Michael H. Ramage FSA MArch PhD MIStructE CEng

Director, Centre for Natural Material Innovation
Reader in Architecture and Engineering
Vice Master, Sidney Sussex College

University of Cambridge
Department of Architecture
1 Scroope Terrace
Cambridge CB2 1PX

mhr29@cam.ac.uk
www.light-earth.com

+44 (0) 1223 760 121

Education and Qualifications

2016	Member, Institution of Structural Engineers Chartered Engineer
2015	University of Cambridge, Doctor of Philosophy in Structural Engineering *Design, Structure and Construction of Thin Tile Vaults*
2012	University of Cambridge, Master of Arts
2002 - 2006	Massachusetts Institute of Technology, Master of Architecture Thesis: *Catalan Vaulting in Advanced Material: New Approaches to Contemporary Compressive Form*
1997 -1998	Boston University Presidential Scholar
1995 -1996	Fulbright Fellowship, Middle East Technical University, Ankara, Turkey
1991 -1995	Carleton College, BA, *cum laude,* Northfield, MN, USA Major: Geology (with distinction) Minor: Archaeology Thesis: *Sources of Lydian Masonry at Sardis, Turkey* (with distinction)

Professional History

2006 - present	University of Cambridge Department of Architecture Reader in Architecture and Engineering (2018-Present) University Senior Lecturer in Architectural Engineering (2012-2018) University Lecturer in Architectural Engineering (2006-2012)
2007 - present	Sidney Sussex College Vice Master (2016-present) Fellow in Architecture (2008-present) Director of Studies, Architecture (2007-present) Tutor (2008-2014); Dean (2015-2016)
2010 - present	Light Earth Designs LLP Founding Partner
2006	Conzett, Bronzini, Gartmann AG, Chur, Switzerland Architectural designer in contemporary engineering firm
2005	Massachusetts Institute of Technology Department of Architecture Teaching Assistant
2002 – 04	ArchNet, Aga Khan Trust for Culture, Cambridge, Massachusetts Research Assistant

Other Appointments and Affiliations

2015 - present	Editorial Committee: *Journal of the International Association of Shell and Spatial Structures*
2009 - present	Reviewer: Routledge, *Construction and Building Materials*, *Structural Engineer, International Association of Shell and Spatial Structures, Proceedings of the Institution of Civil Engineering*
2012 - present	Grant Reviewer: The Royal Society, Engineering and Physical Sciences Research Council, Swiss Federal Institute of Technology (ETH) Zürich, Israeli Ministry of Science, Technology and Space, Puerto Rico Science, Technology, and Research Trust
2012 - 2016	External Examiner: Edinburgh University School of Architecture & Landscape Architecture
2008 - present	Advisory Committee: Interdisciplinary Design for the Built Environment (IDBE)
1995 - present	Member: Sigma Xi, the Scientific Research Society, USA

2011	Scientific Committee, International Association of Bridge and Structural Engineering & International Association of Shell and Spatial Structures annual symposium
2008 - 2010	Board Member of The Construction History Society of America
2007 - 2010	London Technology Network Business Fellow
2007 - 2010	Treasurer of The Construction History Society, UK

Prizes, Awards, and Other Honours

2016	RIBA President's Award for Research, Design and Technology RIBA President's Medal for Research, shortlist Elected Fellow, Society of Antiquaries of London World Architecture Festival, Future Residential Building, shortlist American Architecture Prize, Platinum Award, Tall Buildings Architecture of Necessity, Sweden, Shortlist, Bahay Kawayan Bamboo House
2014	Award for Best Paper, Lessons from Vernacular Heritage, VERSUS Conference Fritz Höger Prize for Brick Architecture, Nominee
2013	Aga Khan Award for Architecture, Shortlist, Mapungubwe Interpretive Centre Architecture of Necessity, Sweden, Shortlist, Living Link Willow Bridge The Structural Awards, Sustainability Award, Shortlist, Living Link Willow Bridge The Wood Awards, Shortlist, Living Link Willow Bridge
2012	Brick '12 Overall Winner, & Special Solution with Brick, Winner
2011	The Bowls Project, American Council of Engineering Companies, Honor Award International Prize for Sustainable Architecture, Silver Medal
2010	The Earth Awards, Built Environment Category, Winner Tsuboi Award for most outstanding paper of the 2009 IASS Symposium Visiting Artist, Yerba Buena Center for the Arts, San Francisco USA
2009	Centre for Research in Arts, Social Sciences and Humanities Early Career Fellowship World Architecture Festival, World Building of the Year (with Peter Rich Architects) World Architecture Festival, Cultural Building of the Year (with Peter Rich Architects) Institution of Structural Engineers, David Alsop Sustainability Award RIBA Downland Prize, Shortlist (with Richard Hawkes)
2008	Holcim Foundation for Sustainable Construction, Acknowledgement Award, Africa Middle East Region (with Peter Rich Architects) Carbon Crucible, National Endowment for Science, Technology and the Arts, UK Happold Brilliant Award, "for excellence in the teaching of building physics in the context of a low carbon economy" (with Engineering Dept., Cambridge University)
2007	Institution of Structural Engineers (with Scott Wilson Engineers) Structural Awards, Best Small Building (under £1 million), Winner David Alsop Sustainability Award, Commendation London's Sustainable City Award, for Best Sustainable Building (with Helionix Designs) *Building* magazine, Sustainable Building of the Year (Small Project) (with Helionix Designs)
2006	Alpha Rho Chi Medal, Massachusetts Institute of Technology: Awarded to the graduating student who has shown an affinity for leadership, performed willing service for the school or department, and gives promise of real professional merit through his or her attitude and personality.
2005	Marvin E. Goody Award, Massachusetts Institute of Technology: To extend the horizons of existing building techniques and use of materials, to encourage links between the academic world and the building industry, and to increase appreciation of the bond between good design and good building.

