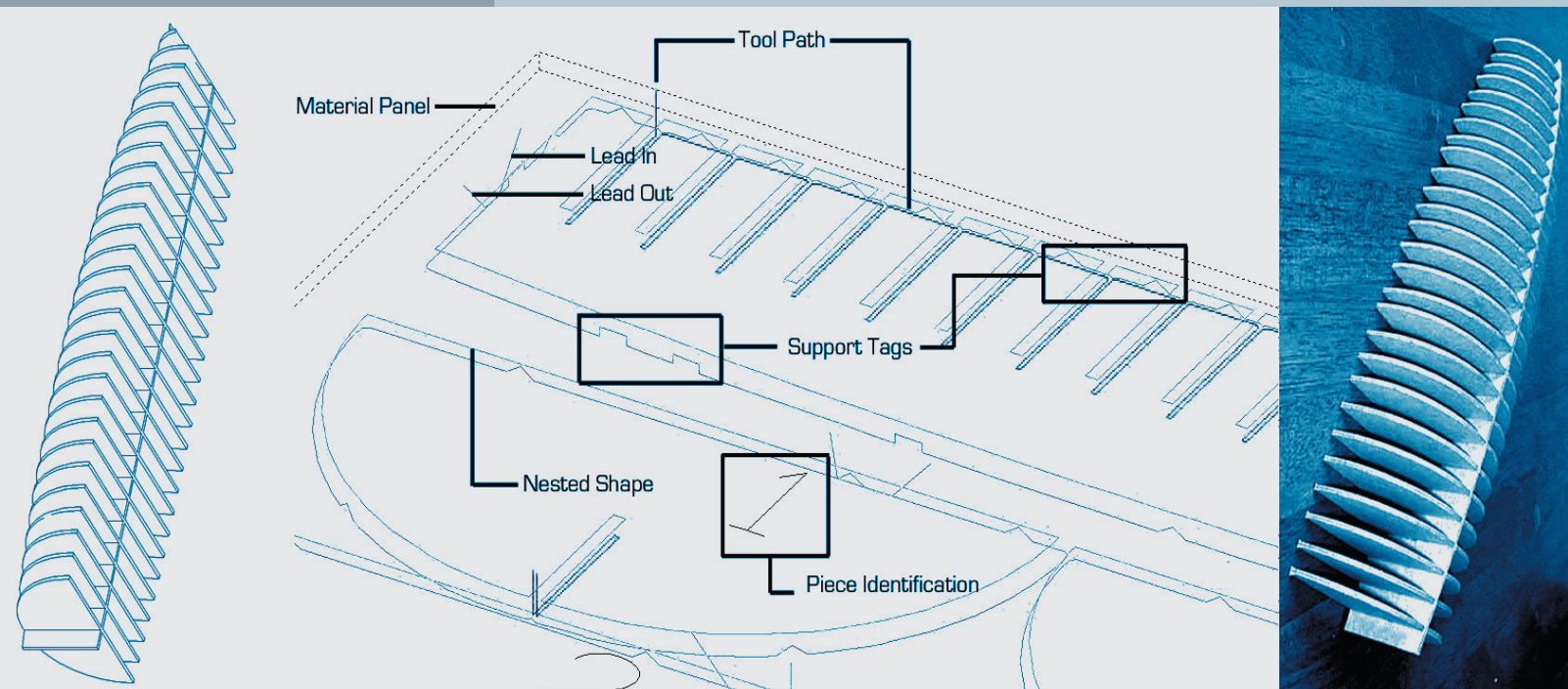# PhD Focus

Fall 2005

AEC Integration Laboratory

For the whole history of architecture and the construction industry, design and production of a building has been based on drawings, whether they were sketches, drafted working drawings generated by hand or by computer. Today, a new paradigm is being explored and adopted, called Building Information Modeling (BIM). BIM addresses the process and quality improvements allowed by moving to fully machine readable and consistent design information, for design, construction and building operations. BIM places emphasis on new design tools for generating intelligent 3D object information using such tools as Revit Building, Bentley Architecture, ArchiCad and Digital Project. Other systems are being offered to contractors, such as ArchiCad Constructor, Navisworks and Tekla. All these new software systems are immature, and have significant limitations. Another capability allowed by the new software are designs based on non-standard methods of fabrication, opening up the world to new designs not possible (or practical) previously. The longer term benefits of BIM are that the information generated will be used in other concurrent and downstream processes for analysis and construction and supported by other software. Some exchanges will be direct, but others will rely on the IFC and other data exchange models. In many cases, these exchanges have not been worked out so as to be useful in a production manner.
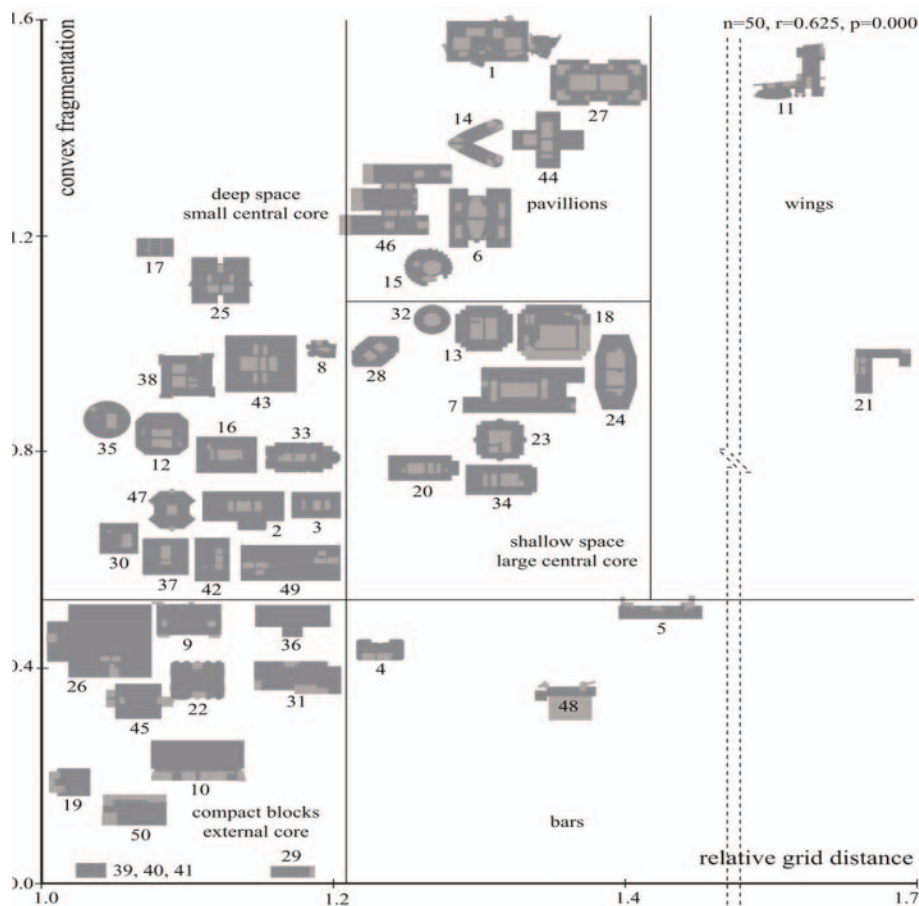
A growing number of firms are involved in these issues. The AEC Integration Lab was initiated through a seed grant allowing the College of Architecture to work with industry groups to explore the many new issues involved in this paradigm shift. The Lab was initiated by Chuck Eastman, Director of the COA PHD Program, and is being operated by Research faculty member Ghang Lee and Eduardo Lyon, a graduate student. The Lab is one of several facilities that will support a new MS Program in COA, called Computation, Composition and Construction (CC), to be offered next year. The MS. program was co-developed with Prof. Thanos Economeau. This program will provide education addressing the application of this new technology to support new types of design scenarios and for forms of teaming processes, and the exploration of new fabrication methods in construction. The Lab also proposes to help firms in their review/adoption of BIM software by:

1. undertaking studies of different BIM software regarding their functional capabilities and limitations, including drawing and report generation and generation of parametric assemblies

2. assessing workflows between different software packages and determining how best to accomplish certain tasks, assessing what works and what does not: interfaces with other applications include analysis packages (structural, thermal, sustainability, acoustics, lighting), ERP and management packages and with production equipment such as CAM software

3. developing custom parametric objects for special building type uses.

It is expected that the Lab will help catalyze both the school and the profession in their moves to a new way of designing and constructing architecture.

