AP Seminar: Block D

March 15, 2026

Engineering Community: Reframing Urban Infrastructure as a System for Social Interaction

Society is rapidly shifting towards urban living as the earth's population increases. It is important to recognize that urban infrastructure is not just a style of design, but a system that can be used to influence many people's behaviors. Modern cities are often designed by engineers for efficiency, which often leads to the overlooking of its effects on human connection. Currently, urbanization has the consequence of reducing social interaction and segmenting communities (Latham 2). Ultimately, this fuels dispersion and increases loneliness in contemporary society. While seclusion has its own impacts on an individual's mental health, the consequences for negligence of human needs in urban design extends beyond mere isolation. Having recently been identified as an "urgent public health issue," loneliness has been linked to significant health consequences and shortened lifespan (U.S. Department of Health and Human Services 8). This is due to the overvaluation of factors such as population density and economic burden. While the value of social infrastructure is well understood, research regarding concrete design principles and direct implementation is limited. A shift in prioritization regarding urban design is required to allocate for an increased sense of community. Implementing design principles that encourage low friction social interaction is a core component of fighting the urban expansion epidemic.

Historically, urban expansion has been interpreted as an engineering problem with the sole purpose of maximizing population density with low economic burden. Ever since 2006, the earth's populace has consisted of more than 50% urban residents as shown in Figure 1 (Ritchie et al). In high-earning countries, this number increases to over 80% (Ritchie et al). Consequently, residents' social interaction has decreased substantially as urbanization takes over, presenting society with a modern-day urban expansion epidemic. According to the Government of Canada, the overall level of community satisfaction was reported to be measurably lower than average in urbanized locations, reflecting an overall increase of social isolation and lack of connection. This feeling of connection, or lack thereof, is often referred to as a sense of community. As stated by Dr. Vivek H. Murthy, the 19th and 21st Surgeon General of the United States, "The lack of social connection poses a significant risk for individual health and longevity. Loneliness and social isolation increase the risk for premature death by 26% and 29% respectively," showing the adverse effects that are rooted in poor sense of community. To address this issue in increasingly vertical cities, engineers must shift core design ideologies to adapt for human behavioral patterns. Strochova Zuzana, a scholar from the University of Ostrava, conducted an analysis of communal areas and their visual design to capture how residents move and interact (322). Her findings state that interaction was significantly more likely to occur in areas that employed design strategies that present infrastructure in a non-threatening way (Zuzana et al. 327). This data demonstrates how infrastructure can have significant impacts on the way people network with each other in a social setting. Building on Zuzana's findings, Ferriera's paper on the significance of coffee shops in the urban environment discusses a

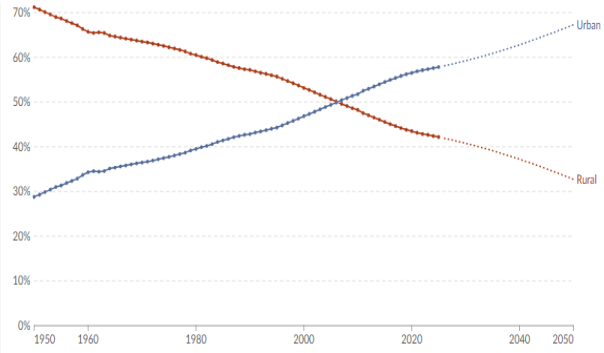


Fig. 1 Global Urban vs. Rural population percentage plotted over time (Ritchie et al)

fitting example of well-designed public space providing people with a sense of community. Ferriera notes that coffee shops are an essential part of people's daily lives, referring to them as third places (aside from home and work) (2). Building on these findings, Zuzana argues that increase of vertical architecture is inevitable given our expansion, but its design fails to be seen as a method of bringing people together (315).

