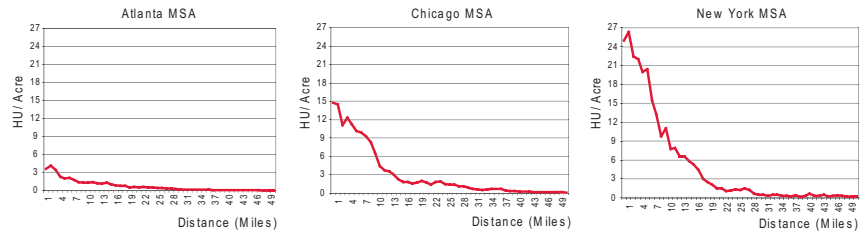
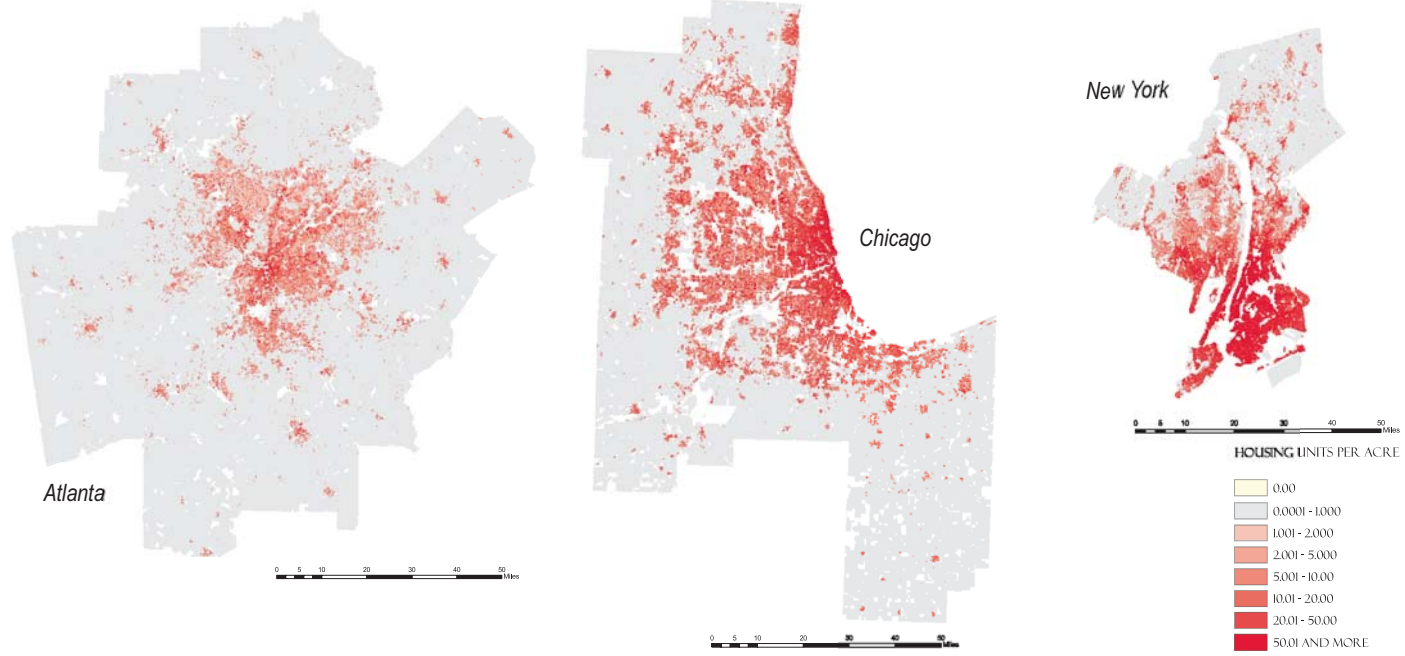


PhD Focus

Fall 2007



THE DISTRIBUTION OF URBAN DENSITY



As the planning profession deals with urban sprawl, questions of urban form and density at the metropolitan scale come to the fore. There is particular interest in how measures of population and housing density, block size, intersection density and street density, are related to travel behavior. Denser areas with a greater mix of land uses are frequently associated with increased transit use and more pedestrian and bicycle travel.