Peer-reviewed Journal Articles

Shah D.U, Sharma B., Ramage, M.H. (2018) Processing bamboo for structural composites: Influence of preservative treatments on surface and interface properties. International Journal of Adhesion and Adhesives. Vol 85, pp15-22 https://doi.org/10.1016/j.ijadhadh.2018.05.009

Reynolds, T.P.S, Burridge, H.C., Johnston, R., Wu, G., Shah, D.U., Scherman, O.A., Linden, P.F., Ramage, M.H. Cell geometry across the ring structure of Sitka spruce. J R Soc Interface. Vol. 15, Issue 142. eiSSN 1742-5662 http://doi.org/10.1098/rsif.2018.0144

Penellum, M., Sharma, B., Shah, D.U., Foster, R.M., Ramage, M.H., (2018) Relationship of structure and stiffness in laminated bamboo composites. Construction and Building Materials, Vol. 165, pp 241-246 https://doi.org/10.1016/j.conbuildmat.2017.12.166

Ramage, M.H. (2018) Supertall timber: Functional natural materials for high-rise structures. Bridge, Vol. 48, Issue 1, pp33-36 ISSN 0737-6278

Wu, Y., Shah, D.U., Wang, B., Liu, j., Ren, X., Ramage, M.H., Scherman, O.A. (2018) Biomimetic Supramolecular Fibers Exhibit Water-Induced Supercontraction. Advanced Materials, 1707169. https://doi.org/10.1002/adma.201707169

Sharma, B., Shah, D.U., Beaugrand, J., Janecek, E.R., Scherman, O.A., Ramage, H.R., (2018) Chemical composition of processed bamboo for structural application. Cellulose, Vol 25, issue 6, pp3255-3266 https://doi.org/10.1007/s10570-018-1789-0

Bourmaud, A., Dhakal, H., Habrant, A., Padovani, J., Siniscalco, D., Ramage, M.H., Beaugrand, J., ShahD.U. (2017) Exploring the potential of waste leaf sheath date palm fibres for composite reinforcement through a structural and mechanical analysis, *Composites Part A: Applied Science and Manufacturing*, V.103, Dec, pp 292-303, (14 pp) https://doi.org/10.1016/j.compositesa.2017.10.017.

Foster, R., Ramage, M., and Reynolds, T.(2017) Rethinking CTBUH Height Criteria in the Context of Tall Timber. Council on Tall Buildings and Urban Habitat Journal. Issue IV. Pp 28-33. (6 pp)

Ramage, M.H., Sharma, B., Shah, D.U., Reynolds, T.P.S. (2017). Thermal relaxation of laminated bamboo for folded shells. *Materials and Design*, Volume 132, 15 October 2017, Pages 582-589 (8 pp) https://doi.org/10.1016/j.matdes.2017.07.035.

Reynolds, T., Foster, R., Bregulla, J., Chang, W-S., Harris, R., Ramage, M.H. (2017) Lateral Load Resistance of Cross-laminated Timber Shear Walls. *Journal of Structural Engineering*, Vol. 143, Issue 12, pp 1943-1954. (6 pp) https://doi.org/10.1061/(ASCE)ST.1943-541X.0001912

Wagemann, E., Ramage, M. (2017) Bamboo for Construction in Pakistan: A Scoping Review. *Proceedings of the Institution of Civil Engineers: Construction Materials,* online August 31, 2017 (7 pp) https://doi.org/10.1680/jcoma.17.00045

Shah, D., Reynolds, T., & Ramage, M. H. (2017). The strength of plants: theory and experimental methods to measure the mechanical properties of stems. *Journal of Experimental Botany*, Volume 68, Issue 16, pp 4497–4516, (20 pp) https://doi.org/10.1093/jxb/erx245

Wu, Y., Shah, D.U., Liu, C., Yu, Z., Liu, J., Ren, X., Rowland, M. , Abell, C., Ramage M.H., Scherman, O.A., (2017). "Bioinspired supramolecular fibers drawn from a multiphase self-assembled hydrogel," *PNAS*. vol. 114 no. 31, pp 8163–8168 (6 pp). www.pnas.org/cgi/doi/10.1073/pnas.1705380114

Sanner, J, Fernandez, A, Foster, R, Ramage, M, Snapp, T, Weihing, D (2017) River Beech Tower: A Tall Timber Experiment. CTBUH Journal, Issue 2, p40-46 (7 pp).

Wu, G., Shah, D.U., Janeček, E., Burridge, H., Reynolds, T., Fleming, P., Linden, P., Ramage, M. & Scherman, O.A. (2017) Predicting the Pore-Filling Ratio in Lumen Impregnated Wood. *Wood Science and Technology*. 51:1277–1290 (14 pp) DOI 10.1007/s00226-017-0933-6 6

Janeček, E., Walsh-Korb, Z., Bargigia, I., Farina, A., Ramage, M., D Andrea, C., Nevin, A., et al. (2017). Time-resolved laser spectroscopy for the in situ characterization of methacrylate monomer flow within spruce. *Wood Science and Technology, 51* (2), 227-242. (16 pp) https://doi.org/10.1007/s00226-016-0882-5

Ramage, M.H., Burridge, H., Busse-Wicher, M., Fereday, G., Reynolds, T., Shah, D.U., Wu, G., Yu, L., Fleming, RP, Densley-Tingley, D., Allwood, J., Dupree, P., Linden, P.F. , Scherman, O. (2017) The wood from the trees: The use of timber in construction, *Renewable and Sustainable Energy Reviews,* Volume 68, Part 1, pp 333-359, (27 pp) http://dx.doi.org/10.1016/j.rser.2016.09.107.

