

# The Future of the City

## Tall Buildings and Urban Design

### **WIT***PRESS*

WIT Press publishes leading books in Science and Technology.

Visit our website for the current list of titles.

[www.witpress.com](http://www.witpress.com)

### **WIT***eLibrary*

Home of the Transactions of the Wessex Institute, the WIT electronic-library provides the international scientific community with immediate and permanent access to individual papers presented at WIT conferences

Visit the WIT eLibrary at <http://library.witpress.com>

# Acknowledgments

---

This book is the culmination of three years of sustained work by us. Writing a book could be a drag at times, but we always felt stimulated by the enthralling experience of dealing with the towering skyscrapers and their urban stage around the globe. Although we take full credit as authors for writing this book drawing upon many sources, we would like to acknowledge the help and encouragement of a few individuals.

We are grateful to Professors Gaines Hall, Tingwei Zhang, Marty Jaffe and Paul Armstrong for reviewing a few chapters of the book and offering valuable comments and suggestions for improving the clarity of the text. We thank Angie Marks, a professional planner, for reviewing some chapters of the book and giving her professional opinion to enhance the quality of the book. Thanks are due also to Cecily Cunz, Jane Cook, Maryam Al-Zoubi and Lindsay Broughel for proofreading the text.

Also, we would like to thank several research assistants including Karen Magnuson Rogulja, Elizabeth Felter, Hamid Jahani and Melissa Ogden for their willing help. We thank the first author's urban design students for critiquing the book and emphasizing the importance of providing a large number of visuals to help students better understand the concepts. We also thank his land use students, who helped in constructing a few maps. Thanks are due also to the students in the second author's "High-Rise and Habitat" seminar class, from whose work he drew some of the contents of the case studies on cities and tall buildings.

We also thank Bill Baker of Skidmore, Owings & Merrill and Bill Miebusch of Turner International and many others who have provided us photographs for the book. We also are thankful to Ryszard Kowalczyk for introducing the second author to Wojciech Olenski, an architect and planner with the Municipal Office of Town Planning and Strategy of Development in Warsaw, to whom we express our gratitude for his time and efforts that he so generously gave to provide information on the City of Warsaw and its tall buildings.

We greatly appreciate the encouragement given us to pursue this book project by Dean Michael A. Pagano of the College of Urban Planning and Public Affairs at the University of Illinois at Chicago and Professors David Perry and Charles Hoch.

Finally, we sincerely thank Carlos Brebbia of WIT Press, our publisher, for lending us his considerable experience in editing and publishing in our efforts to prepare and hone the manuscript. We also extend our thanks to the staff of WIT Press, who were involved in the publishing process, particularly to Elizabeth Cherry.

# The Future of the City

## Tall Buildings and Urban Design

**K. Al-Kodmany**

*University of Illinois at Chicago, USA*

&

**M.M. Ali**

*University of Illinois at Urbana-Champaign, USA*

**WIT**PRESS Southampton, Boston



**K. Al-Kodmany**  
*University of Illinois at Chicago, USA*

&

**M.M. Ali**  
*University of Illinois at Urbana-Champaign, USA*

Published by

**WIT Press**

Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK  
Tel: 44 (0) 238 029 3223; Fax: 44 (0) 238 029 2853  
E-Mail: [witpress@witpress.com](mailto:witpress@witpress.com)  
<http://www.witpress.com>

For USA, Canada and Mexico

**WIT Press**

25 Bridge Street, Billerica, MA 01821, USA  
Tel: 978 667 5841; Fax: 978 667 7582  
E-Mail: [infousa@witpress.com](mailto:infousa@witpress.com)  
<http://www.witpress.com>

British Library Cataloguing-in-Publication Data

A Catalogue record for this book is available from the British Library

ISBN: 978-1-84564-410-9  
eISBN: 978-1-84564-411-6

Library of Congress Catalog Card Number: 2012935886

No responsibility is assumed by the Publisher, the Editors and Authors for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions or ideas contained in the material herein. The Publisher does not necessarily endorse the ideas held, or views expressed by the Editors or Authors of the material contained in its publications.

