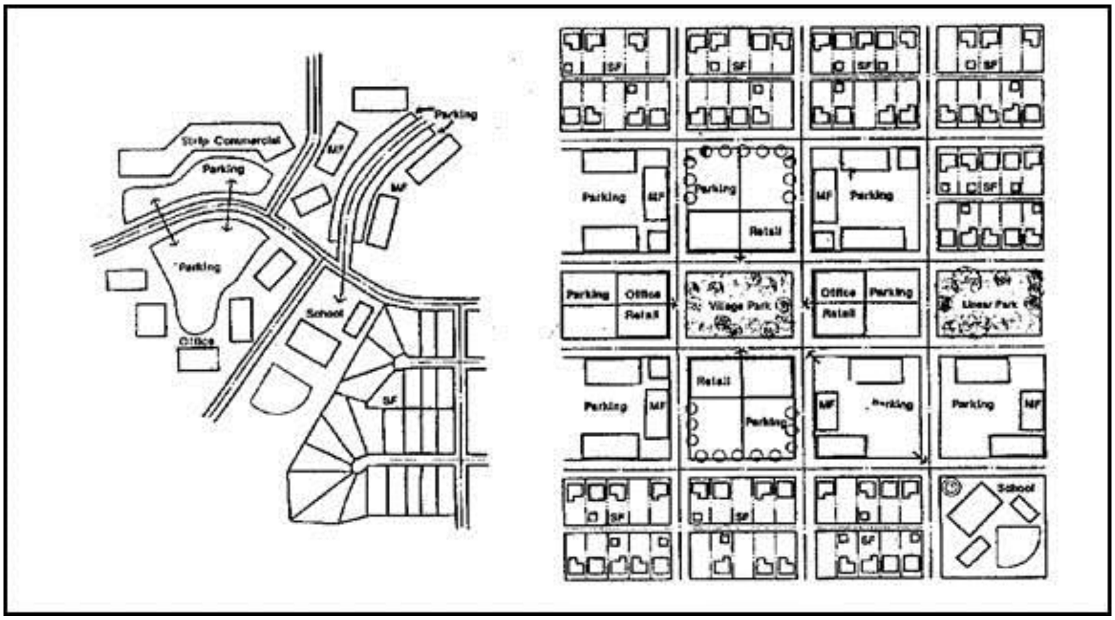
Zoning Module 4 - Connectivity Standards

What is Connectivity

Connectivity refers to the density of connections in path or road network and the directness of links. A well-connected road or path network has many short links, numerous intersections, and minimal dead-ends (cul-de-sacs). As connectivity increases, travel distances decrease and route options increase, allowing more direct travel between destinations, creating a more Accessible and Resilient system. Connected networks reduce congestion and improve safety. They reduce daily miles of vehicular travel per household and improve emergency response times. Connectivity can apply both internally (streets within a particular area) and externally (connections with arterials and other neighborhoods).



A **connected** roadway systems (right above) emphasizes *accessibility* with direct travel and traffic dispersed over more roads. A **hierarchical** road network (left above) emphasizes *mobility* concentrating most traffic on fewer roads. This increases the distance to reach destinations and creates barriers to non-motorized travel. Relative connectivity is an important predictor of the choice to walk. Pedestrian trips are 18% higher in areas where paths are relatively more direct to nearby retail and recreational destinations on foot than by car. Most areas can achieve higher connectivity with relatively simple improvements such as requiring connected network design in new developments, and retrofitting micro paths or other connections. Special circumstances such as rivers and interstate highways may require special bridges, walkways on major roads crossings and Pedways to improve connectivity.

Increasing roadway connectivity must overcome a preference for residential cul-de-sacs, popular because they have limited traffic volumes and speeds, and contribute to a perception of community security. Connected residential streets can have these attributes if designed with short blocks, narrower widths and other traffic calming features to control vehicle traffic speeds and volumes, and community design features to promote a sense of community and security. Another objection to connected street networks is the need for more land for right-of-way, this can be offset by reducing local street widths and the demand for wider arterials.

Connectivity Measurements to Consider

Below is a choice of measurements to quantify how well a roadway network connects to destinations. These can be measured separately for motorized and non-motorized travel, taking into account non-motorized shortcuts, such as paths that connect cul-de-sacs, and barriers such highways and roads that lack sidewalks and safe crossings. Several different methods can be used together and it is often helpful to use more than one method, as some work better than others for particular conditions.

