


Perceptions of Density in the Residential Built Environment

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A high density environment that is perceived as low density, what might that look like?


Why Density Deserves Attention



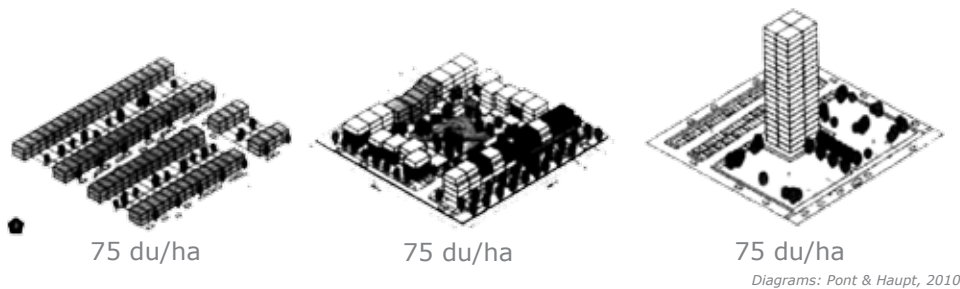
Images: Campbell & MacLean, 2007

Density...is highly associated with people's environmental preferences.

- ...has historically been a means for describing the evolution of a city.
- ...is vital in determining what form a city might take.
- ...is ubiquitous in urban planning communication.
- ...has the potential to communicate many related concepts.
- ...is critical given the current rate of global urbanization.
- ...is the foundation for designing towards sustainable cities.
- ...physically manifests in a multitude of ways for a given measurement.
- ...is extremely complex and requires further defining.



Images: Campbell & MacLean, 2007



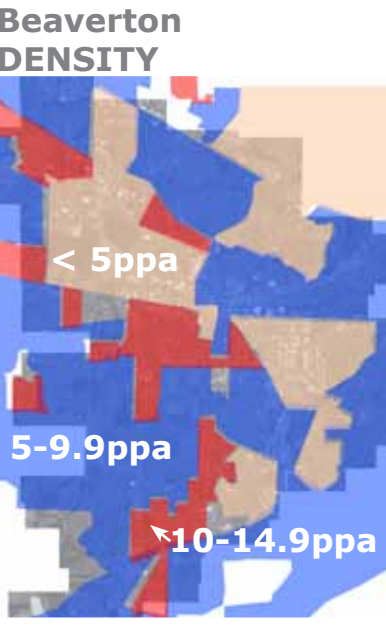
Diagrams: Port & Haupt, 2010

“There is clearly a need for further fundamental research on density. Systematic development of work dealing with the relation between the quantitative and qualitative aspects of space consumption has yet to occur.”
Port & Haupt, 2010, p.14
Department of Architecture: www.architecture.nl

Density in the Suburban Context


U.S. Case Study: Beaverton, OR

A metropolitan suburb with an Urban Growth Boundary



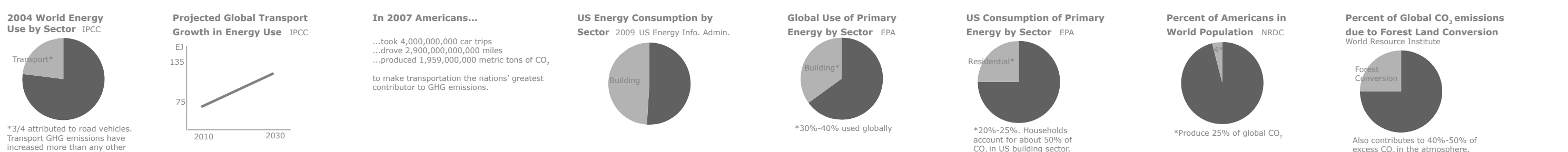
Commercial
Residential
Natural
Transportation

Coarse grain suburban fabric with large, fragmented single use areas. High prevalence of the detached single family home typology with little and inconsistent walkable space favoring auto oriented formal relationships.



- A Wider Street
- Auto Oriented Dwelling
- A Deep Street Setback
- Types of Tree Coverage
- Higher Density SF Homes
- A New TOD
- Expanding Development
- Ubiquitous Strip Mall

Images: by author



- 2004 World Energy Use by Sector** IPCC: *3/4 attributed to road vehicles. Transport GHG emissions have increased more than any other sector in the last decade.
- Projected Global Transport Growth in Energy Use** IPCC: Line graph showing growth from 2010 to 2030.
- In 2007 Americans...**: ...took 4,000,000,000 car trips; ...drove 2,900,000,000,000 miles; ...produced 1,359,000,000 metric tons of CO₂ to make transportation the nation's greatest contributor to GHG emissions.
- US Energy Consumption by Sector** 2009 US Energy Info. Admin. (Pie chart showing Building as the largest sector).
- Global Use of Primary Energy by Sector** EPA: *30%-40% used globally (Pie chart showing Building as the largest sector).
- US Consumption of Primary Energy by Sector** EPA: *20%-25% Households account for about 50% of CO₂ in US building sector. (Pie chart showing Residential as the largest sector).
- Percent of Americans in World Population** NRDC: *Produce 25% of global CO₂.
- Percent of Global CO₂ emissions due to Forest Land Conversion** World Resource Institute: Also contributes to 40%-50% of excess CO₂ in the atmosphere. (Pie chart showing Forest Conversion as a significant portion).