© WIT Press 2013

Printed in Great Britain by Martins the Printer.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the Publisher.

# Preface

---

Each century faces unique challenges, and the 21st century is no exception. Cities today are pressed to confront climate change, massive pollution, dwindling natural resources, excessive urban population, congestion, economic hardship, and social and political unrest. The focal point of the global economy is shifting from the West to the East. Simultaneously, as the East struggles to accommodate an increasing urban population, the West faces the problem of rehabilitating aging urban infrastructure. Sustainability is also becoming a priority for many modern cities. Moreover, beginning with the last decade of the past century, globalization and global competition are spreading worldwide. Collectively, these prevailing winds of change are reshaping our cities and forcing planners, urban designers, and architects to search for innovative ways to ensure that our future cities have better urban environments and offer an improved quality of life to city dwellers.

Today, the tall building increasingly proliferates in our cities; however, it continues to be designed in isolation of its broader environment. Many architects fail to recognize it as a major element and marginalize it as one of several building types. Urban designers also show limited interest in tall buildings because of their self-perception as urbanists and not as architects dealing with any single building type. Although tall buildings have accommodated growing populations and activities on limited land, they have in turn created many problems including congestion, overcrowding, and limited access to light and air. When incorporating tall buildings into cities, planners and designers must consider the larger context and address a wide range of issues including, but not limited to: environmental impacts, overcrowding, congestion, security, building safety, energy efficiency, access, cost, and comfort. Most importantly, designers of tall buildings and cities must avoid fulfilling ego-centric ideas and design fantasies, and instead give careful practical consideration to the design process. To shape a vision for future cities, harmony between tall buildings and the city fabric is essential. It is important to seek out technological innovation and creative artistry in design, while at the same time remaining sensitive to social contexts.

A number of crucial factors make the timing of this book important. The forces of globalization have merged with information technology to make the world “hyper-connected.” Newly developed building materials and construction technologies have changed the way tall buildings are experienced. Further, the past decade has witnessed a worldwide increase in the construction of tall and supertall buildings of unprecedented heights. As Asian cities like Shanghai, Shenzhen, Tokyo, Osaka, Bangkok, Seoul, Jakarta, Manila, and Singapore, are noticeably engaged in tall building construction, a revival in design and construction is also occurring in American cities such as Chicago and New York as well as European cities as diverse as London, Paris, Frankfurt, Warsaw, and Amsterdam. Thus, the contemporary growth of tall buildings and cities should be viewed as neither West-centric nor East-centric, but as a global phenomenon duly reflecting the regional and local contexts. Despite the revival in tall building construction, the recent global economic crisis has added complexity to urban design and raised questions about the viability of constructing tall buildings. Energy consumption and climate change are added pressures that demonstrate that the future of our planet and its inhabitants is uncertain. These factors point to a single fact – in this competitive world, mediocrity in any area has become unacceptable. Henceforth there is a great demand for innovation in every human endeavor, and the tall building is no exception. Innovative design of the city and its tall buildings has become a clarion call of our times. We no longer can afford to nostalgically view and design cities in the old way of the 20th century. We must look to the future. Thus, this book has been written in a forward-looking manner.

Internationally reputed architects take center stage in the public realm, not only in regard to designing aesthetically spectacular objects but also in regard to urban branding. The narrative of *avant-gardist* tall buildings has spread internationally among contemporary cities. These buildings push architectural design and structural engineering to their limits, and may be aptly called “extreme” tall buildings which are noted for blending loftiness and iconicity. This book documents a number of case study examples to show how “extreme” tall buildings are becoming a trend and changing the way that we understand and interact with modern cities. With advances in computation, structure, materials, and systems, buildings have been emancipated from the constraints of stereometric “box-like” forms, orthogonal grids, and Euclidean geometries. These extreme forms of tall buildings are intended to be dynamic rather than static and flexible rather than rigid. Examples of these tall buildings are the Burj Khalifa in Dubai, and the Capital Gate in Abu Dhabi, UAE; the Tornado Tower in Doha, Qatar; the Shanghai Tower (under construction) in Shanghai, the CCTV Tower in Beijing, China; Taipei 101 in Taipei, Taiwan; the Lotte World Tower in Seoul (under construction), the Haeundae I’Park in Busan, South Korea; the Aqua Tower and the Trump Tower in Chicago, Eight Spruce Street Tower in New York City, USA; the Absolute World Towers in Mississauga, Ont., Canada; the Shard and the Swiss Re Building in London, UK; and the Turning Torso in Malmö, Sweden. The list could go on.