Ramage, M.H., Foster, R.M., Smith, S., Flanagan, K. and Bakker, R. (2017). "Super Tall Timber: Design research for the next generation of natural structure", 2017. *The Journal Of Architecture* Vol. 22:1, 104-122 (19 pp). http://dx.doi.org/10.1080/13602365.2016.1276094

De Wolf, C., Ramage, M., Ochsendorf, J. (2016). Low carbon vaulted masonry structures. *Journal of the International Association for Shell and Spatial Structures*. 57 (4) n 190. 275-84, (10 pp) http://dx.doi.org/10.20898/j.iass.2016.190.854

Sharma, B., Bauer, H., Schickhofer, G., Ramage, M.H., (2016). Mechanical characterisation of structural laminated bamboo. *Proceedings of the Institution of Civil Engineers-Structures and Buildings*. 170 (4) pp 250-264 (15 pp). https://doi.org/10.1680/jstbu.16.00061

Foster, R., Reynolds, T., and Ramage, M. (2016). "Proposal for Defining a Tall Timber Building." J. Struct. Eng. , 142(12). Pp 1943-54 (9 pp) 10.1061/(ASCE)ST.1943-541X.0001615

Foster, R.M. and Ramage, M.H. (2016). "Briefing: Super Tall Timber - Oakwood Tower", *Proceedings of the Institution of Civil Engineers - Construction Materials,* Volume 170 Issue 3, pp. 118-122. (5 pp) http://dx.doi.org/10.1680/jcoma.16.00034

Reynolds, T., Sharma, B., Harries, K., & Ramage, M. (2016). Dowelled structural connections in laminated bamboo and timber. *Composites Part B: Engineering*, 90, 232–240. (9 pp). http://doi.org/10.1016/j.compositesb.2015.11.045

Shah, D. U., Bock, M. C. D., Mulligan, H., & Ramage, M. H. (2016). Thermal conductivity of engineered bamboo composites. *Journal of Materials Science*, 51(6), 2991–3002. (12 pp) http://doi.org/10.1007/s10853-015-9610-z

Liu, X., Smith, G., Jiang, Z., Bock, M., Boeck, F., Frith, O., Gatóo, A., Liu, K., Mulligan, H., Semple, K., Sharma, B., & Ramage, M. (2016). Nomenclature for Engineered Bamboo. *BioResources,* 11(1), 1141-1161. (21 pp). doi:10.15376/biores.11.1.1141-1161

Wagemann, E, Gatóo, A, Ramage, M.H. (2015) "Bahay Kawayan. Post Disaster Housing in Bamboo." *ARQ,* August, no.90, Estructuras Desmontables, Ediciones ARQ: pp.68-69. (2 pp)

Sharma B, Gatóo A, Ramage M.H. (2015) "Effect of processing methods on the mechanical properties of engineered bamboo." *Journal of Construction and Building Materials*, 83: pp 95-101. (7 pp).

Sharma B, Gatóo A, Bock M, Ramage M.H. (2015) "Engineered Bamboo for structural applications." *Journal of Construction and Building Materials*, 81: pp 66-73. (8 pp)

Ramage, M.H., Hall, T., and Rich, P. (2014) "Light Earth Designs: Natural Material, Natural Structure" *Earthen Architecture: Past, Present and Future*. CRC Press pp 305-310. (6 pp).

Sharma, B., Gatóo, A., Bock, M., Mulligan H., Ramage M.H. (2014). "Engineered bamboo: state of the art." *Proceedings of the Institution of Civil Engineers: Construction Materials*. 168:2, pp 57-67. (11 pp)

Gatóo, A., Sharma, B., Bock, M., Mulligan H., Ramage M.H. (2014). "Sustainable structures: bamboo standards and building codes." *Proceedings of the Institution of Civil Engineers: Engineering Sustainability* 167 (ES5). pp 189–96. (8 pp)

Fleming, P, Smith S, and Ramage, M.H. (2014.) "Measuring-Up in Timber: a Critical Perspective on Mid-and High-Rise Timber Building Design." *Architectural Research Quarterly* 18 (01). pp 20–30. (11 pp)

Farina, A, Bargigia, I, Janeček, E, Walsh, Z, D'Andrea, C, Nevin, A, Ramage, M.H., Scherman, O, and Pifferi, A. (2014.) "Nondestructive Optical Detection of Monomer Uptake in Wood Polymer Composites." *Optics Letters* 39 (2). pp 228–31. (4 pp).

Trujillo, D., Ramage, M.H. and Chang, W-S. (2013). "Lightly Modified Bamboo for Structural Applications." *Proceedings of the Institution of Civil Engineers: Construction Materials* 166 (4). pp 238–47. (10 pp)

Heath, A. Paine, K., Goodhew, S., Ramage, M.H. and Lawrence, M. (2013). "The Potential for Using Geopolymer Concrete in the UK." *Proceedings of the Institution of Civil Engineers: Construction Materials* 166 (4). pp 195–203. (9 pp)

Atamturktur, S, Li, T., Ramage, M.H., and Farajpour, I. (2012). "Load Carrying Capacity Assessment of a Scaled Masonry Dome: Simulations Validated with Non-Destructive and Destructive Measurements." *Construction and Building Materials* 34. Elsevier: pp 418–29.

Brown, D., Saito, K., Liu, M., Spence, R., So, E., and Ramage, Michael H. (2012). "The Use of Remotely Sensed Data and Ground Survey Tools to Assess Damage and Monitor Early Recovery Following the 12.5. 2008 Wenchuan Earthquake in China." *Bulletin of Earthquake Engineering* 10 (3). Springer: pp 741–64. (25 pages)

Ramage, M.H. and R.H. Tykot. (2011) "Geological analysis of Lydian building stones and their quarry sources," in C. Ratte, *Lydian Architecture,* Archaeological Exploration of Sardis, pp127-132. (6 pages)

Ramage, M.H., Ochsendorf, J. and Rich, P. (2010) "Sustainable Shells: New African vaults built with soil-cement tiles," *Journal of the International Association of Shell and Spatial Structures*, Vol.51 No. 4 December, pp 255-261. (7 pages)

Ramage, M.H., Ochsendorf, J., Rich, P., Bellamy, J.K., Block, P. (2010). "Design and Construction of the Mapungubwe National Park Interpretive Centre, South Africa," *African Technology Development Forum Special Issue: Architecture and Development,* October, pp 14-23. (10 pages)

Ramage, M.H., Rich, P., Ochsendorf, J., & Fitchett, A. (2009). "Mapungubwe: National Park Interpretive Centre." *Architecture South Africa: Journal of the South African Institute of Architects*. (Jan-Feb), pp 28-30.