Tool Path

Material Panel

Lead In

Lead Out

Support Tags

Nested Shape

Piece Identification

From design to fabrication to assembly - Work of Eduardo Lyon

deep space
small central core

pavillions

wings

convex fragmentation

relative grid distance

shallow space
large central core

compact blocks
external core

bars

n=50, r=0.625, p=0.000

Floorplates compared according to the measures of shape proposed by Shpuza, Peponis, and Bafna

Measuring the effects of floorplate shapes on office layouts

The internal layout of office buildings change over time so that we can clearly distinguish between building design and interior design. But how does building design influence interior design? Ermal Shpuza, an Assistant Professor at Southern Polytechnic State University and a Ph.D. candidate at Georgia Tech has worked with Dr. John Peponis (principal investigator) and Dr. Sonit Bafna, to study how the floorplate shape of office buildings affects office layouts.

The study, which has been funded by the General Services Administration, focuses on the structure of internal circulation, including not only shared corridors but also circulation within open plan areas. Layouts are measured according to the direction changes involved in moving from any workstation to any other. This resonates with previous research findings, at Georgia Tech, The University of London and elsewhere, indicating that directional distance affects patterns of movement, communication and work in the office. Based on a study of a sample of 50 office interiors, Shpuza, Peponis, and Bafna have identified three kinds of office layouts, those with a relative low

degree of connectivity, those with-high connectivity in a grid-like pattern and those with high connectivity in a fishbone-like pattern. Then they have inserted different kinds of layouts in a sample of office floorplates, using a consistent set of generative rules. Based on this work they show that two new measures of floorplate shape, developed as part of this research, predict the likely degree of integration of circulation. The first measure is a measure of universal metric distance; it indexes how compact a floorplate is. The second measure is a measure of convex fragmentation; it indexes how far a floorplate breaks down into distinct sub-areas. Figure 1 shows how a sample of 50 floorplates varies according to these measures.

The measures can be used for preliminary evaluations of large office building portfolios according to their suitability for different kinds of internal layouts. Different floorplate shapes are preferable, depending on whether an office layout evolves towards one ideal type or another. However, the measurement of the underlying constraints exercised by floorplate shape upon internal layout does not imply determinism. Designers can always work to overcome or accommodate constraints, depending on the specific requirements of a given organization.

Working with Steelcase to relate office design to organizational dynamics

Steelcase, one the market leaders in office furniture and systems world wide, is committed to the development of the knowledge base that informs office design so that it best serves the needs of client organizations.

Steelcase's Community Based Planning represents a carefully thought out approach to office design which is aimed at: first, helping client organizations recognize and describe their needs; second, help designers formulate an appropriate response and design solutions.

As part of Community Based Planning Steelcase have been developing innovative analyses of different kinds of interaction networks which characterize the day to day function and human capital of an organization.

The aim is to use network analysis in order to understand the business dynamics and performance of a client organization and the manner in which office furniture and interior design can help support or improve such dynamics.

A Georgia Tech team let by John Peponis and including Dr Craig Zimring, Dr. Sonit Bafna, Dr. Mahbub Rashid and Dr. Yan Zhang has been working with Steelcase to help them evaluate and further develop their analytical tools and procedures, as well as to assess the impact that these tools have had on a sample of client organizations and office settings.

The joint Steelcase and Georgia Tech research team are looking into the effects of workplace designs on three areas of business performance: the efficiency of the work process and especially the effectiveness of organizational innovation and learning; the creation of an environment that contributes to employee satisfaction and motivation; the projection of organizational and cultural identity to support an organizations recognition and standing in the communities involved with its business cycle.

Ph.D. Program hosts conference on Building Information Modeling

A new generation of AEC software is one of several catalysts that that are expected to lead to major changes in the way that architects, engineers and contractors work and collaborate. Another catalyst is the search for new working processes, such as design/build and negotiated contracting. A third catalyst is the growing efficiencies of custom-off-site fabrication, based on manufacturing automation. Together, these catalysts are expected to radically change how architects, contractors, consulting engineers, subcontractors, practice and collaborate.