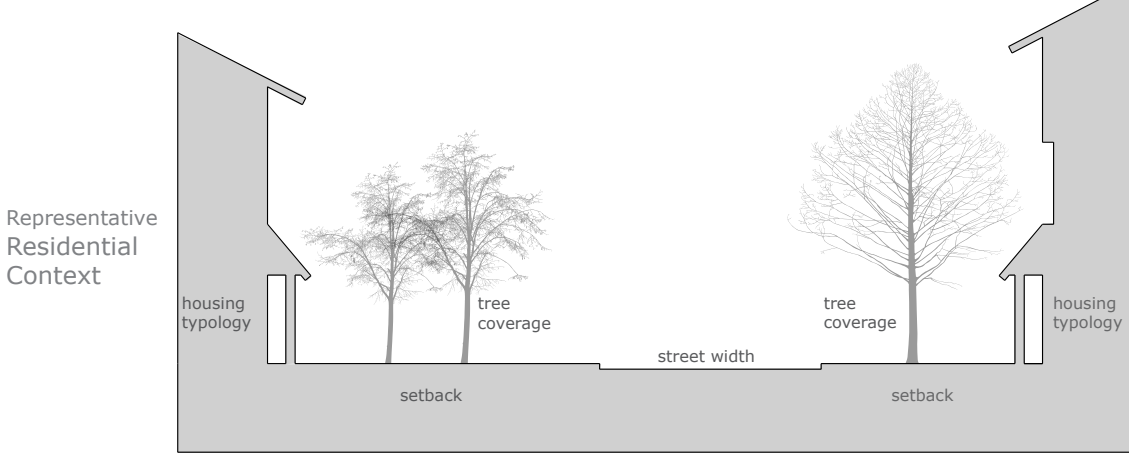
Perceptions of Density in Suburbia

THESIS: Spaciousness & preference: a study in the perception of density in the suburban residential built environment

DEPENDENT VARIABLES

Spaciousness
Preference

INDEPENDENT VARIABLES



Representative Residential Context

Formal & Spatial Relationships

- Mass Verticality Boundary
- Horizontality Linearity Rhythm Datum Verticality Repetition
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- Horizontality Linearity Rhythm Datum Verticality Repetition
- Mass Verticality Boundary

RESEARCH QUESTION:


To what degree do street width, setback distance and tree coverage contribute to perceptions of density with respect to housing typologies?

HYPOTHESES

- Environments with three story or taller buildings will be perceived as less spacious than those with fewer stories; regardless of tree cover or setback.
- Environments with more tree coverage will be preferred (Hur et al, 2010, Kearney 2006) and perceived as less spacious than environments with less tree coverage; regardless of setback or housing typology. (Stamps, 2010, trees as less permeable boundary)
- Setback distance will be the strongest predictor of perceived spaciousness. (Stamps, 2009, 2011, street setbacks)
- Street width will not factor into perceived spaciousness when the setback is far. (Stamps, 2009, 2011, street setbacks)
- All factors equal, environments with detached housing will be perceived as more spacious than attached. (Stamps & Zacharias, 2004, building spacing; Stamps, 2010, boundary permeability)

SURVEY METHODOLOGY

A 32 question survey, utilizing discrete choice modeling, will be sent to 400 residents of Beaverton, OR. Below are three examples of the 47 stimuli systematically organized in the survey questions. Participants are asked to choose the "MOST Preferred" and the "MOST Spacious feeling" of the stimuli presented in each question.



- stacked row houses : wide street : large trees
- detached sfh : narrow street : short setback
- row houses : wide street : large trees
- stacked row houses : wide street : wide set back

CITATIONS

Campbell, J. & MacLean, A. (2007). *Measuring Density*. Lincoln Institute of Land Policy.

Hur, M., Naser, J. & Chun, B. (2010). Neighborhood satisfaction, physical and perceived naturalness and openness. *Journal of Environmental Psychology*, 30, 52-57.

Kearney, A. (2006). Residential Development Patterns and Neighborhood Satisfaction: Impacts of Density and Nearby Nature. *Environment and Behavior*, 38, 112-139.

Port, M.B. & Haupt, R. (2010). *Spacematrix: Space, Density, and Urban Form*. Rotterdam, NL: Nai Publishers.

Stamps, A.E. (2009). On space and spaciousness. *Environment and Behavior*, 41, 526-548. Advance online publication. doi: 10.1177/001316508317931

Stamps, A.E. (2010). Effects of Permeability on Perceived Enclosure and Spaciousness. *Environment and Behavior*, 42, 864-886.

Stamps, A.E. (2011). Effects of Area, Height, Elongation, and Color on Perceived Spaciousness. *Environment and Behavior*, 43, 252-273.

Stamps, A. & Zacharias, J. (2004). Perceived Building Density as a Function of Layout. *Perceptual and Motor Skills*, 98, 777-784.