Ramage, M.H. (2009) "Designing Shell and Membrane Structures" *Form and Forces*. Chapter 12. E. Allen and W. Zalewski (Eds.), John Wiley & Sons. pp 331-354.

Ramage, M.H. (2007). "Guastavino's Vaulting Revisited," *Construction History*, Vol. 22, November, pp. 47-60.

Ramage, M.H. (2007). "Structural Vaulting Built with Aircrete Masonry," *Masonry International*, Vol. 20, No. 1 April, pp 29-34.

Tykot, R.H. and Ramage, M.H. (2002) "On the Importation of Monumental Marble to Sardis." In *ASMOSIA 5: Interdisciplinary Studies on Ancient Stone*. Museum of Fine Arts, Boston, 1998, edited by J.J. Herrmann, N. Herz & R. Newman, London: Archetype, pp. 335-339.

Ramage, M.H. and R.H. Tykot. (1996) "Movement of Monumental Marble to Lydian Sardis." *American Journal of Archaeology*, vol. 100 p 377.

Matthews, R.J., Pollard, T., and Ramage, M.H. (1998) Project Paphlagonia: Regional Survey in Northern Anatolia, in *Ancient Anatolia Fifty Years' Work by the British Institute of Archaeology at Ankara*, London: Oxbow Books, pp. 195-206.

Publications Not Peer-Reviewed

Bakker, R., Ramage, M. and Foster, R. (2017) "Natural Building Materials" in Buhler, M.M. and Kosta, I. [Eds.] World Economic Forum White Paper – Shaping the Future of Construction: Insights to redesign the industry, World Economic Forum, Switzerland, p. 82 (1 page)

Gatóo A, Wagemann E, Ramage M. H. (2015) *Bahay Kayayan: a transitional house for the Philippines*. Department of Engineering, Cambridge University, ISBN 978-0-903428-36-1, 2015. (50 pages)

Ramage, M.H. (2013). "Light Earth Designs: Site Specific Practice and Research." *Architectural Journal.* Special Issue: Innovation Strategy in Sustainable Design Practice (in Chinese). 2013/07 pp. 3-7. (4 pages)

Mulligan, H. and Ramage, M.H. (2013). "Tomorrow's Material Today: From Data to Design in Engineered Bamboo." *World Architecture 2013/12: Exploring the Potentials of Bamboo*. pp. 35-39. (5 pages)

Wagemann, E., Ramage, M.H. (2013). "Relief for the curriculum: Architecture education and disaster recovery", *Scroope: The Cambridge Architecture Journal,* issue 22. pp. 129-133. (5 pages)

Ramage, Michael (2012). "Don's Diary." Cambridge Alumni Magazine. University of Cambridge Issue 66. p. 3. (1 page)

Ramage, Michael (2012). "*Ladrillo Recargado*: exploring the work of Alfonso Ramirez Ponce," *Scroope: The Cambridge Architecture Journal,* Issue 21. pp. 52-59. (8 pages)

Selected Conference Papers and Presentations

Ramage, M.H (2017). Supertall Timber: Functional Natural Materials for High-Rise Structures, in US Frontiers of Engineering, National Academy of Engineering, Hartford, USA. (4 pages).

Ramage, MH, Snapp, T., Weihing, D. (2017) River Beech Tower. Chicago Committee on High Rise Buildings, Chicago, Illinois, USA

Ramage, MH (2017). Enhancing and extending the classroom with digital content: teaching structural design to students with diverse subject knowledge. Cambridge University Teaching Forum, Cambridge UK.

Reynolds, T., Feldmann, A., Ramage, M., Chang, W-S., Dietsch, P. (2016) Design Parameters for Lateral Vibration of Multi-Storey Timber Buildings. In: International Network on Timber Engineering Research, Graz, Austria.

Wu G., Shah D., Janeček E, Ramage M.H., and Scherman O.A. (2015) "Predicting the Pore-Filling Ratio in Lumen Impregnation from Weight Percentage Gain and Densities of Wood" in *Proceedings of the 8th European Conference on Wood Modification*, Helsinki, Finland.

Shah, DU, Reynolds TPS, Busse-Wicher M, Yu L, Dupree P, Ramage MH. (2015) "Probing the role of xylan in the irreversible deformation of *Arabidopsis thaliana*" in *Proceedings of the 8th International Plant Biomechanics Conference*. Nagoya, Japan. (5 pages)

Sharma B, Gatóo A, Ramage, M.H. (2015) "Natural Fibre Composites: Engineered Bamboo for Construction." *Proceedings of the 7th Biennial Conference on Advanced Composites In Construction* (ACIC), Cambridge, UK, pp. 41-46. (6 pages)

Ramage M.H., Sharma B, Gatóo A, Konstantatou M, Reynolds T, Fereday G, Fleming P, Shah D, Wagemann E. (2015) "Prelude: the future of structural bamboo." *Proceedings of the International Association for Shell and Spatial Structures (IASS): Future Visions*, Amsterdam, The Netherlands. (9 pages)

Sharma, B, Konstantatou, M, Reynolds, T, Ramage, M.H. (2015) "Engineered Bamboo for Shell Structures." *Proceedings of the International Association for Shell and Spatial Structures (IASS): Future Visions*, Amsterdam, The Netherlands. (12 pages)

Sharma B, Gatóo A, Ramage M.H. (2015) "Engineered Bamboo: Material Innovation for a Sustainable Built Environment." *Engineering Sustainability*, Pittsburgh, Pennsylvania. (2 pages)

Fleming, P., and Ramage, M.H. (2014) "Tectonic Strategies for Using Fast-Growing, Low-Grade Softwoods for Engineered Wood Products." *Proceedings of the World Conference on Timber Engineering,* A Salenikovich, ed. (10 pages)

Ramage, M.H., Bock, M., Gatóo A., Mulligan, H., B. Sharma, Y. Xu. (2014) "Structural Bamboo Products: A Novel Engineering Material," *Forest Products Society International Convention*, Quebec, Canada. (2 pages)

