



True Smart and Green City?
8th Conference of the
International Forum on Urbanism



Conference Proceedings Paper

Comparative Analysis of Material Criteria in Green Certification Rating Systems and Urban Design Guidelines

Jungwon Yoon ^{1*}, and Jiyoung Park ^{2*}

¹ University of Seoul, Department of Architecture, 163 Seoulsiripdae-ro, Dongdaemun-gu, Seoul 130-743, Korea

² Inha University, Department of Architecture, Inharo 100, Nam-gu, Incheon 402-751, Korea

E-Mails: jwyoona@uos.ac.kr (Jungwon Yoon); jypark@inha.ac.kr (Jiyoung Park)

1. Introduction

Background

More countries to introduce and develop green cities

Administrative governments and policy councils involved in setting up tools and guidelines to accelerate formation of sustainable urban neighborhoods and implement green city planning and development

Green Certification rating systems: BREEAM (Building the Research Establishment Environmental Assessment Method) in UK, LEED (Leadership in Energy and Environmental Development) in USA, CASBEE (Comprehensive Assessment System for Building Environmental Efficiency) in Japan

Specialties of neighborhood development and city planning: BREEAM Communities, LEED ND, and CASBEE UD

Goals

To focus on material assessment criteria in green certification rating systems and descriptive standards on materials in urban design guidelines

Strategies

1. Identifying and comparing material criteria in green certification rating systems including BREEAM Communities, LEED ND and CASBEE UD by adopting the concept of three legs of sustainability
2. Outlining material requirements in urban design guidelines of New York, London, Tokyo and Seoul
3. Comparing the material criteria for building, infrastructure and landscape of all the guidelines with the previously discussed green certification rating systems

2. Material Criteria in Green Certification Rating Systems: BREEAM Communities, LEED Neighborhood Development and CASBEE for Urban Development

2.1. Framework of Sustainable Material Assessment: the Circle of Sustainable Materials

The Circle of Sustainability

Mostly used for cities and urban settlements, by a series of global organizations

Helping understanding sustainable urban design which ensure to provide social and economic benefits while mitigating the environmental impacts of the built environment

Applicable to sustainable material assessment

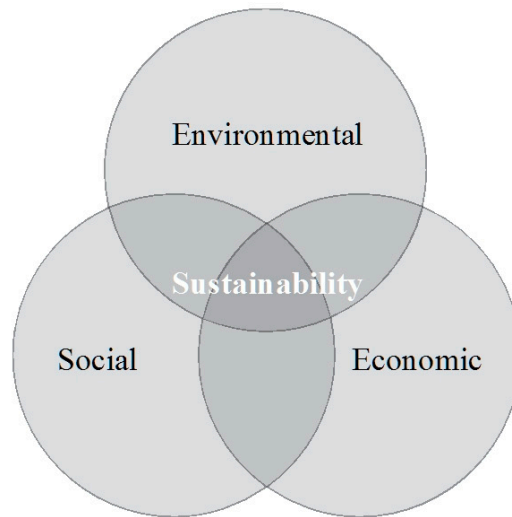
Principles

- Each sphere includes three indicators to cover environmental, economic, and social issues in an equal attitude.
- Indicators are proposed based upon some concepts in Pharos Lens, Building Materials and Furnishings Sustainability Assessment Standards by the Whole Building Design Guide, and University of Michigan Sustainability Assessment, and Ten Shades of Green to cover common values of green materials.
- Environmental indicators include: Resources, Health & Safety, and Habitat & Settlement.
- Economic indicators include: Life Cycle Cost, Durability & Adaptability, and Efficiency.
- Social indicators include: Locality, Harmony, and Preservation.
- Each Indicator can be assessed in different uses of materials applied in urban designs. The material application sphere can be categorized into: (1) infrastructure, (2) landscape and (3) building.