One key characteristic that can increase social interaction in urban space is informality. According to a study conducted by Jie Qi (PhD), micro-interactions are significantly more likely to occur when a building's design displays a relaxed and open feel (173). Additionally, Strochova Zuzana's research investigates how informality can be directly expressed in urban settings. Zuzana's findings state that using lighting, color choice, and other visual features significantly increase the likelihood of interaction occurring in that particular location as shown in Figure 2 (Zuzana et al. 327). This is plausible in real design because overly formal infrastructure can present itself as restrictive and closed. Together, these findings show how an informal space conveys a sense of security to its inhabitants, maximising overall community. To develop this idea further, reducing the use of defensive design aspects has been shown to present positive benefits. A study conducted by Siriwan Rujibhong, who holds a PhD in urban development and design, evaluated 1206 residents living in high-rise buildings in Bangkok where participants were given a psychological questionnaire to analyze their sensation of community (140-142). Additionally, an in-depth analysis of the buildings was used to numerically score and correlate certain architectural



Fig. 2 Heatmap of Resident Interactions in Relation to Visual Interventions (Zuzana et al)

features to the participants' responses (Rujibhong 140-142). Predictive modeling was used to find 10 determinants of sense of community with a 95% certainty (Rujibhong 140-142). One major factor found was the "Defensible Characteristic of the Building" referring to things such as gates, security cameras, and surveillance (Rujibhong 143). Minimizing these features and promoting openness proved to significantly increase social satisfaction of the residents. Similarly, Mengshi Yang (Shanghai International College of Design and Innovation, TongJi University) conducted a study that analyzed movement tendencies of high-rise residents in a simulated environment built by a team of engineers and psychologists in Minecraft (3). The city was constructed with an unorthodox geometry with an attempt to allow effortless access to all respective zones, as shown in Figure 3. Each participant participated in the game over the course of five days while completing tasks and sustaining interaction to accurately simulate a real social environment. After looking at the cumulation of over 5, 000 participants' movement patterns, Yang concluded that transportation is a trivial component of urban design (15). Investigation of the city's design reveals how both engineers and players preferred to stay away from designs that include limited pathways and conventional tight layouts, suggesting that distribution of density could counterintuitively increase cohesion. As Yang stated, "Analyzing the comprehensive set of trajectories, it becomes evident that participants' spontaneous construction of new pathways primarily aims to overcome the initial two-dimensional planar limitations" showing that residents showed greater satisfaction when given freedom to optimize movement to their likings.

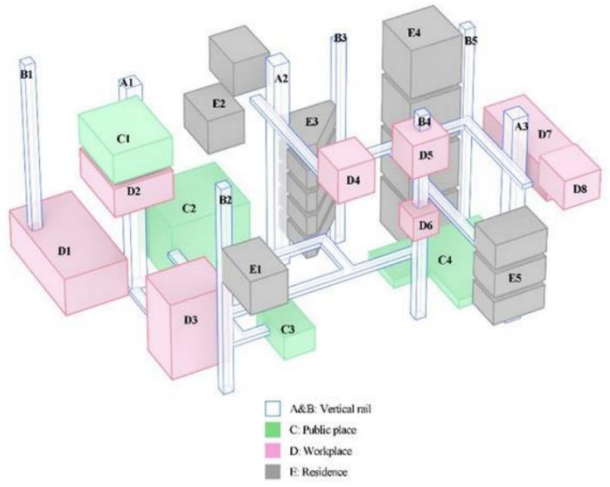


Fig 3: Three-dimensional view of Minecraft vertical city plan (Yang)