Mulligan, H., Bock, M., Gatòo, A., Sharma, B., Xu, y., Ramage, M.H.. (2014) "Comparing Life Cycle Analysis of Typical bamboo Board Products from China and Colombia," *Forest Products Society International Convention*, Quebec, Canada. (2 pages)

Fleming, P., Singler, S., and Ramage, M.H. (2014). "Construction history and alteration of the oak roof structure of the Sidney Sussex College Hall," *Proceedings of the First Conference of the Construction History Society*, p. 113-120. (8 pages)

Fleming, P. and Ramage, M.H. (2013). Minimalist Materiality in Wood: working with wood as a natural material, *International Symposium on Transmaterial Aesthetics,* Berlin, Germany. (8 pages)

Ramage, M.H. and Dejong M.J. (2011)"Design and Construction of Geogrid-reinforced Thin-shell Masonry" in *Taller, Longer, Lighter: meeting growing demand with limited resources*, edited by D. A. Nethercot and S. Pellegrino. London. (7 pages)

DeJong, M.J., Ramage, M.H., Travers B., Terry S. (2011) "Testing and Analysis of Geogrid-reinforced Thin-shell Masonry" in *Taller, Longer, Lighter: meeting growing demand with limited resources*, edited by D. A. Nethercot and S. Pellegrino. London. (8 pages)

Wray, G., Sinclair, M., Ramage, M.H. (2011). The Bowls Project – A Prototype for Full Scale Testing as an Alternate Approval Process for Small Scale Base-Isolated Structures, *Proceedings of the 2011 Structures Congress,* Nevada. pp 839-851. (13 pages)

Fleming, P., Ramage, M.H., Smith, S. (2010). "Super Tall Timber." in *High Rise Shuffle – 4th International Alvar Aalto Meeting on Modern Architecture*, edited by Antti Ahlava and E. Laaksonen. Alvaro Aalto Academy, Helsinki, pp 32-40. (9 pages)

Ramage, M.H., J. Ochsendorf, and P. Rich. (2009). "Sustainable Shells: New African vaults built with soil-cement tiles," in *Proceedings of the International Association for Shell and Spatial Structures (IASS),:* edited by A. Domingo and C. Lazaro. Valencia: IASS, pp. 1512-1520 (9 pages)

Ramage, M.H, F.A. McRobie, R. Thomas. (2008) "Architectural engineering: collaborating to deliver energy efficient buildings," in *The Oxford Conference: A Re-evaluation of Education in Architecture*, edited by S. Roaf and A. Bairstow. Southampton: WIT Press, pp. 207-210. (4 pages)

Ramage, M.H., W.W. Lau, and J. Ochsendorf. (2007). "Compound curves in thin-shell masonry: Analysis and construction of new vaults in the UK." *International Association of Shell and Spatial Structures 2007 Proceedings*, Venice: IASS. (8 pages)

Grant Funded Projects

Current

FIREne: Flame InhibitoR Enable by graphENE 2017-2018
InnovateUK £100K
PI Ramage; Industrial Partner Cambridge Nanosystems

A graphene-based coating patented by FGV Cambridge Nanosystems (CNS) shows the potential to reduce the flammability of wood. FIREne investigates the performance of these coatings for building components. Collaboration between CNS and the Centre for Natural Material Innovation will optimise 'green' formulation of the coating and its effectiveness in flame retardancy by measuring bonding to and penetration through the wood's cellular structure. The most efficient interaction between coating and wood will be identified based on a range of industry-standard fire tests, carried out in collaboration with the BRE Centre for Fire Safety Engineering at the University of Edinburgh.

Structural Design Principles: Diverse content for diverse minds 2016-2017
Learning and Teaching Innovation Fund, Cambridge University £18K
PI Ramage

The aim of this project is to provide better and more accessible Structural Design teaching for architecture students. In this project I will develop a series of videos and interactive digital media that will include lecture material and other content necessary for architecture students to learn and understand structural design. The videos will be short, containing key concepts and demonstrations that the students could return to repeatedly. My research is closely linked to the teaching I do, and relies on the same structural principles that I teach. With this project I can bring the research to the students, and show them applications of the material they are learning. In my experience as a teacher, the tangible application of abstract information makes it more interesting and retainable.

Natural Material Innovation 2014-2019
The Leverhulme Trust, Programme Grant: £1.75M
PI Ramage; Co-Is Prof. P. Linden, Prof. P. Dupree, Prof. O. Scherman

There is no other team in the world that works across multiple scales and disciplines on natural materials in architecture and engineering. My vision is to establish new sustainable applications for renewable, energy-efficient and plant-based natural materials in the built environment, in order to improve building quality and mitigate the human impact on climate change. The research proposes to redesign natural materials to carry out different functions that will change the way we construct cities and civil infrastructure. This effort starts at the molecular level and continues through to engineered solutions that provide new approaches to sustainable living. My diverse programme brings together people and research in plant sciences, biochemistry, chemistry, fluid dynamics, engineering and architecture in a groundbreaking manner. It aims to fundamentally transform the way we build, and we will develop and extend research to enable the substitution of traditional manufactured materials with new naturally-based materials.

Natural Structural Materials: Super Tall Timber 2015-2017
Engineering and Physical Sciences Research Council Bright IDEAS Award: £250K
PI Ramage

The research funded through this Bright IDEAS proposal will enable the use of natural materials in taller and larger buildings as a substitute for steel and concrete, and to reduce the carbon emissions associated with them. Natural materials are uncommon in the built environment beyond a domestic scale, but my research suggests these materials have unmet potential as more sustainable alternatives to steel and concrete.

Completed

Preparation for Disaster: Bamboo Shelter in Pakistan 2016-17
EPSRC GCRF Cambridge University, £20K
PI Ramage

A pilot project to lay the groundwork for a more comprehensive study over two years with the International Organization for Migration (IOM) Pakistan. The objectives of the project are to prepare resources, information, guidelines, and training for the humanitarian community, so that the next time reconstruction is required, it can be done efficiently and effectively using bamboo as an available and sustainable local resource. Our research will explore the situation of bamboo construction in the country, including how feasible it is, what types of treatment exist, what local knowledge in construction is available, and what the perceptions and barriers are to bamboo housing. We will provide practical recommendations to NGOs and communities on using bamboo for disaster preparedness.