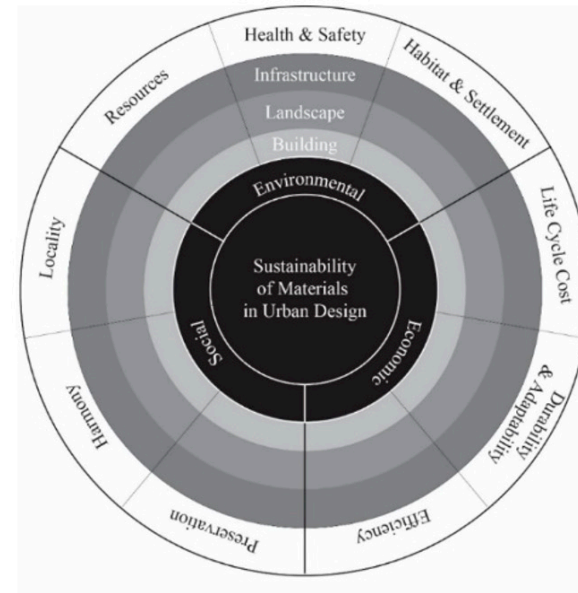
2. Material Criteria in Green Certification Rating Systems: BREEAM Communities, LEED Neighborhood Development and CASBEE for Urban Development

2.1. Framework of Sustainable Material Assessment: the Circle of Sustainable Materials

Figure 1. (a) The Circle of Sustainability: Three Legs of Sustainability
(b) The Circle of Sustainable Materials: Based on Three Legs of Sustainability



(a)



(b)

2. Material Criteria in Green Certification Rating Systems: BREEAM Communities, LEED Neighborhood Development and CASBEE for Urban Development

2.2. Analysis of Material Criteria in BREEAM Communities, LEED ND and CASBEE UD

Objectives

To examine differences of material assessment criteria, evaluation parameters and methods, descriptions in green certification rating systems – BREEAM Communities, LEED ND and CASBEE UD

Assessment Criteria and Categories

BREEAM Communities

Assessment criteria grouped into five categories

Considered in three steps from step 1 establishing the principles, step 2 determining the layout to step 3 designing the details.

LEED ND

Addressing five topics

CASBEE UD

Classifications of environment, society, and economy as major criteria of assessment by adopting the Three Legs of Sustainability in its structure

2. Material Criteria in Green Certification Rating Systems: BREEAM Communities, LEED Neighborhood Development and CASBEE for Urban Development

2.2. Analysis of Material Criteria in BREEAM Communities, LEED ND and CASBEE UD

Table 1. Assessment Criteria of BREEAM Communities, LEED ND and CASBEE UD

(Q means quantity of minor items. Note that this number is not equal to available credits for each item)

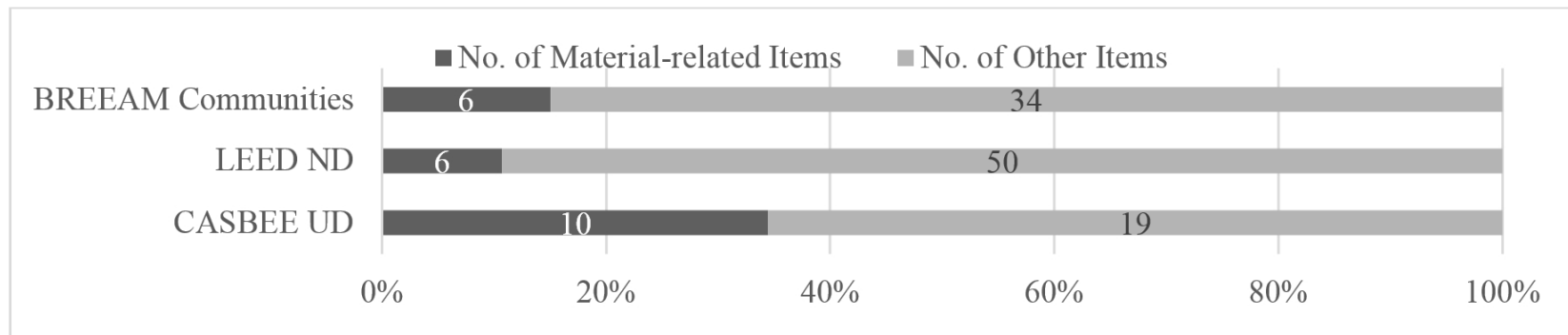
(Grey Shade indicates assessment criteria relevant to sustainable materials) (In LEED ND, P : Prerequisite, C : Credit)