Although these new tall buildings are changing many cityscapes, rationalization and decision-making processes for such forms are limited at the present and occasionally misleading. It is clear that designers need to take a fresh look at how cities should incorporate the tall building, the most overriding building type in the modern city. A comprehensive treatise on these diverse topics is overdue. The authors of this book offer a critical appraisal of vertical architecture and its many implications in the urban setting. Despite the fact that many actors make design decisions, the onus lies primarily on planners, urban designers, and architects to impress upon policymakers and stakeholders the importance of choosing best possible solutions and understanding their greater consequences.

This work consists of a broad-ranging survey of tall buildings and urban design as they relate to each other, and touches on multi-faceted issues that define the character as well as the social and economic role of this important building type. Among the many wide-ranging issues this book discusses are the physical, environmental, socio-cultural, economic, architectural and engineering criteria for tall buildings, as well as the ecology and sustainability of these enormous skyward complexes, most of them being vertical cities within a city. The authors conclude, but do not promote, that the demand for compact urban environments and ample green space will continue to play in favor of vertical architecture as cities come to grips with their future.

The book offers critical perspectives for interpreting architectural projects as significant elements of the 21st century global urban landscape. It is an attempt by the authors to topically address tall buildings and urban design in an inclusive manner in an effort to bridge the gap between the two. It is meant to be a comprehensive guide for both scholars and practitioners. It is broadly organized into three principal parts examining the links among the emergence and impact of tall buildings, regulations and guidelines, and case studies. The first part (Chapters 1–6) discusses the multifaceted aspects of the tall building and the underlying basis for this building form in the context of a city. These first six chapters cover a wide range of architectural, technical, and urban design topics that include the historic context and rationale behind building tall, the evolving skyline of cities, urban systems, placemaking with tall buildings, architectural and engineering qualities, and the iconicity of skyscrapers. Chapters 7–9, constituting the second part, deal with spatial planning, sustainable design, and developmental controls and regulatory issues that architects and urban designers must consider. In the third part, Chapters 10 and 11 present case study examples of high-rise cities and innovative urban design, followed by Chapter 12, which wraps up the book with musings and visions of future cities touching upon the key issues and arguments along the way.

Written in a simple and direct style that makes it easy to read and understand the subject matter, this book contains an abundance of photographs and sketches depicting tall buildings and their urban contexts. These are intended to explain theoretical concepts and practical applications while providing insightful information beyond what can be expressed by words. Further, these copious pictures and graphic images accompanied by explanatory captions are intended to enhance the textual content and the book’s overall quality and appeal. While the book discusses a significant number of tall buildings, other skyscrapers were built or under construction around the world during its writing – a testament to the rapid growth and evolution of this building type. It is hoped that the readers, whether they are scholars, students, or professionals, will be better informed about tall buildings and cities, and relish the exhilarating urban experience of the 21st-century city.

# Table of contents

---

<b>Preface</b>	<b>v</b>
<b>Introduction</b>	<b>1</b>
<b>Reshaping cities in the vertical age</b>	<b>1</b>
<b>Chapter 1</b>	<b>11</b>
<b>The logic of vertical density</b>	<b>11</b>
1 Definitions	11
2 Overview	14
2.1 Historical background	14
2.2 The contemporary city and its transformation	16
2.3 Tall buildings and recession	19
3 Why Tall Buildings?	28
3.1 Population	31
3.2 Global competition and globalization	31
3.3 Urban regeneration	32
3.4 Agglomeration	32
3.5 Land prices	33
3.6 Land consumption	35
3.7 Energy and climate change	36
3.8 Transportation and infrastructure	38
3.9 Human aspirations, symbolism, and ego	39
3.10 Emerging technologies	40
4 Arguments against Tall Buildings	40
4.1 Economics	41
4.2 Environmental impact	42
4.3 Civic infrastructure	42
4.4 Socio-cultural factors	42
4.5 Perception	43
4.6 Public safety concerns	43

