Ewing, R., and R. Cervero. Travel and the Built Environment: A Synthesis. *Transportation Research Record*, 1780: 87-114. 2001.

In this paper the authors review the literature to explore the effects of the built environment on key transportation outcome variables: trip frequency, trip length, mode choice, and composite measures of travel, vehicle miles traveled and vehicle hours traveled. Studies of trip chaining behavior are not covered in this review for lack of empirical work relating trip chaining to land use and design variables.

The paper divides the literature into four sets. These grouped into literature pertaining to

a) Neighborhood and activity center designs
b) Land-use pattern
c) Transportation networks
d) Urban design features
e) Composite transit or pedestrian design indices

<u>Neighborhood and Activity Center Designs</u>

The studies categorize the built environment as either contemporary or traditional, automobile or pedestrian oriented.

The main findings of the studies are as follows:

- Overall trip frequencies depend mainly upon household socio-economic characteristics, and travel demand is inelastic with respect to accessibility.
- Trip lengths are shorter in traditional urban settings with central locations, fine land-use mixes, grid-like street networks, and activity centers expected to produce shorter trips.
- Walking and transit trips substitute for longer automobile trips in traditional urban settings.

Land-Use Pattern

The studies characterize land-use patterns by residential densities within neighborhoods; employment densities within activity centers; various measures of land -use mix within neighborhoods and activity centers; and measures of micro accessibility, which reflect the number of specific attractions within a given distance of residences.

The main findings of the studies are as follows:

- Total household vehicular travel, whether VMT or VHT, is primarily a function of regional accessibility. Controlling for it, studies differ regarding the effects of local density and mix on total vehicular travel. Regardless, such effects are small in comparison to those of regional accessibility. This means that dense, mixed-use developments in the middle of nowhere may offer only modest regional travel benefits.
- As for components of VMT, trip frequencies appear to be largely independent of land-use variables, depending instead on household socio-economic characteristics. Any drop in automobile trips with greater accessibility, density, or mix is roughly matched by a rise in transit or walking/biking trips.
- Trip lengths are generally shorter at locations that are more accessible, have higher densities, or feature mixed uses. This holds true for both home-end and non-home-end trips.
- Of all travel variables, mode choice is most affected by local land-use patterns. Transit use depends primarily on local densities and secondarily on the degree of land-use mixing. Walking depends as much on the degree of land-use mixing as on local densities. A pedestrian-friendly environment is not the same as a transit-friendly environment.
- For both transit and walking, employment densities at destinations are as important as, and possibly more important than, population densities at origins. In this sense, preoccupation of the transit oriented design

literature with residential density and neighborhood design may be misguided.

Transportation Networks

Street networks are categorized by street connectivity, directness of routing, block sizes, and sidewalk continuity. From simulation studies, travel and traffic appear to be as sensitive to street network designs as they are to land-use patterns. Interest in the impacts of the transportation network on travel is recent, and studies on this topic are far less numerous that studies of land-use impacts.

The main findings of the studies are as follows:

- The relative attractiveness of networks to alternative modes depends fundamentally on design and scale. Grids with skinny streets, short blocks, and traffic-calming measures are hardly conducive to long distance car travel. Conversely, grids with six lanes of fast-moving traffic, long blocks, and no medians or pedestrian refuge islands are no help to pedestrians.
- The evidence relating transportation networks to vehicular travel is inconclusive.

Urban Design Features

These studies deal with the effects of building orientation, landscaping, pedestrian amenities, and other micro features on travel.

The main findings are as follows:

- With few exceptions, parking is neglected in travel studies. This represents an area of high payoff for future research.
- Urban design features have marginal impact on primary trips (for example, whether and how to get to a particular destination). They have more effect on secondary trips, that is, trips within an activity center that can be made either by foot or by car. Many participants in travel diary surveys may not even record these secondary trips. Thus, travel studies that rely on travel

diaries (that is a vast majority) probably understate the importance of urban design.

Composite Transit or Pedestrian Oriented Design Indices

If urban design features have any effect on travel, independent of land-use and transportation variables, it is likely to be a collective effect involving multiple design features. It may also be an interactive effect involving land-use and transportation variables. ”A sidewalk may enhance pedestrian accessibility slightly, while increased traffic may inhibit accessibility slightly…an area which combines high traffic and no sidewalks may have much lower accessibility than would be expected given that each individual influence is slight.” This is the idea behind composite measures such as the “pedestrian environment factor” in Portland and “transit serviceability index” in Montgomery County, Maryland.

Composite measures constructed thus far vary in two important respects. First, the underlying variables from which composite measures are constructed may be subjectively or objectively measured. “Ease of street crossing” has a higher degree of subjectivity than “Typical building setback.”

Second, the underlying variables may be combined into composite measures either through arbitrary weighting of variables or through statistical estimation of variable weights on the basis of association among variables. The latter involves factor analysis.

The area of construction of composite indices requires much more empirical testing and replication of results.