Green Certification System	BREEAM Communities		LEED ND		CASBEE UD	
	Categories	Q	Categories	Q	Categories	Q
Assessment Criteria	Governance	4	Smart Location and Linkage	14 (P5, C9)	Environment: Resource	4
	Social and economic wellbeing	17			Environment: Nature	4
	Resources and Energy	7	Neighborhood Pattern and Design	18 (P3, C15)	Environment: Artifact	1
			Green Infrastructure and Buildings	21 (P4, C17)	Social: Impartiality / Fairness	2
	Land Use and Ecology	6	Innovation and Design Process	2 (C2)	Social: Safety/Security	4
					Social: Amenity	4
	Transport and Movement	6	Regional Priority Credit	1 (C1)	Economy: Traffic/Urban structure	4
No. of Items	5	40	5	56 (P12, C44)	Economy: Growth potential	3
					Economy: Efficiency/Rationality	3
No. of Minor Items related to material	6		6		10	

2. Material Criteria in Green Certification Rating Systems: BREEAM Communities, LEED Neighborhood Development and CASBEE for Urban Development

2.2. Analysis of Material Criteria in BREEAM Communities, LEED ND and CASBEE UD

Figure 2. Comparison of Ratio of Material Criteria in Assessment of Urban Development Sustainability



- CASBEE UD has the highest ratio of material assessment items in its rating system compared to LEED ND and BREEAM Communities

2. Material Criteria in Green Certification Rating Systems: BREEAM Communities, LEED Neighborhood Development and CASBEE for Urban Development

2.2. Analysis of Material Criteria in BREEAM Communities, LEED ND and CASBEE UD

Comparative Analysis of Detailed Items

Circle of sustainable materials is adopted as a tool [Table 2]

Assessment Criteria and Categories

BREEAM Communities

Assessment criteria grouped into five categories

Considered in three steps from step 1 establishing the principles, step 2 determining the layout to step 3 designing the details.

LEED ND

Addressing five topics

CASBEE UD

Classifications of environment, society, and economy as major criteria of assessment by adopting the Three Legs of Sustainability in its structure

2. Material Criteria in Green Certification Rating Systems: BREEAM Communities, LEED Neighborhood Development and CASBEE for Urban Development