The new design software that generates the information to make the new possibilities is based on 3D parametric modeling. These new tools are not schematic design level rendering tools, but rather software allowing 3D detailing down to the construction level. Together with analysis, costing, simulation and other engineering and business applications, this new software allows the development of what is being called Building Information Modeling (BIM). The parametric modeling applications allow 3D definition of all the parts, connections, specifications, functions and other product information about the building. Combined with integrated scheduling systems, cost estimating systems, and analysis tools, this software offers new opportunities for improving the quality of design, shortening the building procurement life cycle, and reducing costs.

An important confirmation of BIM is that the General Services Administration (GSA) has committed to begin a set of demonstration projects using BIM throughout the country starting in fiscal year 2006. Their work was predicated on a recent study by the National Institute of Standards and Technology (NIST) that the US construction industry spent $15.8 billion dollars on inadequate interoperability.

This conference was held April 19-20, 2005, and addressed the opportunities offered by the new technology, for building owners, for architects and designers, and for contractors and developers. Georgia Tech has been a leader in the development and testing of BIM modeling applications, and the integration software needed to allow applications to work together.

The LaiserinLetter™ and its Editor, Jerry Laiserin, has been tracking this new technology and advising clients on its capabilities. Chuck Eastman of the Ph.D. Program and Laiserin were co-organizers of the conference. The conference included major presentations by developers of Revit, Architectural Desktop, Bentley Systems, Gehry Technologies' Digital Project, Tekla Structures, and IES Virtual Environment. Supporting applications for BIM modeling included Interspec, Navisworks Jetstream, EPM EXPRESS Data Manager, Enterprixe Project Workspace, Tectonic Network and Solibri Model Checker, plus others. Speakers included Chuck Eastman, Fried Augenbroe and Jeffrey Beard from the Ph.D. Program, Jerry Laiserin, Paul Teicholz from Stanford CIFE, Dennis Sheldon from Gehry Technologies, Vladimir Bazjanac from Lawrence Berkeley Labs, Bob Lipman from NIST, Joe Dietrich from the AISC, and David Orndorff from the PCI.

The review presented at the conference showed that the technology is being evaluated and adopted by all levels of the AEC industry, but that there are still many detail problems to resolve before it becomes the universal way of building. Some of the issues raised were: lack of staff that were knowledgeable and trained on the new software, current limitations of what the software could do, resolving intellectual property problems when all data about a project is stored together, and how to manage the data.

At the same time, a number of case studies were presented showing what is currently being accomplished. These included projects in structural steel, precast concrete, and projects by the GSA. Another conference is being planned for next year.
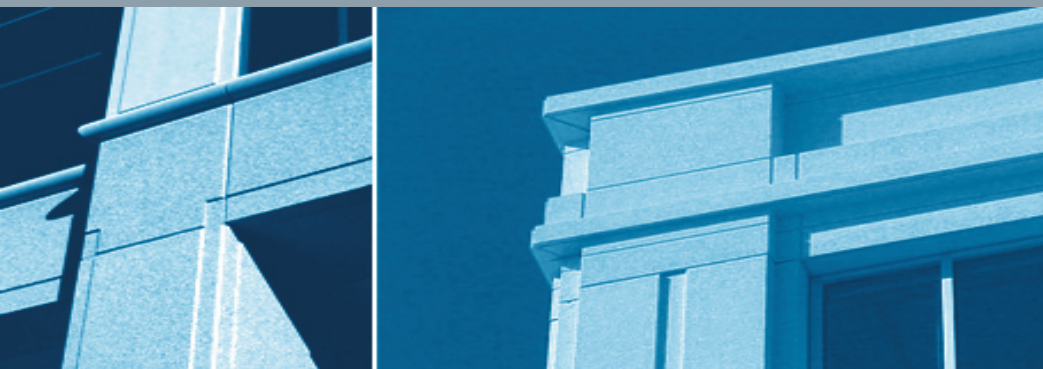
Precast Concrete Software Consortium Disbands

Over the past four years, the Precast Concrete Software Consortium has brought together over 40 experts in precast concrete design and production to develop a new generation of smart parametric modeling system for the detailed design and production of precast concrete buildings and systems. The consortium relied on Georgia Tech's Architecture Ph.D. Program to coordinate and distill requirements, and to translate them into implementable software requirements. Chuck Eastman led Georgia Tech's group and was aided by Rafael Sacks of the Technion, the Israel Institute of Technology, and Ghang Lee, then a PhD student. In 2003, after a very competitive review and evaluation, the work of the consortium led to the selection of Tekla Inc. as the developer of the needed software.