At the GIS center, professor Steven P. French and Ph.D. student Martin Scoppa analyzed how density and urban form vary between older and newer "sunbelt" regions. They examined the ten most populous metropolitan statistical areas (MSAs) in the U.S. and, using GIS, they investigated how block size and housing density vary with respect to distance from the center of the region.

While the ten areas had over four million population in 2000, they vary significantly in size. For example, the Houston MSA is five times larger than the New York MSA in land area, even though New York has nearly three times the population. More populous areas tend to have a larger number of blocks, but the number of blocks is not perfectly correlated with population. In general, older cities, such as New York and Philadelphia, have the largest percentage of small blocks; however, Los Angeles and Miami also have a surprisingly large proportion. Generally, blocks of less than 10 acres

dominate the fabric of most of the metropolitan areas, with the significant exception of Atlanta. Newer auto-oriented cities have a larger number of blocks greater than 10 acres, except Miami.

The authors constructed concentric rings around each central city (centered on the City Hall) and calculated the number and average size of blocks within each ring. The average size of blocks in the inner ring (0-2 miles) is quite consistent across all metropolitan areas averaging about 4.7 acres. Block sizes begin to diverge significantly beyond 5 miles from the center. In the 10-20 mile ring New York blocks still average less than 8 acres, while at that same distance Washington and Atlanta's blocks have more than 5 times that size. At a distance greater than 20 miles out, four areas have blocks that are approximately 100 acres in size: Dallas-Ft. Worth, Atlanta, Houston and Washington, DC. If these blocks were square they would be roughly 2000 feet or nearly one-half mile, on a side. These areas with are unlikely to support pedestrian activity.

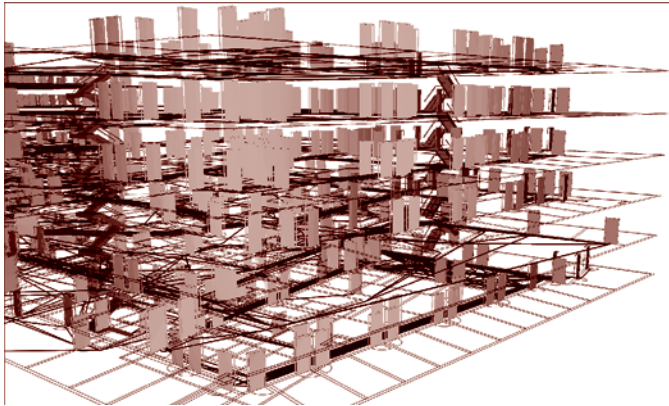
Housing unit density measures the intensity of development within the urban fabric. As might be expected New York is the densest MSA in terms of average population and housing units per block. Los Angeles has significantly lower average population densities, but is the second densest MSA overall. Washington, DC is the only other MSA that averages over 100 people per block.

After categorizing housing density into seven

density ranges, the authors find blocks with between 1 and 5 housing units per acre are the most common in 9 of the 10 ten metropolitan areas, typically about one-third of the total blocks. This is somewhat surprising, given the differences in the age and structure of these areas. Dallas-Fort Worth has the largest proportion (43%) of blocks in the 1-5 HU/acre range, and New York has the lowest (23%). Atlanta is the only metropolitan area where the largest percentage of blocks falls into the least dense category (0-1 HU/acre).

As predicted by urban economic theory, housing density declines with distance from the center of the metropolitan area. The steepest declines occur in those areas that have the greatest density at their core. Almost all US metropolitan areas exhibit very low housing density (< 3 HU/Acre) by 10 miles out from the center. The problem of low density sprawl is not unique to newer, Sunbelt cities. This analysis highlights the land use impediments to moving away from the automobile as the primary transportation mode and to greater reliance on mass transit.

Professor French believes that more knowledge of the structure and function of urban areas and their emerging activity centers is fundamental to taming sprawl and creating more sustainable urban land patterns. His team is continuing to investigate density patterns and will link this to transportation patterns in future research.



