure 3: Example Connectivity Index Calculation

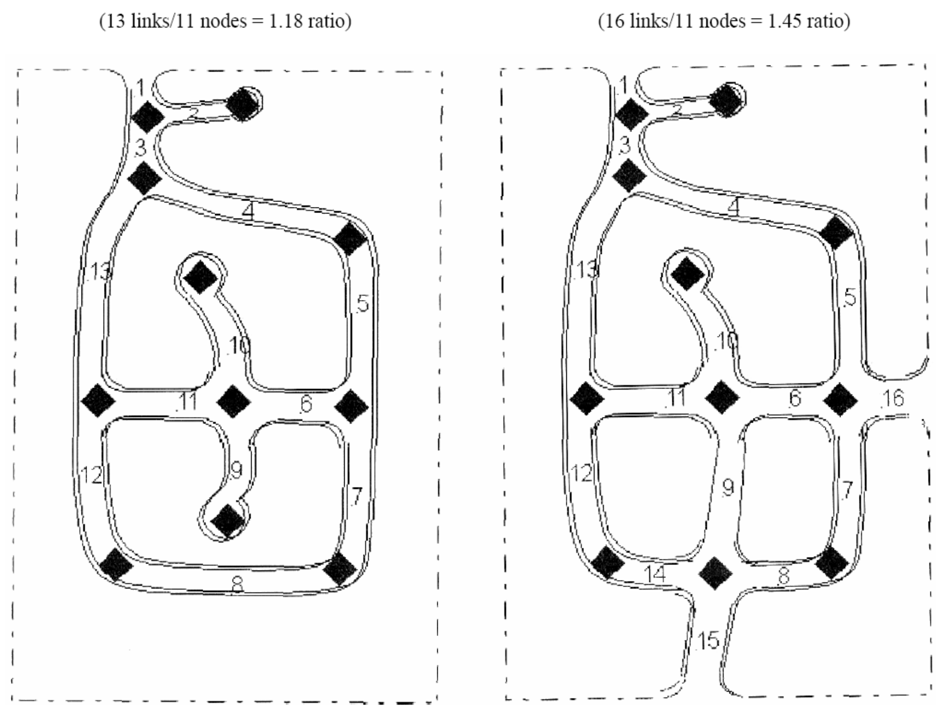


Figure 4: Example Connectivity Index Calculation

2. A link is defined as a segment of road between two intersections or from an intersection to a cul-de-sac/stub-out. This includes road segments leading from the adjoining highway network or adjacent development.
3. Nodes are defined as intersections and cul-de-sacs. They do not include the end of a stub-out at the property line or intersection with the adjoining highway network.
4. No dead-end streets shall be permitted except in cases where such streets are designed to connect with future streets on abutting land, in which case a temporary turnaround easement at the end of the street with a diameter of at least *[one hundred (100)]* feet must be dedicated and constructed.
5. Cul-de-sacs shall only be permitted if they are:
    a. less than *[four hundred (400)]* feet in length (See Figure 5 on how to measure cul-de-sac length.) or
    b. less than *[six hundred sixty (660)]* feet in length and have a pedestrian connection from the end of the cul-de-sac to another street. (See Figure 6.)

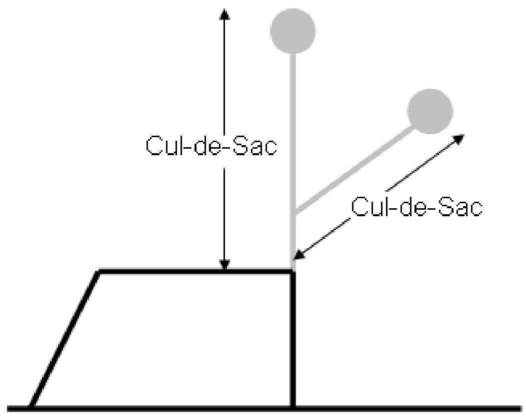


Figure 5: Measuring cul-de-sac length

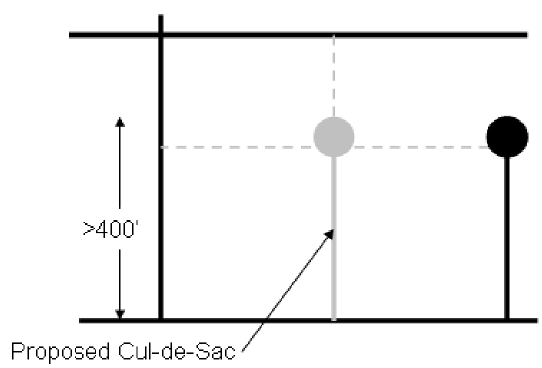


Figure 6: Providing pedestrian connections from cul-de-sac

Connectivity (External)

1. To ensure future street connections where a proposed development abuts unplatted land or a future development phase of the same development, street stubs shall be provided to provide access to all abutting properties or to logically extend the street system into the surrounding area. All street stubs shall be provided with temporary turn-around or cul-de-sacs and the restoration and extension of the street shall be the responsibility of any future developer of the abutting land.