Structural Bamboo Products 2012-2016
Engineering and Physical Sciences Research Council: £545K (Total funding €1.25M)
PI Ramage; Co-Is Prof. L. Gibson (MIT; NSF funding) & Prof. G.Smith (UBC, NSERC funding)

Structural bamboo products (SBP), similar to plywood, oriented strand board, or glue-laminated wood products, have enormous potential to partially replace the use of more energy intensive materials in rapidly developing countries. Widespread use is hampered by limited knowledge of their structural and thermal behaviour, and lack of appropriate building codes. The goal of this project is to develop modern structural building materials from renewable bamboo.

EcoHouse Initiative 2012-2015
Anglo American Group Foundation: £300K
PI Ramage; Co-Is Prof. Peter Guthrie, Allan McRobie, Dr. Gemma Burgess

The EcoHouse Initiative is a multidisciplinary programme that aims to facilitate sustainable growth in the context of poverty and climate change in the developing world. The Initiative links students, academics, NGOs, and governments in the development of sustainable housing solutions and urban planning. We research, design and build with local organisations. The aim is to introduce affordable sustainable housing in communities for the urban poor.

Prelude: demonstrating the potential of structural bamboo
ESRC Impact Acceleration Account award: £4k
PI Ramage

This funding was specifically to fund the cost of building and installing our structural pavilion in Amsterdam for exhibition in summer 2015.

Knowledge Exchange Platform for Communities in Need
HEFCE Higher Education Innovation Funding-5: £46K
PI Ramage

The project established a knowledge transfer scheme between higher education institutes and low-income communities in urban settings. To enable a two-way flow of information between community and university, a digital knowledge exchange platform and a participatory design scheme was developed. This captured the local skill sets, needs and aspirations of community members. Information was processed by our group and findings shared during community meetings held in partnership with UN-Habitat.

Michael H. Ramage FSA MArch PhD MIStructE CEng

East to West and Back Again: mutual influence in Cistercian and Seljuk architecture in the late 12th and early 13th centuries 2012-2015
British Academy: £10K
PI Ramage; Co-I Dr. James Campbell

> The appearance of the pointed arch in Western architecture and its possible origin in the Middle East has been the subject of speculation since at least the 17th century and possibly before. The similarities in form and spatial arrangement between certain Cistercian churches in 12th century France/Switzerland and the Seljuk hans of 13th century Turkey have been commented on in secondary literature, but have not been seriously investigated. This study examined whether these buildings are merely close in morphology or if they were actually built in similar ways.

SENSUM: Framework to integrate space-based and in-situ sensing for dynamic vulnerability and recovery monitoring 2013-2015
EU FP7: £180K (Total consortium funding €1.9M)
Co-I Ramage; PI Dr. Emily So; (Partners: GFZ, DLR (Germany); NGI (Norway)

> SENSUM delivered innovative methodologies and software tools for dynamic, multi-resolution monitoring of pre-disaster vulnerability and preparedness and post-disaster recovery planning and monitoring, based on current and future space-based products and a novel approach to in-situ observation for data rich and data poor countries.

Materials and Construction for Energy Efficient Buildings in Developing Countries 2012-2014
Newton Trust: £74K
PI Ramage

> This project explored the role of material efficiency for construction in low-income communities in the developing world. Through an understanding of architecture, engineering, and materials science we researched interventions that can have incremental and step-change improvements in transitional and permanent housing for the poorest of the poor.

DTG Studentship: Novel wood structures 2009-2014
Engineering and Physical Sciences Research Council: £70K; Ramboll UK: £45K
PI Ramage

Commercialisation of Satellite-based Monitoring and Evaluation Data for Long-term Disaster Recovery 2011-2012
Engineering and Physical Sciences Research Council: £174K
PI Ramage; Co-I Dr. Keiko Saito

> The project brought to the market systematic and independent monitoring and evaluation data that meets the needs of stake holders such as national governments, international donors and NGOs. The project will use the outcomes of EPSRC project 'Indicators for Measuring, Monitoring and Evaluating Post-Disaster Recovery' (EP/F015232/1), where a suite of twelve Performance Indicators were developed using high-resolution satellite imagery.

Digital Construction: a novel approach to building structural form 2010-2012
Royal Society: £15K
PI Ramage

> Engineering projects are designed in CAD, but few tools exist to go from data to construction. I researched the interface of digital design and construction to develop tools to deliver digital construction information directly to a builder.

CASE Studentship: Novel Wood/Polymer Composites for Better Engineered Natural Timber 2008-2012
Engineering and Physical Sciences Research Council: £70K; Ridgeons, Cambridge: £30K
Co-I Ramage, with Dr. Michelle Oyen and Dr. Oren Scherman

Simulation Platform for Resource and Emissions Limited Systems 2010-2011
NESTA / UKERC: £20K
Co-I, with Dr. A. Macrina, KCL, Dr. C. Ennis, U Teesside, Dr. A Heinemeyer, York, Dr. M. Ricci, UWE and Dr. T. Schnier, U Birmingham

My role was the built environment researcher and analysing the associated emissions.

Field survey of Wenchuan Earthquake in Sichuan, China 2008-2009
Engineering and Physical Sciences Research Council: £25K
PI Ramage

A field survey of the areas affected by the 12.05.08 earthquake was conducted with the aim of assembling quantitative damage data and developing the use of remote sensing for the monitoring of earthquake damage and recovery.