Screenshot of SMC running graph-based circulation checking

Circulation in buildings has been studied from many perspectives, including way-finding, space syntax, and also Monte Carlo simulation of an individual's navigation behavior and its group effects. With the growing availability of digitally readable building models, it is now easy to simulate and assess circulation aspects of architectural designs. A research team in Design Computing has developed software to automatically assess circulation in courthouses according to circulation rules. Courthouses have very particular circulation requirements, involving three different classes of user: the public, the judges, jury, and court staff, and the defendants. These three groups are segregated and are only allowed to meet in the courtroom. Additional circulation requirements address the many other spaces, including law libraries, judge's chambers, and U.S. Marshal's space.

The work relies on the IFC neutral building format (Industry Foundation Classes) that is exportable by all the major building Information Modeling (BIM) software tools. The circulation rules were taken from the U.S. Courts Design Guid. 216 circulation rules were identified. Circulation rules have a generic structure consisting of a start-space type or condition, an end-space type or condition, and pathway space type or conditions. A single rule applies to all the instances of a space type, such as judges' chamber suite. It is important that the space names in the IFC model match those used in the circulation rules.

A complete circulation graph is made of the building, including all floor levels. All building spaces are identified, and all doors, stairs and elevators between spaces are used to connect them. This provides an accessibility graph. The

circulation within each space, particularly all spaces used for through-circulation, is analyzed to identify the metric distance between all door pairs, based on assumptions regarding normal walking behavior. The route generation method developed relies on paths keyed to the concave corners of the space. Other information is appended to each space, such as its minimal passage width, length between one door and another and security level. A metric graph traversal algorithm was developed that finds the shortest path meeting various space traversal requirements, if such a path exists. As shown in the Figures 1 and 2 of an actual courthouse model, the application can assess 2,800 different space-to-space circulation tests involving more than 27,000 routes in less than 30 seconds. The software was built on top of the Solibri Model Checker platform. The circulation testing has identified many faults in proposed courthouse designs, although several of them are convenience issues involving distance. Additional designs of GSA courthouses will be tested this year. This effort is an early example of the development of machine implementable design guides and review systems that will become increasingly part of an architect's working environment.

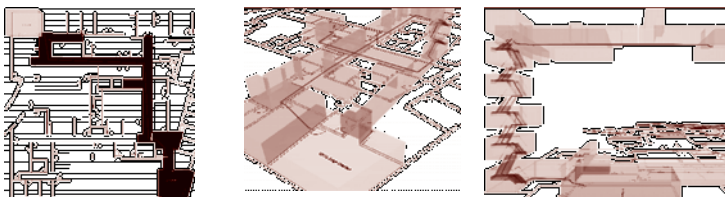
This work is part of the BIM-Enabled Design Guide Automation Project for the GSA, Office of Chief Architect. The team developing the software included Yeon-suk Jeong, a post doctoral fellow from Yonsei University, and Ph.D. students Jaemin Lee, Jin-kook Lee, Hugo Sheward, Sherif Abdelmohsen, and Paola Sanguinetti. The team is led by faculty member Chuck Eastman. For more information, visit websites:

<http://www.gsa.gov/bim>, and <http://dcom.arch.gatech.edu/gsa>.

Two measures of connectivity and configuration that are applicable to standard GIS representations of street networks have been introduced by John Peponis and Sonit Bafna. The reach of a point measures the total street length covered by all paths extending out from that point that are no longer than a given threshold value. The directional distance of a street network from a point is measured according to the minimum number of direction changes required to reach any part of the network from that point, consistent with typical measures used in space syntax. Reach is a measure of street density and hence of urban potential. The higher the reach the greater the chances that a variety of premises, conditions and functions are accessible from any given point. Directional distance is a measure of cognitive load. As directional distance increases so potentially accessible parts of the network become less intelligible and are less likely to be visited. A new Java program written by Zongyu Zhang has implemented these measures to enable the analysis of large metropolitan areas, exchanging input and output with ArcView or ArcGIS. Each road segment is evaluated according to its position within the surrounding area at varying scales, ranging from half a mile to several miles. Thus, the local structure of urban space is measured over very large areas sometimes extending more than 100 miles across.