4.7 Historic context and placemaking	43
4.8 Digital revolution	44
5 Tall Buildings in the 21st Century	44
<b>Chapter 2</b>	<b>47</b>
<b>Economics and city infrastructure</b>	<b>47</b>
1 Economic Considerations	47
1.1 Feasibility studies	47
1.2 Economic building height	48
2 City Infrastructure	49
2.1 Transportation	49
2.2 Utilities	52
3 Social Services	57
3.1 Security	58
3.2 Health care	59
3.3 Recreation	59
3.4 Education	60
3.5 Fire safety	62
<b>Chapter 3</b>	<b>67</b>
<b>The city skyline and visual integration</b>	<b>67</b>
1 Historical Context	67
1.1 The built heritage	67
1.2 Recent challenges	67
1.3 Managing change	68
1.4 The City of London	68
2 Skyline Impact and Visual Integration	75
2.1 Skyline views	76
2.2 Design principles and approach	78
3 Night Skyline	95
<b>Chapter 4</b>	<b>105</b>
<b>Placemaking with tall buildings</b>	<b>105</b>
1 Elements of Imageability	105
1.1 Landmarks	106
1.2 Paths	106
1.3 Edges	114
1.4 Districts	114
1.5 Nodes	115
1.6 Interrelationships of elements	115
2 Human Scale	115
2.1 The tower base	115
2.2 Tower articulation	115
2.3 Streetscape	117
3 Socioeconomic Activities	117
3.1 Location	117



3.2 The ground plane	118
3.3 Building access	118
3.4 Indoor spaces	121
3.5 Public spaces	122
3.6 Public art as placemaker	127
4 Cultural Associations	127
4.1 The Petronas Towers	131
4.2 Jin Mao Tower	131
4.3 Burj Al Arab	131
4.4 Urban Forest Tower	133
4.5 Shreepati Skies	133
4.6 Naga Towers	135
<b>Chapter 5</b>	137
<b>Achieving architectural and engineering qualities</b>	137
1 Design Quality	137
1.1 Form and aesthetics	137
2 Anatomy of the Tall Building	155
2.1 Physical components	155
2.2 Tall building segments	157
3 Quality in Space Programming	159
3.1 Community spaces	165
3.2 Access and egress	165
4 Engineering Systems	167
4.1 Structure and structural art	167
4.2 Environmental control systems	174
4.3 Quality of construction	178
5 Microclimates around Tall Buildings	178
6 Security	179
7 Sustainable Design	180
8 Management and Operations	181
8.1 Effect of design and occupancy on operations	182
<b>Chapter 6</b>	183
<b>The rise of the iconic high-rise</b>	183
1 Vertical Iconicity	183
1.1 The four skyscraper ages	183
1.2 The age of pluralism, or the fifth skyscraper age (ca. 1990–present)	184
2 Why Iconic Skyscrapers?	184
2.1 Human aspirations	184
2.2 Architectural ambitions and people’s perceptions	184
2.3 Computational power	185
2.4 Technological breakthroughs	185
3 Classification of Iconic Towers	186
3.1 Dynamic forms	186