Implementing social infrastructure has been proven to be notoriously difficult due to many factors such as political status and economic position. Despite the existence of design obstacles, social infrastructure should continue to be a major focus of urban development. Yulia Strashnova, a scholar from the Moscow State University of Civil Engineering, carried out a study with an objective to "determine the phases of SI [Social Infrastructure] development, due to the political, socio-economic circumstances of Moscow development over 100 years" (4). After extensive research and analysis, Strashnova came to discern four stages of Moscow's development. During the first stage (1917-1950s), also referred to as the "Origin," infrastructure was prioritized around rapid industrialization driven by political status in an attempt to maintain soviet independence (Strashnova 5). This reveals how diplomatic conflict can cause a city's motives regarding infrastructure to shift away from social values. Between the years 1950 and 1980, the Moscow government began to formulate an understanding of social infrastructure and its uses (Strashnova 7). State planning began to construct more housing for their increase on population, which fed into the requirement to build more service providing buildings such as hospitals, schools, and cinemas (Strashnova 7). In 1958, the "Rules and Regulations of Urban Planning and Development" was devised based on the frequency of service use in the area (Strashnova 7). Between the year 1980 and 2000, Moscow ran into a devastating economic crisis due to negative political and demographic changes (Strashnova 7). As Strashnova states, "Social infrastructure was critically affected with the volumes reduction of housing and public construction" (7). During this time, many buildings lost their function and social infrastructure development came to a halt (Strashnova 7). This shows how even after proper planning and design, social infrastructure can still fail under harsh economic circumstances. After recovering from their economic struggles, Moscow began to regain control of how they use their social infrastructure (Strashnova 10). During this time, plans

were centered around building more infrastructure rather than creating higher quality buildings that optimize sense of community (Strashnova 10). This is a very important perspective to understand, allowing for the use of infrastructure to employ its full potential. While Strashnova claims that social infrastructure is a powerful tool to enhance a cities sense of community, Ebba Högström complicates this perspective arguing that its effectiveness depends on many other social factors and context (378). Högström's research investigates how social infrastructure can have varying effects based on localization, finding that certain consequences arise reducing inclusivity. Högström found that there are many instances of social infrastructure having counterintuitive effects such as indirectly promoting stigmatism, exclusion, and inaccessibility. As Högström states "[it is important to research] the ways localisations of social infrastructure support, maintain, or hinder inclusion and community-building" it is evident that social infrastructure is a heavily nuanced and complex topic that can easily have negative effects when design is compromised (377). Despite challenges, the prior mentioned shortcomings of social infrastructure are purely design flaws that can be learned from in the future, rather than failures that discredit the use of social infrastructure as a whole (Högström 378).

To truly maximise sense of community with the knowledge and understanding we have right now, three main design principles must be implemented: (1) Intelligent population density distribution, (2) Reduced defensive characteristics, and (3) Encouraged informality in design. Building on the works of Yang and Rujibhong, it is clear that distributing population density with intent must be done both within buildings and throughout cities to ensure efficient use of all the resources available. While overcrowded areas undeniably impede social interaction, extremely low population density can lead to reduced micro-interactions entirely. Furthermore, data from Rujibhong and Zuzana support the reduction of defensive characteristics to maximise sense of

community. This would require the invalidation of harsh gates, surveillance, restricted areas, and other similar design features in future building plans. Likewise, Zuzana confirms that increasing the informality of any given place through design will harbor greater connection between the inhabitants. To implement this, designs must include features that signal flexibility and openness such as roof gardens, shared lounges, and pathways that can encourage more unrestricted, frictionless movement. Moreover, incorporating iterative feedback from residents and community members through surveys will significantly accelerate the process of social infrastructure development. Contrary to previous approaches that approach social infrastructure as a spatial functionality problem, these three design principles directly handle the issue by analysing the psychological and behavioral factors of the human species to deliver maximum interaction. By shifting the priorities of modern urban design, cities' social infrastructure can overcome the shortcomings discussed in the previous studies to move towards a community with more meaningful social connection.

To recapitulate, current urban design ideologies present many flaws that hinder social interaction. To combat this, deliberate changes to building frameworks must be created to account for residents' psychological and behavioral traits. Improved urban design through the previously discussed principles will allow for minimized social friction to increase total quality interactions. While evident constraints have the potential to invalidate the use of social infrastructure in extreme conditions, they reflect shortcomings in current design, rather than core flaws in the use of social infrastructure as a concept. Intentional urban design will have significant positive impacts on society as cities grow towards increasing vertical infrastructure. Neglecting human nature during the urbanization process further has the capability to decrease social cohesion in the long term. Therefore, in upcoming years, engineers and architects should shift their mindset towards

constructing an environment that emphasizes the requirements of its inhabitants, moving towards a more connected population.

Word Count: 1981

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