Taken as averages to characterize urban areas, the new measures are highly correlated with standard measures such as block, street, and intersection density per square mile. They complement standard measures by offering descriptions which bear more directly on the experience of urban networks. However, the new measures can be used to distributively characterize individual road segments and thus to describe the internal relational structure of areas. The ability to analyze large bodies of data has already led to two kinds of findings: first, comparative characterizations of cities and parts of cities which can be used to benchmark any given area under study and to guide design development or evaluation; second, functional characterizations of specific areas leading to the formulation of hypotheses about urban form and structure, specifically about the way in which street networks, as the more permanent framework of urban evolution, interact with the distribution of movement or land uses.

These findings have been presented by Ph.D. students Martin Scoppa, Dawn Haynie and Ayse Ozbil at the 6th international symposium on space syntax that was held at the Istanbul Technical University in June 2007, and are more fully described in the proceedings: [<http://www.spacesyntaxistanbul.itu.edu.tr/papers.htm>]. The morphology lab of the College of Architecture had a very strong presence regarding not only urban but also architectural studies.



Examples of circulation paths represented by the graph

The social, psychological, and cognitive sciences have shown that auditory distractions are a hindrance to performance on complex cognitive tasks. The architectural sciences have repeatedly shown that open plan workplaces are high in auditory distractions coming from the surrounding work environment. However, most workplaces in North-America and Canada are open plan, because the open plan office appears to be a rational trade off between the requirements of economy and those of communication and flexibility. The question arises whether current open plan workplace that is high in externally generated involuntary auditory distractions is valuable for knowledge-based organizations.

Furthermore, many exploratory studies on identifying workplace design and environment variables for knowledge workers provide evidence that the key requirement of knowledge workers from their workplace is the support for anywhere, anytime concentration and collaboration, which is not feasible with open plan workplace designs.

Parminder Juneja, a PhD candidate is working with Assistant Professor Kathy O. Roper and Professor William Bill Rouse, executive director of Tennenbaum Institute, to research this issue in office settings in order to analyze the value of distraction controllable adaptable workspace (DCAW). Tennenbaum Institute's (www.ti.gatech.edu) mission is to provide knowledge and skills for enterprise transformation. The working hypothesis is that at a time of enterprise transformation, when the economy is increasingly becoming knowledge-based, a distraction controllable adaptable workspace will represent a major improvement of distraction conditions for knowledge workers and hence better promote knowledge-based organization's financial bottom-line. A DCAW is a workspace that will promote anywhere, anytime collaboration and concentration. It will allow quick transformation to an open, partially open or closed environment (where closed environment portrays shutting down environment generated distractions) to suit one's functional, psychological, and physiological needs.

Consequently, the objective of this study is to explore the value of DCAW for knowledge-based organizations factoring-in an estimate of the costs resulting from auditory distractions. Because, these costs include key soft factors like psychological costs, physiological costs, and social costs, a multi-attribute utility model will be designed to provide a quantifiable value to score alternatives on all key attributes. The goal is to facilitate corporate decision makers in choosing the best alternative for workspace type in accordance with their organization's work, policies and budgetary bottom-line.

Daphne Hobson: The Domestic Architecture of the Earliest British Colonies in the American Tropics: A Study of the Houses of the Caribbean 'Leeward' Islands of St. Christopher, Nevis, Antigua and Montserrat. 1624-1726

Advisor: Dr. Ronald Lewcock

The study investigates cultural and social processes in early British colonialism by examining domestic architecture. It focuses on the 'Leeward' islands in the Caribbean where, in 1624, the British established their first tropical colony that survived. No more than two or three houses are extant from the period. Literature is virtually silent on social aspects of the settlements, which is peculiar because there is a body of writings about the economic successes of their 'sugar revolution' in that period. The historical research was conducted on contemporary manuscripts in 18 archives and collections in Britain, the USA and the Caribbean. The historical material accumulated is comprised of hundreds of official inventories and brief text descriptions of houses, a few official maps, business letters and governors' reports. Qualitative and statistical methods were applied to analyze the data.