3.2 Structural art forms	196
3.3 Green	202
4 Iconic Tall Buildings and the City	203
<b>Chapter 7</b>	207
<b>Strategies for regulating vertical density</b>	207
1 Nature and Importance of Regulations	208
1.1 Purpose of regulations	208
1.2 Focus of regulations	208
1.3 Role of the government	208
1.4 Role of regulatory bodies	209
1.5 Role of political leaders	209
2 Guiding Spatial Strategies	209
2.1 The Compact City strategy	209
2.2 Decentralized Concentration strategy	211
2.3 Strategic locations for tall buildings	215
2.4 Overlay analysis	221
3 Zoning and Controlling Density	223
3.1 Setbacks and building widths	223
3.2 Height	224
3.3 Floor area ratio	225
3.4 Open space requirements	225
3.5 Parking and accessibility	227
3.6 Air rights	229
3.7 Air traffic regulations	229
3.8 Incentive zoning	229
3.9 Tax increment financing	229
4 Form-Based Codes	229
4.1 SmartCode	231
4.2 Transect-based planning	231
5 Envisioning and Digital Tools	232
5.1 Spatial planning and visualization tools	232
<b>Chapter 8</b>	239
<b>Sustainable tall buildings and cities</b>	239
1 Facets of Sustainability	239
1.1 Community life and social sustainability	240
1.2 Energy efficiency	241
1.3 Transportation	243
2 Sustainable Design Features, Technologies, and Strategies	244
2.1 Site	244
2.2 Sustainable architecture	246
2.3 Renewable energy	260
2.4 Tall buildings and birds	264
3 Sustainable High-Rise Cities	267
3.1 The urban challenge	269
3.2 The city as an ecosystem	269

4 From Cityscape to Skyscape	270
5 Toward Creating Sustainable Cities	270
6 New Sustainable Cities	271
6.1 New Songdo City	272
6.2 Masdar City	274
<b>Chapter 9</b>	277
<b>Urban and architectural design guidelines</b>	277
1 The Greater Perspective	277
1.1 Urban conditions	277
1.2 Site selection	287
1.3 Spatial clusters	289
1.4 Block considerations	291
1.5 Social issues	304
2 Design Guidelines for Tall Buildings	307
2.1 Building design	307
2.2 Parking design	311
2.3 Accessibility	314
2.4 Safety regulations and building codes	315
2.5 New safety measures	316
3 Guide for Evaluation of Tall Building Proposals	317
4 Public Participation	320
4.1 View corridors	321
4.2 Master plan preparation	321
4.3 Master plan scoping	321
4.4 SWOT analysis	322
4.5 Code amendment	322
<b>Chapter 10</b>	325
<b>Skyscraper cities of the world</b>	325
1 The International Scene	325
2 East and Southeast Asia	326
2.1 Shanghai	326
2.2 Hong Kong	334
3 Middle East and South Asia	340
3.1 Dubai	340
3.2 Mumbai	344
4 Australia	347
4.1 Melbourne	347
5 Europe	350
5.1 Frankfurt	351
5.2 London	354
5.3 Warsaw	357
6 North America	361
6.1 New York	362

6.2 Chicago	365
6.3 Vancouver	368
<b>Chapter 11</b>	<b>373</b>
<b>Innovative Urban Design for Tall Buildings</b>	<b>373</b>
1 Iconic Design	373
1.1 Kartal, Istanbul	374
1.2 Yongsan International Business District	377
2 Generic	378
2.1 Waterfront City, Dubai	379
3 Sustainable Urban Design	380
3.1 New Songdo City	380
3.2 Linked Hybrid	381
4 Ecological Urban Design	385
4.1 West Kowloon Vertical Park and Waterfront Cultural Centre	385
5 Eco-Iconic Approach	386
5.1 Gwanggyo City Center	386
5.2 Zira Island Master Plan	386
6 Fantasy-Driven Design	388
6.1 Paradise Islands	388
7 Necessity-Driven Design	392
7.1 Marina Bay Sands	392
8 Futuristic Urban Design	393
<b>Chapter 12</b>	<b>397</b>
<b>Future skyscraper cities</b>	<b>397</b>
1 Attraction to Cities	397
2 Visionary Skyscrapers	398
2.1 La Citta Nuova	398
2.2 La Ville Radieuse	399
2.3 The Illinois Tower	399
2.4 Cities in the sky	399
3 Visionary Cities	408
3.1 The imaginary future city of Hugh Ferriss	410
3.2 The arcology of Paolo Soleri	410
3.3 Metabolist city	410
3.4 Archigram	411
4 Skyscraper Cities of the 21st Century	411
4.1 Emergent and future urban forms	411
4.2 Technological innovations and breakthroughs	412
4.3 The height paradox: is sky the limit?	413
4.4 The wave of the future	415
<b>References</b>	<b>421</b>
<b>Index</b>	<b>439</b>