Facade Assemblies, Control Joint Lines reveal and change in depth with control lines
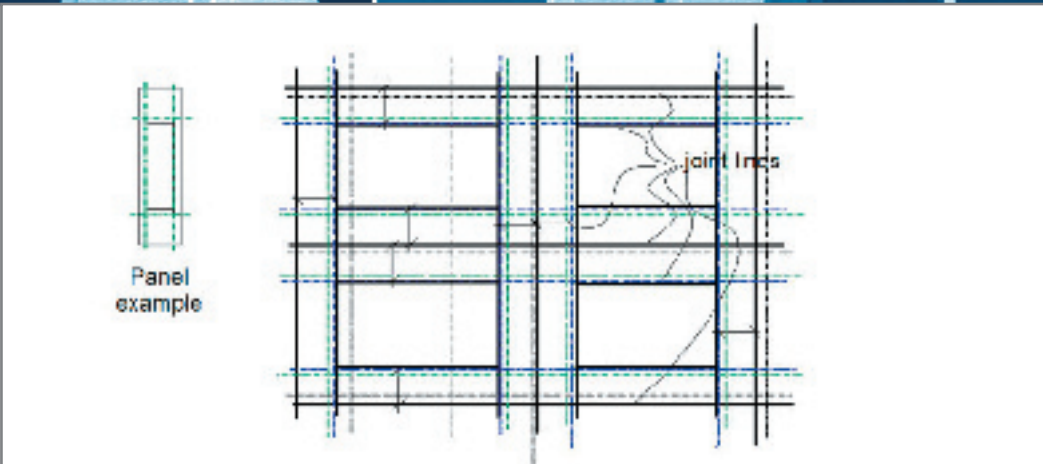
Ellen Do joins COA Ph.D. Program

In the 2004-2005 Academic year, the Ph.D. Program carried out a search for a new faculty member to support its growing PhD Program. The search was broad. The program was searching for someone with exceptional research talent, a strong academic record, was viewed as a future star, would attract students, and that would integrate well into our current areas of study.

During the Fall and early Spring of 2005, 48 complete applications were received in a wide variety of areas, many from overseas. Several applicants were recent Georgia Tech graduates. Telephone conferences were held with both references and many of the candidates, in order to develop a short list. In the early Spring, the candidate list was prioritized and led to five exceptionally strong candidates. All of the five visited Georgia Tech and were interviewed. In late Spring, Ellen Yi-Luen Do was selected and eventually recruited. She will begin her appointment at Georgia Tech in January 2006, as Associate Professor, with a joint appointment in College of Architecture's Ph.D. Program and the College of Computing, Human Centered Computing Program.

Ellen received her Bachelor degree of architecture from National Cheng Kung University in Taiwan. She came to the United States for her Master degree at Harvard University, under the advisement of Bill Mitchell at the Graduate School of Design. She went on to get a PhD at Georgia Tech in 1998, during which she did most of her research with Mark Gross at the University of Colorado. Ellen's thesis titled "The Right Tool at the Right Time – Investigation of Freehand Drawing as an Interface to Knowledge Based Design Tool" involved interactive sketching and sketch recognition, linked to a design knowledge-base. Her Georgia Tech advisor was Craig Zimring.

She became a post doctoral fellow there, then accepted a position at the University of Washington where she was initially an Assistant Professor, then gained Associate Professor and tenure. In 2004, she and Mark Gross both moved to Carnegie-Mellon University. Since her graduation, she has presented and published over 70 papers in international journals and conferences.

She has done extensive work in user interfaces for design and creativity, design cognition, smart construction objects, objects with feedback, and many lightweight design aids, among other areas. She has a strong following of enthused students. The PhD faculty and students look forward to Ellen joining us soon.