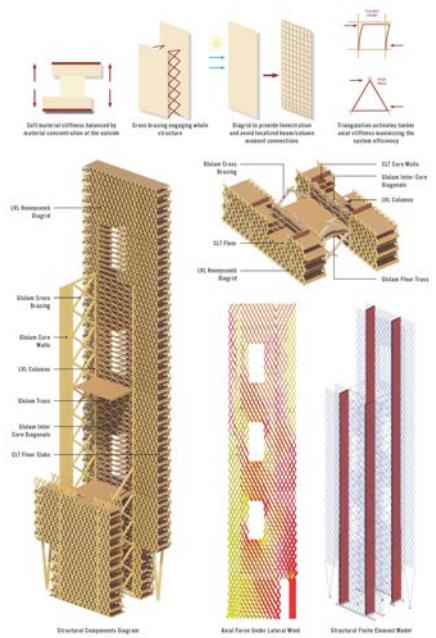
Buildings and Structures

2017 *Rwanda Cricket Stadium, Kigali*
650 m² Light Earth Designs: Michael Ramage, Tim Hall

Michael H. Ramage FSA MArch PhD MIStructE CEng

2016 ***Oakwood Tower, The Barbican, London***
Centre for Natural Material Innovation, PLP Architecture, Smith & Wallwork Engineers
River Beech Towers, Chicago
Centre for Natural Material Innovation, Perkins+Will, Thornton Thomasetti

Selected Reviews:
Stinson, E (2017). "Get ready for skyscrapers made of wood" *Wired* 05.30
The Economist, Sept. 10 2016. "Top of the tree: The case for wood is not barking"
Wilcox, K. (2016). "Team Designs 300m Timber Tower." *Civil Engineering*, 26 April.
Hurst, W. (2016). "Wooden skyscraper proposed for the Barbican." *Architects' Journal* 8 April.
Marsh, J. (2016). "Spreading like wildfire: Why wooden skyscrapers are springing up across the world." *CNN.com* 26 April.



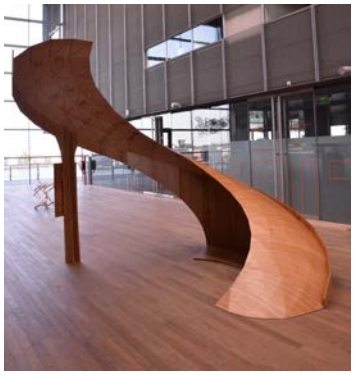
Michael H. Ramage FSA MArch PhD MIStructE CEng

2015 ***Sussex Cellars, St. James Place. London***
750 m² Michael Ramage, Vault design, in building by Short & Associates, and MJP Associates

Review:
Latham, I. (2015) Hidden Depths. *Architecture Today* 260 (July). pp 34-42. (9 pages)

2015 ***Prelude. Muziekgebouw, Amsterdam***
Michael Ramage, Bhavna Sharma, Ana Gatoo, Marina Konstantatou, Darshil Shah, Tom Reynolds

Exhibition:
International Association of Shell and Spatial Structures EXPO June-August 2015



2013 ***FR2 Offices, Chicago***
1000 m² Light Earth Designs: Michael Ramage, Tim Hall, Peter Rich

Review:
Ryan, R. (2014) Nature and Matter in a Working Space. *The Plan* 072. pp 26-36. (11 pages)

Michael H. Ramage FSA MArch PhD MIStructE CEng

2012 ***The Living Link Bridge, Waterbeach, Cambridgeshire***
Michael Ramage, Simon Smith, Patrick Fleming

Exhibition:
Architecture of Necessity 2013 Virserums Konsthall, Virserum, Sweden, May-Dec. 2013.

Awards:
Architecture of Necessity, Sweden, shortlist
The Structural Awards, Sustainability Award, shortlist
The Wood Awards, shortlist

2010 ***The Earth Pavilion, London***
75 m² **Light Earth Designs:** Michael Ramage, Peter Rich, Tim Hall

Reviews:
Gregory, R. (2010). Earth Pavilion by Peter Rich Architects and Michael Ramage. *Architectural Review*, 228(1365), 76-81. (6 pages)

Dahmen, J. F. D. and Ochsendorf, J (2012). Earth masonry structures: arches, vaults and domes. in Hall, M et. al. *Modern Earth Buildings: Materials, Engineering, Constructions and Applications,* Woodhead Publishing 427-460 (33 pages).

Exhibition:
HRH Prince Charles START Festival 2010, London

Awards:
2010 The Earth Awards, Built Environment, Winner

2010 ***The Bowls Project, Yerba Buena Center for the Arts, San Francisco***
75 m² Michael Ramage with McCall Design Group and Degenkolb Engineers

Review:
King, J., "Public Art: Domes Rise at Yerba Buena Center for the Arts," *The San Francisco Chronicle*. 3 July 2010.

Exhibition:
Yerba Buena Center for the Arts, San Francisco, June-October 2010

Award:
2010 American Council of Engineering Companies, Honor Award

2009 ***Mapungubwe National Park Interpretive Centre, South African National Parks***
1500 m² Peter Rich, Michael Ramage, John Ochsendorf

Selected Reviews:
Mostafavi, M. ed. (2013). *Architecture Is Life*. Müller, Zürich. pp 74-81. (8 pages)

Maglica, I. (2012) Mapungubwe Interpretation Centre. *Brick '12: Award-winning International Brick Architecture*. Callwey, Munich. pp 16-21. (6 pages)

Hudson, J. (2012). Architecture: *From Commission to Construction*. Lawrence King, London pp. 158-167 (10 pages)

Zami, M. S., & Lee, A. (2011). Widespread adoption of contemporary earth construction in Africa to address urban housing crisis. *The Built & Human Environment Review, 4(2)*.