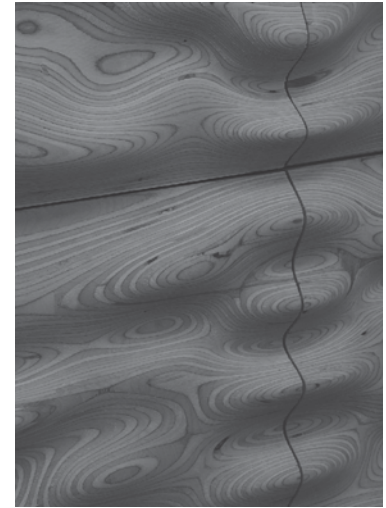
The documentary record revealed the colonists' process of adaptation to the unfamiliar environment and the role of national culture. The first century of colonization was one of interaction with the indigenous Caribs and the integration of their construction techniques and knowledge with British customary practices. The study identified typologies, stylistic trends and correlations with house types in French and Spanish colonies. Eighty years after first settlement, traditional British types predominated in the housing stock. The residences of the elite exhibited the currents of polite English society with symmetrical facades, novel plan arrangements, hierarchies of entertainment spaces, and luxurious imported furniture and fabrics; nevertheless, the structural systems of many fine houses reflected Carib precedents.



Figure 1. Detail of the Map of Mountserrat 1673 in the Blathwayt Atlas showing the captain-general's house. [Reproduced in the dissertation with permission of the John Carter Brown Library of Brown University.]

Eduardo Lyon: Component Based Design And Digital Manufacturing: A DfM Model For Curved Surfaces Fabrication Using Three Axes CNC Router

Advisor: Prof. Charles Eastman



This thesis explores new ways to integrate manufacturing process information into design processes. Through the use of design for manufacturing (DfM) concept, and looking at relations between its potential application in architectural production and its implementation using digital manufacturing technologies, the author implemented a DfM model that varies from previous models by incorporating learning in the process. This process was based on the incremental development and refinement of design heuristics and metrics. The DfM model developed in this research is a process model to be implemented as a framework within educational settings. It is based in two basic strategies; first a process description in the form of alternative design strategies; and second, the implementation of design heuristics and design metrics. Subsequently, the author tested and refined the model using a sequence of case studies with students. In the final stage, the research evaluated and further developed the DfM model in a component design case study. The general purpose in performing this case study sequence was to test the proposed DfM model. The second objective was to refine the DfM model by capturing knowledge from the case studies. As a summary, this research proposes a top-down development approach to create a design for manufacturing model that integrates design and construction in architecture, based on three possible applications fields: DfM teaching approach development, design processes improvement, and DfM methods development. The final purpose is to provide better foundational constructs for architectural education and to improve teaching approaches that integrate design and manufacturing.

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Dr. Robert Craig named Architecture Editor for Grove Encyclopedia of American Art (Oxford University Press), a 5 volume set of books

Dr. Robert Craig received the SESAH Essay Award 2007 for his paper "Pilgrimage route to paradise: the sacred and profane along the Dixie Highway" in Stager C, Carver M A (eds), 2006, Looking beyond the highway: Dixie roads and culture (Knoxville: University of Tennessee Press)

2007 Best Paper Award, "Sustainable Performance of an Alternative Energy System for Rural Houses in the United States", by Ospina-Alvarado, A., and Castro-Lacouture, D., paper presented at the COBRA 2007 Conference, Royal Institute of Chartered Surveyors, RICS, Atlanta, Georgia, USA, September 5-6

The Neurosciences Critical Care Unit at Emory University Hospital has received the 2008 ICU Design Citation Award co-sponsored by the Society of Critical Care Medicine, the American Association of Critical Care Nurses and the American Institute of Architects. The product of a unique collaboration between Owen Samuels, MD, director of neuroscience critical care at Emory, and Craig Zimring, an environmental psychologist and professor in the College of Architecture at Georgia Tech, the Unit was designed and built around evidence-based design principles.

Dr. Elisabeth Dowling is a Jury member for the 2008 Richard H. Driehaus Prize for lifetime contributions to classical design, Henry Hope Reed Award for significant contributions in support of classical architecture by a non-architect (the prize includes a bronze medal and a monetary prize of \$50,000). The jury includes Elizabeth Dowling, Paul Goldberger, architectural critic for The New Yorker; Adele Chatfield-Taylor, president of the American Academy in Rome, and David M. Schwarz, architect.