## About the authors

---

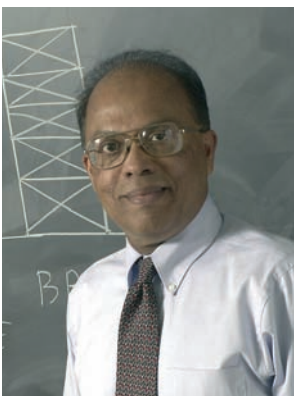


Kheir Al-Kodmany is an Associate Professor in the Department of Urban Planning and Policy at the University of Illinois at Chicago (UIC). Before joining the UIC faculty, Dr Al-Kodmany worked on tall building projects as an architectural designer for the Chicago firm Skidmore, Owings & Merrill. He won several international architectural and urban design competitions. His current academic research focuses

on sustainable urban design, vertical density, infrastructure, and geospatial visualization applications for planners. He has developed 3D modeling, virtual reality, GIS, and web-based mapping survey tools and software for effective participatory planning and design. He also served as the

Co-Director of the Urban Data Visualization Laboratory at UIC and has engaged many communities in using GIS.

Dr Al-Kodmany helped the Saudi Government in facilitating the performance of safe Hajj by applying visualization and crowd management techniques to reconfigure and expand the existing infrastructure to accommodate about three million pilgrims who travel to Mecca for the event annually. He helped the City of Chicago in crowd management, emergency evacuation and planning for the “Taste of Chicago” event. He also worked as a consultant to the Jordanian Government on integrating high-rise development in the Amman Master Plan. According to a study conducted by the Association of Collegiate Schools of Planning, Dr Al-Kodmany ranked seventh in the number of publications by all US planning faculty members 1998–2003. He received the Outstanding Research and Outstanding Teaching Awards from the University of Illinois at Urbana-Champaign upon completing his PhD there. He received his early training in architecture from his late father Professor Abdul Muhsen Al-Kodmany, a former Le Corbusier trainee.



Mir M. Ali is Professor Emeritus and former Chairman (1993–2003; 2007–2011) of the Structures Division of the School of Architecture at the University of Illinois at Urbana-Champaign. He is a Fellow of the American Society of Civil Engineers (ASCE) and the Council on Tall Buildings and Urban Habitat (CTBUH). He was bestowed ASCE’s Millennium Challenge Prize

(1999) for his winning article on skyscrapers in a worldwide competition. He received a Fulbright Award (2008) to study the feasibility of constructing tall buildings in Malta.

Dr Ali was the Chairman of CTBUH’s Committee 30-Architecture (1990–1998) and a Group Leader of its Group PA-Planning and Architecture (1998–2005) overseeing eight topical committees. He also served on CTBUH’s several other committees and was the founding

editor of the Council’s CTBUH Journal (1999–2002). He has been interviewed on tall buildings by the New York Times, Toronto Star, Chicago Sun Times, Chicago Daily Herald, Milwaukee Journal Sentinel, The Architectural Record, Spectrum, Rolling Stones, Popular Science, Discovery Channel, Associated Press and several other newspapers, radio stations and television channels.

He was a TOKTEN Fellow of the United Nations (1989). He served as a member of the Advisory Committee, Strategic Transportation Planning (STP) appointed by the Government of Bangladesh (2003–2005). His considerable industrial experience includes Skidmore, Owings & Merrill and Sargent & Lundy in Chicago. His consultancy work includes projects in Canada, Singapore, Pakistan, Ethiopia, Bangladesh, United Arab Emirates and the United States. He also worked as a consultant with the US Army Corps of Engineers. Books authored/co-authored and edited by him include Architecture of Tall Buildings; Art of the Skyscraper; Catalyst for Skyscraper Revolution; and The Skyscraper and the City. Dr Ali published numerous papers on tall buildings, cities, sustainability and other topics, as well as gave seminars and invited lectures nationally in the United States and internationally.