Commentary: A street stub may either be a local road, collector, or frontage road. The planning director and developer should take into account the purpose of each stub and future traffic patterns that may exist once adjacent land develop occurs and a street connection is made. Cut-through traffic and speeding on local residential streets should be discouraged through proper location and inclusion of traffic calming measures. In contrast, collectors and frontage roads should have logical, direct routes that make cross parcel driving possible. This may include a road that traverses the land from one property line to the opposite property line.

2. Streets within and contiguous to the subdivision shall be coordinated with other existing or planned streets within the general area as to location, widths, grades, and drainage. Such streets with shall be aligned and coordinated with existing or planned streets in existing or future adjacent or contiguous to adjacent subdivisions. All streets, alleys, and pedestrian pathways in any subdivision or site plan shall connect to other streets and to existing and projected streets outside the proposed subdivision or other development.

3. Street connections shall be spaced at intervals not to exceed *[six hundred sixty (660)]* feet (1/8 mile) along each boundary that abuts potentially developable or redevelopable land. Blocks longer than *[four hundred (400)]* feet in length shall have a mid-block pedestrian pathway connecting adjacent blocks. See Figure 7.

Commentary: Minimizing the block length of local streets allows better access for pedestrians, bicyclists and automobiles. The number may be changed to lower than 660 feet. The appropriate length may be determined based from a typical block length based on historical precedence in the area. It is common for American cities to have block lengths between 200 and 400 feet.

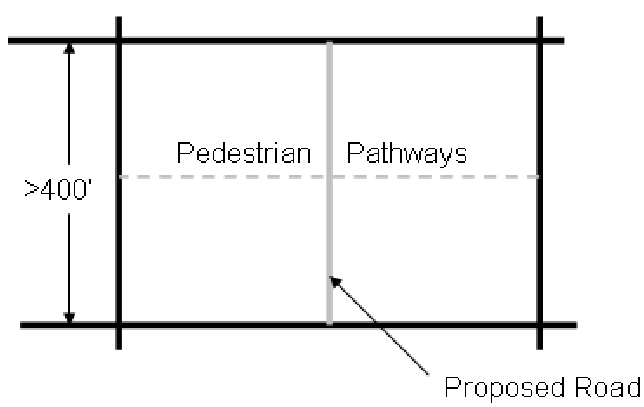


Figure 7: Mid-block pedestrian pathways

4. The *[City Engineer*] may require any limited movement collector or local street intersections to include an access control median or other acceptable access control device. The *[City Engineer]* may also allow limited movement intersection to be initially constructed to allow full movement access.

Commentary: Local and state access management regulations will regulate the minimum spacing and design. Full intersection access on an arterial should be between ¼ and ½ mile. Partial intersection access, controlled by a median, may be at shorter distances. More frequent access improves overall roadway connectivity but may impact the operations on an arterial roadway.

5. Gated street entryways into residential developments shall be prohibited.

References

1. Street Connectivity: An Evaluation of Case Studies in the Portland Region, Metro Regional Government, June, 2004.
2. Best Development Practices: Doing the Right Thing and Making Money at the Same Time, Florida Department of Community Affairs, May 1995.
3. Pedestrian and Transit Friendly Design, Florida Department of Transportation, March 1996.
4. Model Street Connectivity Standards Ordinance, Washington Department of Transportation , 2006.
5. Unified Development Ordinance, Section 31-612, Street Improvement Standards, City of Suffolk, Virginia. (from website August 2008)
6. Unified Development Ordinance, Section 10-1, Street Improvement Standards, City of Kannapolis, North Carolina. (from website August 2008)
7. Fort Collins, Colorado, Land Use Code, Division 3.6, Transportation and Circulation. (from website August 2008; last changes to regs in 2006)
8. Connectivity, Safe Routes to Schools Guide, Pedestrian and Bicycle Information Center (from website August 2008).
9. Street Network Types and Road Safety: A Study of 24 California Cities, Wesley E. Marshall and Norman Garrick, University of Connecticut, 2008

This Page Intentionally Left Blank