Alumni

Dr. Samia Rab, (1997 graduate, Associate Professor and Head of the Architecture Department, at the American University of Sharjah) works on issues of conservation, which are of particular interest in an environment undergoing rapid growth. Through her publications in local and regional journals she tries to instill conservation ethics in disciplines allied of environmental design within the context of the U.A.E. and the Arabian Gulf states. She is currently working on a paper with Canadian Environmental Conservationist, Dr. Brent Ingram: "Shaping Memory: Trends, debates & practices in heritage conservation". This is envisioned as the first critical global survey of heritage conservation extending from material aspects of buildings, neighbourhoods and environments to the cultural practices that sustain traditional communities. As Head of Architecture, Dr. Rab is leading efforts to get NAAB accreditation. The program is already accredited by the Middle States Commission on Higher Education.

Dr. Ghang Lee (2004 graduate, Assistant Professor at the Department of Architectural Engineering, Yonsei University in Seoul, Korea) is currently directing the Building Informatics Group at Yonsei and leading several research projects including the Virtual Construction project, the Robotic Crane project, and a project to develop an improved pull-out test method, a type of non-destructive concrete testing methods. His other recent research interests include building information modeling (BIM), surface engineering, and modular construction. Dr. Ghang Lee received the Best Teacher award in 2006 from Yonsei University and the Best Lecture Notes award in 2007 from the Korean Society for Engineering Education. On December 8th 2007, he and his students will hold the "Architecture and Music" concert at a club in Seoul linking music to architecture.

Dr. Samiran Chanchani (2002 Graduate) is principal of HistoryWorks, LLC, a Cultural Resources Management and Historic Preservation consultancy he established in Cincinnati, Ohio in 2006. Dr. Chanchani has worked as a Project Manager and Principal Investigator for a wide range of Cultural Resources and Preservation Planning projects dealing with historic architecture. As an expert on Sections 106 and 110 of the National Historic Preservation Act, Dr. Chanchani has developed historic contexts, documented historic architectural properties, and completed National Register of Historic Places eligibility evaluations. He has prepared plans for the short- and long-term preservation of historic buildings, objects, structures, and districts, particularly when these were likely to be affected by construction or other proposed undertakings. Dr. Chanchani is an adjunct Assistant Professor at the School of Architecture and Interior Design (SAID), University of Cincinnati.

Dr. Thomas W. Sanchez (1995 graduate) is an Associate Professor and the new Director of the Urban Planning Program in the College of Architecture + Planning at the University of Utah. He is also a Nonresident Senior Fellow with the Brookings Institution's Metropolitan Policy Program. Dr. Sanchez taught urban planning at Iowa State University, Portland State University, and Virginia Tech. His research has been in the areas of transportation, land use, residential location behavior, and questions of social equity in planning – with research being sponsored by the National Science Foundation, Federal Transit Administration, U.S. Environmental Protection Agency, Fannie Mae Foundation, U.S. Department of Housing and Urban Development, Brookings Institution, the Civil Rights Project at Harvard University, and state departments of transportation. His book on transportation equity (co-authored with Marc Brenman) *The Right to Transportation: Moving to Equity*, will be published by the American Planning Association in 2007.

Dr. Casey Dawkins (2003 graduate) is currently Director of the Virginia Center for Housing Research and an Assistant Professor of Urban Affairs and Planning at Virginia Tech. His current research focuses on (1) the causes, consequences, and measurement of residential segregation and (2) the link between land use regulations and housing affordability. He has written two books and over 20 refereed journal articles and book chapters on these topics. Dr. Dawkins was recently awarded an Urban Scholars Fellowship from the U.S. Department of Housing and Urban Development to examine the impact of racial segregation on racial disparities in the transition to first-time homeownership. Other organizations sponsoring Dr. Dawkins' research include the Fannie Mae Foundation, the Brookings Institution, the National Association of Realtors, the Center for Housing Policy, and the Ewing Marion Kauffman Foundation. He is co-guest editor of two special issues of *Urban Geography* focusing on the measurement of residential segregation and neighborhood change; he is also an associate editor of the journal *Housing Policy Debate*, and serves on the editorial advisory board of the *Journal of the American Planning Association*.

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