Chilton, J. (2010). Heinz Isler's Infinite Spectrum: Form−Finding in Design. *Architectural Design*, 80(4), 64-71. (8 pages)

Pagliari F. (2010) Mapungubwe Interpretive Centre. *The Plan* 043 pp 86-95. (10 pages)

Fitchett, A. (2010) "Mapungubwe Interpretation Centre, South Africa," *Domus* 932 (1). pp 26-32. (7 pages)

Fagan, G. (2010). "Mapungubwe Interpretation Centre by Peter Rich Architects, Mapungubwe National Park, South Africa", *The Architectural Review*. 227 (1356) 40-47. (8 pages)

Long, K & Slessor, C. (2009). "Talent and passion converge at the 2009 World Architecture Festival," *The Architectural Review*. 226 (1354), pp 37-38. (2 pages)

Michael H. Ramage FSA MArch PhD MIStructE CEng

Awards:
South African National Parks Design Competition, Winner
Holcim Foundation for Sustainable Construction
Acknowledgement Award, Middle East and Africa region
Structural Awards, Institution of Structural Engineers
David Alsop Sustainability Award
World Architecture Festival
World Building of the Year Award, and Winner, Culture Category
International Prize for Sustainable Architecture
Brick '12 Overall Winner, & Special Solution with Brick, Winner
Aga Khan Award for Architecture, Shortlist
Fritz Höger Prize for Brick Architecture, Nominee

Michael H. Ramage FSA MArch PhD MIStructE CEng

2008 ***Crossway, Staplehurst, Kent***
300 m² Vault and stair: Michael Ramage & Philip Cooper

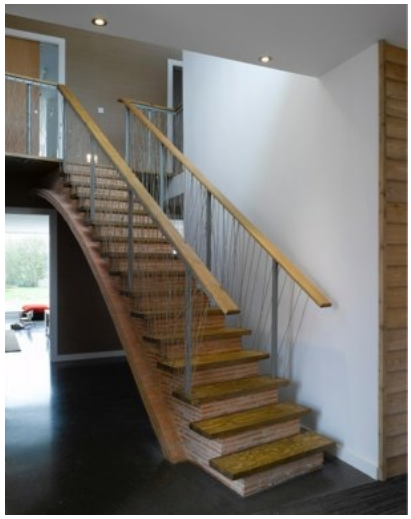
Reviews and Publications:
McCloud, K. (2009) "The Eco Arch," *Grand Designs*, Channel 4, Broadcast 18 February

Strongman, C. (2009) "Local Hero," *Grand Designs Magazine*. August. pp 62-70

Hickman, L. (2009) "Crossway eco home vaults into future," *The Guardian*. 18 February.

Kennett, S. (2009) "Medieval architecture inspires zero-carbon home." *Building*. 18 February.

Awards:
2009 RIBA Downland Prize, shortlist



2006 ***The Pines Calyx, St. Margaret's Bay, Kent***
400 m² Vaults: Michael Ramage, John Ochsendorf & Wanda Lau

Reviews:
Ochsendorf, J. (2014). Guastavino Masonry shells. *Structure,* 26. Pp. 26-29 (4 pages)

Davis, L., Rippmann, M., Pawlofsky, T., & Block, P. (2012). Innovative funicular tile vaulting: A prototype vault in Switzerland. *Structural Engineer, 90(11), 46-55. (10 pages)*

Jones, W. "The Pines Calyx: curvy carbon-neutral conferencing," *Building Design*. 20 Feb 2008.

Awards:
Structural Awards, Institution of Structural Engineers
Best Small Building (under £1 million), Winner
David Alsop Sustainability Award, Commendation
London's Sustainable City Award for Best Sustainable Building
Building magazine, Sustainable Building of the Year (Small Project)

Selected Invited Lectures

"Natural Structure"
The Planting Festival, Woodfordia, Queensland Australia 2017

"New Possibilities in Wood: structural bamboo and super-tall timber"
Timber EXPO, National Exhibition Centre, Birmingham 2015, 2016

"Natural Structures: Tradition Today"
The Institution of Structural Engineers Caribbean Regional Conference Barbados 2015

"Natural Structure: materials, form and force"
The Institution of Structural Engineers Sustainability Conference, London 2014

"Natural Structure"
Hong Kong Institute of Architecture, Hong Kong 2013

"Old Technology, New Design: insights from history for contemporary practice"
TEST - Teaching of Environment, Sustainability and Technology in Architecture & Design, The Building Centre, London 2013

"Environmental Architecture"
Who Pays for the Environment? A Symposium on Nature, Architecture, Sustainability and John Ruskin's Guild of St George, Art Workers' Guild, London 2012

"Sustainable Shells: novel earth tile vaults"
Yerba Buena Center for the Arts, San Francisco 2010

"Form & Forces: Medieval vaults in the 21st Century"
Institute of Physics, Trinity College, Cambridge 2009

"Graphic statics: teaching structures through design,"
The Oxford Conference 2008, Oxford 2008

"Natural Structure: materials, form and force"
The Institution of Structural Engineers Beds. and Adjoining Counties AGM, Cambridge 2015
University of Westminster, London, 2015
Cambridge International Summer School, Cambridge 2012-2016
Cambridge Advanced Leadership Programme, Judge Business School 2012-2017

"From Data to Design in New Bamboo"
CAR Showroom, Cambridge Architectural Research 2013

"Form without formwork"
Structures Seminar, Cambridge University Engineering Department 2011

"Sustainable Shells: novel earth tile vaults"
Ramboll UK, London 2011
Price & Myers Consulting Engineers, London 2011
Universidad Nacional Autónoma de México, Mexico City 2010
Pachuca Chamber of Architects, Pachuca, Mexico 2010

"Form & Forces: Medieval vaults in the 21st Century"
Cambridge International Summer School, 2010
Martin Centre Seminar, Department of Architecture 2009

"Complex Simplicity: Medieval techniques for contemporary buildings,"
Wilson Society Lecture, Sidney Sussex College, 2009
Expedition Engineering, London 2009

"Wood in Buildings, Building in Wood"
Friends of the Sedgwick Museum Society, 2008

"Thin Shell Masonry Vaults,"
Architectural Association, London, 2008
Lecture and workshop, University of East London, November 2007

"Compound curves in thin-shell masonry: design, analysis, and delivery,"
Rhinoceros 4.0 software launch, London Metropolitan University, 2006

"The Pines Calyx Domes: A New Application of Brick Vaulting,"
British Architecture Week, Pines Garden, St. Margaret's Bay, England, 2006
Clay Bricks in the 21st Century, MIT, Cambridge Massachusetts, 2006