From the middle of 2003 until September, 2005, the Consortium and Tekla worked together to develop detailed specifications, tests, and further develop the desired software, undertaking extensive production testing. In late August of this year, the Technical Committee of the consortium approved a release candidate of Version 11.1 as substantially meeting the consortium's criteria. This was after over six months of testing and enhancement. As a result of accepting the software's functionality, the purpose of the Consortium was completed and it disbanded. While the consortium members will receive special pricing for their help in developing the software, it is being widely marketed to all precast concrete designers and producers. On the academic side, this effort was the basis for Ghang Lee's Ph.D. thesis and has resulted thus far on 15 journal and conference papers. The work of the consortium required identification and translation of the essential procedures involved in precast concrete design and production, ranging from parking structures to architectural facades.

The system had to be highly customizable to respond to the different specialties of the different precast companies involved. It includes integrated structural analysis, semi-automatic drawing and report generation, and open interfaces allowing development of further applications. This effort has been unique in the construction industry, where such collaboration to develop new software has been rare, and where research and development efforts have been rare. It provides and example of what can be realized when a group can focus on specific desired outcomes.

Ellen Do, PhD Program new faculty member

PhD News

Publications

Book chapter

Zimring C and Dogan F, (2005). Facility Performance Evaluation in the Public and Private Sectors. In W. F. E. Preiser and J. C. Vischer (Eds.), Assessing Building Performance. Oxford, UK: Elsevier. pp. 180-187.

Journal articles

Bafna S, (2005). "Symbolic Content in the Emergence of the Miesian Free Plan." The RIBA Journal of Architecture 10 (2): 181-200.

Dogan F and Nersessian N, (2005). "How DOORKNOB Gets Its Meaning," Journal of Learning Sciences, 14(1): 127–137.

Gharipour M, (2005). "Book Review: History of Persian Gardens," to be published in Garden History Journal, 32 (2).

Gharipour M, (2005). "Healing Gardens: An Examination of the Relationship between Healing and Natural Environment," Journal of Environmental Studies, 1(4): 35-49.

Harris-Kojetin L, Kiefer K, Joseph A, & Zimring C, (2005). Encouraging Physical Activity Among Retirement Community Residents - The Role of Campus Commitment, Programming, Staffing, Promotion, Financing and Accreditation. Seniors Housing & Care Journal 13 (1): 3-20.

Sacks R, Eastman CM, Lee G, and Orndorff D, (2005). "A Target Benchmark of the Impact of Three-Dimensional Parametric Modeling in Precast Construction." Journal of the Precast/Prestressed Concrete Institute, 50(4): 126-139.

Conference proceedings

Ashuri B, Rouse WB, and Augenbroe G, "Data Collection Framework for Strategic Workspace Allocation in Knowledge-Based Enterprises," The Proceedings of the 26th American Society for Engineering Management National Conference, Virginia, October 2005.

Bafna S, "Symbolic Construction in Non-Discursive Media. The Design Evolution of Louis Kahn's Unitarian Church at Rochester." The Proceedings of the 5th International Symposium on Space Syntax, Delft, June 2005.

Dogan F and Nersessian N, "Design Problem Solving with Conceptual Diagrams," 2005 Cognitive Science Society Conference, Stresa, Italy, July 2005.

Economou A, "Tracing axes of growth: The 7 Space Symmorphic Groups and Their Extensions," The Proceedings of the 5th Symposium in Space Syntax, Delft, Netherlands, June 2005.

Economou A and Herndon M, "Linespace: An Automated Generation of the 19 Spaces with 1 Axis of Growth" Proceedings of the 9th Conference of Iberoamerican Society of Digital Graphic, Lima, Peru, October 2005.

Gharipour M and Zimring C, "Design of Gardens in Healthcare Facilities," The Proceedings of the First Conference on Environmental Health and Exposure, Atlanta, October 2005.

Gharipour M, "A Historic Study on the Structure of the Bazaar of Isfahan in Iran," The Proceedings of the UIA 2005 Istanbul Conference, Istanbul, July 2005.

Kim J and Roper K, "Economic Evaluation of Outsource Providers, " The Proceedings of IFMA WWP 2005, Houston, October 2005.

Jiang P and Peponis J, "Historic and Emergent Urban Centers in the Metropolitan Atlanta Region: Spatial Dynamics and Morphogenesis," The Proceedings of the 5th Symposium in Space Syntax, Delft, Netherlands, June 2005.

Lyon E, "Design for Manufacturing in Architecture Mapping in Between Curved Surfaces Design and Fabrication " The Proceedings of eCAADe 2005 Conference, Lisbon, Portugal, September 2005.