1. The number of roadway links divided by the number of roadway nodes (Ewing, 1996). Links are the segments between intersections, node the intersections themselves. Cul-de-sac heads count the same as any other link end point. A higher index means increased route choice and more direct connections for access. A simple box is scored a 1.0. A four-square grid scores a 1.33 while a nine-square scores a 1.5. Dead end and cul-de-sac streets reduce the index value. This sort of connectivity is particularly important for non-motorized accessibility. A score of 1.4 is the minimum needed for a walkable community.
2. The ratio of intersections: Divide intersections by dead-ends, expressed on scale from 0.0 to 1.0 (USEPA, 2002). An index over 0.75 is desirable.
3. An average measurement of the length of block faces in a development. A very connected system has block lengths of 200-400 feet. This measurement should also identify the maximum block length allowed.
4. The number of surface street intersections within a given area, such as a square mile. The more intersections, the greater the degree of connectivity.

Comment: *In a study done in California, cities with an average of 106 intersections per square mile had 1/3 of the number of traffic fatalities (3.2 per 100,000 residents) as areas with 63 intersections per square mile (10.6 per 100,000 residents). A perfect grid of 300-400 foot blocks extended over a full square mile of will have 175 to 250 intersections.*

5. An Accessibility Index divides direct travel distances by actual travel distances. A WPDI of 1.0 is the best possible rating, indicating that pedestrians can walk directly to a destination. An average value of 1.5 is considered acceptable. You can also develop a standard for number of dwelling units with a walk distance of ¼ mile and ½ mile of destinations (i.e. schools or village centers) Aiming for 50% and 25%
6. The percentage of parcels that would be rendered in accessible by the failure of any one link in the system. This needs to be measured for all links. If more than 10% of parcels are inaccessible with the failure of one link the connectivity is considered failed. This measurement can be particularly important to emergency responders.

Comment: *These measurements are affected by how each area is defined, such as whether parklands and industrial areas are included in analysis. It is therefore important to use professional judgment in addition to quantitative measurements when evaluating connectivity.*

Using the Standards

Connectivity can be increased during roadway and pathway planning when subdivisions are designed, by adopting street connectivity standards or goals, by requiring alleyways and mid-block pedestrian shortcuts, by constructing new roads and paths connecting destinations, by using shorter streets and smaller blocks, and by applying traffic calming strategies. Typical street connectivity standards or goals that should be included in your policies and regulations are listed below. Standards should be flexible

- Average intersection spacing for local streets to be 200-400 feet.
- Limit maximum intersection spacing for local streets to about 600 feet.
- Limit maximum intersection spacing for arterial streets to about 1,000 feet, require mid-block pedestrian connections no farther than 500 feet apart.
- Limit maximum spacing between pedestrian/bicycle connections to 350 feet in local networks (create mid-block paths if needed).
- Reduce street pavement widths to 24-34 feet.
- Limit maximum block size to 5-12 acres.
- Limit or discourage cul-de-sacs (for example, only if topography demands, or to a small % (>20%) of streets). Require pathway connections where cul-de-sacs are allowed.
- Limit the maximum length of cul-de-sacs to 200 or 400 feet.
- Limit or discourage gated communities and other restricted access roads.
- Require multiple access connections between a development and arterial streets.
- Require minimum connectivity measures, or reward developments with high connectivity through incentives.
- Require permanent pedestrian and cycling connections, and sometime connections for transit and emergency vehicles, where connections must be closed to general traffic.
- In your planning process require street "stubs," to connect into future developments.
- Require Pedways – These are networks in major commercial areas, such as a shopping center, that connect buildings, parking and transportation hubs via sidewalks or walkways.

Comment: *These standards reflect best practices. Adapt them to existing conditions in your community; for instance, if the historic street grid in your community has block lengths of 450 feet that would be the appropriate standard for your community. Allow for exceptions, but identify criteria and findings for when exceptions are appropriate and require a governing board to rule on them rather than making them administrative. Connectivity is rarely perfect, but you will get closer to that perfection applying these standards consistently with few exceptions.*

Examples of Street Connectivity Standards

Measure	Standard	Notes
Connectivity	1.4 Minimum	Ratio links/nodes, Excludes links on perimeter arterials
Intersections/Square Mile	150 Minimum	Includes perimeter intersections
Block Perimeter	1,400 ft. Maximum	Measured at street centerline
Block Length	500-600 ft. Maximum	Traditional neighborhoods are often 200-400 ft.
Emergency Access	10% Maximum	% of lots rendered inaccessible if one street is blocked
Proximity	65% Minimum	% of DUs within 1/4 mile of village nodes

References:

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