Park H, Economou A, and Papalambros P, "Hermes: A Computational Tool for Proportional Studies in Design", The Proceedings of CAAD Futures 2005 - Learning From The Past: A Foundation For The Future. Vienna, Austria, June 2005.

Peponis J and Bellal T, "In Fallingwater: Spatial Structure at the Scale of Quasi-Synchronic Perception", The Proceedings of the 5th Symposium in Space Syntax, Delft, Netherlands, June 2005.

Sacks R, Wessman R, Eastman C, Lee G, and Orndorff D, "3D Parametric Modelling of Precast Structures - a Revolutionary Change." The Proceedings of the 18th BIBM International Congress and Exhibition, Amsterdam, Netherlands, 2005.

Stavroulaki G and Peponis J, "Seen in a Different Light: Icons in Byzantine Museums and Churches", The Proceedings of the 5th Symposium in Space Syntax, Delft, Netherlands, June 2005.

Shpuza E and Peponis J, "Floorplate Shapes and Office Layouts: a Model of the Relationship between Floorplate Shape and Circulation Integration," The Proceedings of the 5th Symposium in Space Syntax, Delft, Netherlands, June 2005.

Swarts M, Monaghan M, and Economou A, "Performing Palladio," Proceedings of the 9th Iberoamerican Society of Digital Graphic Conference, Lima, Peru, October 2005.

Zamani P, "Unfolding Memory: Layering as a Principle of Arrangement and as a Spatial Concept for Memory," The Proceedings of the 5th Symposium in Space Syntax, Delft, Netherlands, June 2005.

Presentations

Eastman C, Industry Presentations at Architectural and Contractor Offices on Building Information Modeling: at SOM, New York, Fall 2005. (two), Perkins and Will, Cooper Carry, and Gilpane, Webcor and SA Mortenson.

Eastman C, (2005) Presentation at the Federal Information Council, at AIA headquarters, August 2005.

Eastman C, panelist, GSA Awards Panel for Building Information Modeling, at the AIA Convention in Las Vegas, May 2005.

Eastman C, panelist, Status Report on Interoperability, at the AIA Convention in Las Vegas, May 2005.

Eastman C, "Redesigning Architecture: the Impact of Building Information Modeling, College of Architecture, Design, and Planning, New Jersey Institute of Technology, September 2005.

Eastman C, "Challenges to Architecture from Building Information Modeling", presentation to the New York AIA Technology Group, July 2005.

Economou A and Gamble M, Sorts F(x): An Assessment of CourtsWeb 4.0 in a Studio Setting. PBS-GSA Capital Construction Conference, Miami, April 2005.

Economou A, "Immersion, Agency, Transformation: Seminar on Game Engines and Virtual Spaces," University of the Aegean, June 2005.

Economou A, "Formal Structures in Architecture and Music," University of Volos, School of Architecture, Volos, Greece, October 2005.

Economou A and Knight T, "Creativity-Rules. SMArchS Colloquium," MIT School of Architecture, Cambridge, October 2005.

Elliott ML, Sundquist ES, "Elites and the Grassroots: The Politics of Growth Machine and Sustainable Community Development in Chattanooga and Seattle," Association of Collegiate Schools of Planning (ACSP), Kansas City, October 2005.

Gharipour M, "A Study of the Syntactic Structure of Bazaar in Iran," Middle Eastern Studies Annual Conference, Washington DC, November 2005.

Gharipour M, "Segmentation of Spaces in Iranian and Japanese Houses," The 2005 Annual Conference of Asian Studies on the Pacific Coast (ASPC), Ontario, June 2005.

Hobson D, "1623-1706 Patterns in the Domestic Architecture of the English settlers in the Leeward Islands, West Indies," Society for Post-Medieval Archaeology Conference: The Colonial Landscape of the Caribbean, June 2005.

Joseph A and Zimring C, "Activity-Friendly Environments for Older Adults: Results from a Survey of 800 Continuing-Care Retirement Communities," Symposium presentation at Environmental Design Research Association (EDRA) 36th Conference, Vancouver, April 2005.

Juneja P and Augenbroe G, "A Comprehensive View of the Cost of Built Space as Enterprise Production Factor," The 26th American Society for Engineering Management National Conference, Virginia, October 2005.

Kim J and Roper K, "Economic Evaluation of Outsource Providers, " IFMA Workplace Conference, Houston, October 2005.

Lee G, "Challenges and Opportunities in BIM Interoperability," ACADIA, Savannah, October 2005.

Monaghan M and Swarts M, "The Villa Capra is a Musical Box," Southeastern Society of Architectural Historians, (SESAH), Fort Worth, October 2005.

Peponis J, "Structure and Description in Design Formulation," 23 eCAADe Conference, Technical University of Lisbon, September 2005.

Sundquist ES, "You Get What You Measure: From Mobility- to Accessibility-Based Transportation Performance Standards," Association of Collegiate Schools of Planning (ACSP), Kansas City, October 2005.

Zhang Y and Augenbroe G, "The Influence of Surface Diffusivity on Reverberation Time Prediction", 149th Meeting of Acoustical Society of America, Vancouver, April 2005.

Zhang Y, Augenbroe G, and Vidakovic B, "A Simplified Method to Estimate the Free Path Length Variance", 149th Meeting of Acoustical Society of America, Vancouver, April 2005.

Zimring C, Briefing to the Board of Trustees, President and Senior Staff of the Robert Wood Johnson Foundation on the Hospital of the 21st Century, Atlanta, October 2005.

Zimring C, Featured speaker, The Role of the Physical Environment in the Hospital of the 21st Century: Building for Improved Patient Outcomes and Staff Satisfaction. Institute of for Healthcare Improvement 1st Annual International Summit on Redesigning Hospital Care, San Diego, May 2005.

Zimring C, Keynote speaker, National Council of Architectural Registration Boards Annual Meeting, Miami, May 2005.

Zimring C, Featured speaker, Keeping Hospital Construction Projects Healthy, Reducing Financial Risk in Healthcare Capital Programs, Atlanta, January 2005.

Zimring C, Featured speaker, SSM Healthcare 2005 Planning Innsbrook, St Louis, Mo, February 2005.

Zimring C, Featured "Hot Topic" Session speaker, American College of Healthcare Executives Congress on Healthcare Management, Chicago, March 2004.

Zimring C, Glasscock Memorial Lecturer, Texas A&M University, April 2005.

Zimring C, Featured speaker, American Society of Health-System Pharmacists Midyear Clinical Meeting, Orlando, December 2004.

Awards

Gharipour M, Houtan Award on Persian Studies, November 2005.

Kim J, 2005 International Facility Management Association (IFMA) Foundation Scholarship, October 2005.

Waddick C, First recipient of the David Kibbey Memorial Scholarship, 2005.

Other news

Anjeli Joseph started a job as the Director of Research at The Center for Health Design in Californoia.

Gayle Nicoll was invited to the Ontario Building Code Building Designation System committee to create the examinations for the Building Code portion of examinations for architects who are going to become certified and registered.

Correction

Ermal Schpuza started a job as Assistant Professor at the College of Architecture in Southern Polytechnic State University not Texas A&M University.

Alumni news:

Fehmi Dogan is currently working at the Department of Architecture at Izmir Institute of Technology, Turkey as an assistant professor and holds the assistant director position at the same department. He has been involved in curriculum development of the undergraduate and graduate program of the Department, has been advising graduate students, and has been teaching both graduate and undergraduate courses. Dogan is also serving on the Jury of a national competition for Manisa Town Hall in Turkey. Dogan has published and presented papers during 2005 in close collaboration with the faculty at Georgia Tech.

Contact Information

Mercedes Saghini,
Ph.D. Academic Assistant,
mercedes.saghini@arch.gatech.edu

Paula Peche,
Ph.D. Research Coordinator,
paula.peche@coa.gatech.edu

Chuck Eastman,
Director, COA Ph.D. Program,
chuck.eastman@coa.gatech.edu

Mohammad Gharipour,
Ph.D. Focus Student Coordinator,
mohammad@coa.gatech.edu

Email correspondence should be addressed to: "paula.peche@coa.gatech.edu" and paper mail correspondence should be addressed to: Ph.D. Office: Room 219, College of Architecture, Georgia Institute of Technology, Atlanta, Georgia 30332-0155, USA.

Ph.D. Office: Room 219
College of Architecture
Georgia Institute of Technology
Atlanta, Georgia 30332-0155