2.2. Analysis of Material Criteria in BREEAM Communities, LEED ND and CASBEE UD

Table 2. Material Criteria in Green Certification Rating Systems

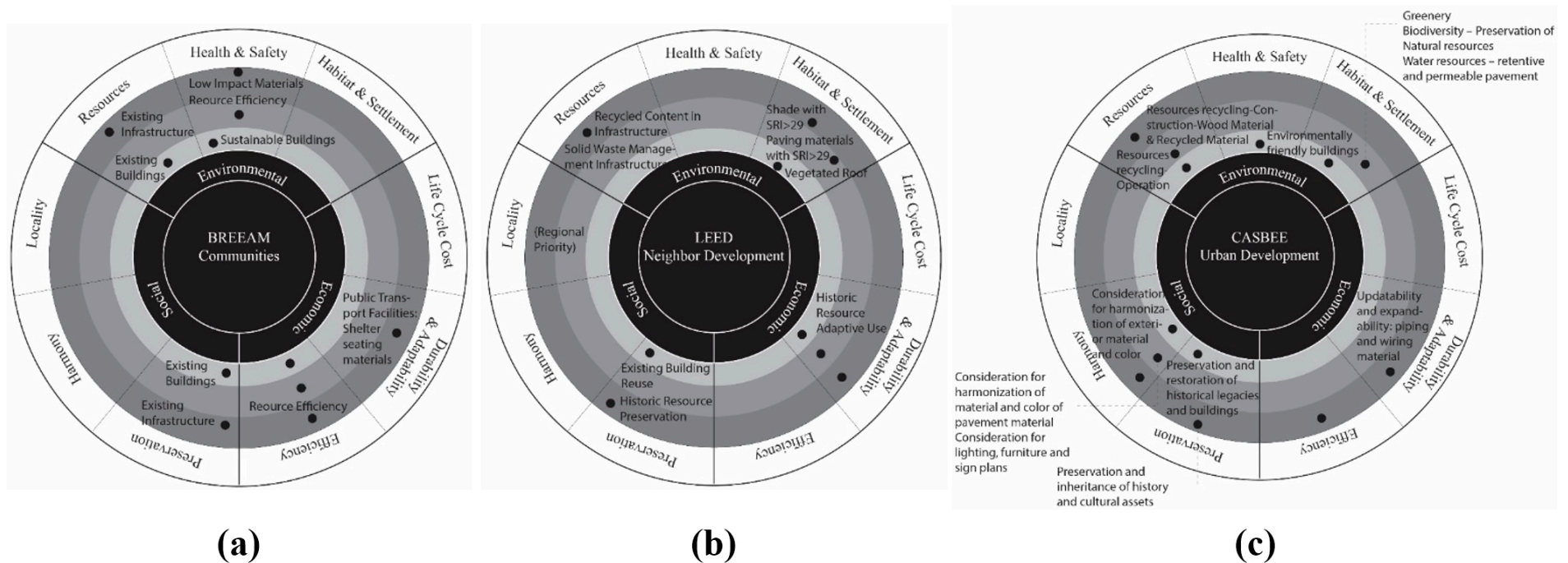
(Dark grey shade indicates infrastructure, Medium grey shade indicates landscape, and blank shade indicates buildings and all.)

Part	Criteria	BREEAM Communities	LEED ND	CASBEE UD
Environmental	Resources	Existing Infrastructure	Recycled Content in Infrastructure Solid Waste Management Infrastructure	Resources recycling- Construction-Wood Material
		Existing Buildings		Resources recycling- Construction- Recycled Material
	Health & Safety	Low Impact Materials	-	Environmentally friendly buildings
		Sustainable Buildings		
		Resource Efficiency		
	Habitat & Settlement	Sustainable Buildings	Shade with SRI>29	Greenery Biodiversity – Preservation of Natural resources
			Paving materials with SRI>29	Water resources – retentive and permeable pavement
Vegetated roof			Environmentally friendly buildings	
Economic	Life Cycle Cost	-	-	-
	Durability & Adaptability	Public Transport Facilities: Shelter seating materials	Historic Resource Adaptive Use	Updatability and expandability: piping and wiring material
	Efficiency	Resource Efficiency		
Social	Preservation	Existing Infrastructure	Historic Resource Preservation	Preservation and inheritance of history and cultural assets
		Existing Buildings	Existing Building Reuse	Preservation and restoration of historical legacies and buildings
	Harmony	-	-	Consideration for harmonization of material and color of pavement material
				Consideration for lighting, furniture and sign plans
	Locality	-	(Regional Priority)	-

2. Material Criteria in Green Certification Rating Systems: BREEAM Communities, LEED Neighborhood Development and CASBEE for Urban Development

2.2. Analysis of Material Criteria in BREEAM Communities, LEED ND and CASBEE UD

Figure 3. Circles of Sustainable Materials (a) BREEAM Communities. (b) LEED ND. (c) CASBEE UD



- All of rating systems cover the three spheres of sustainability
- BREEAM Communities and LEED ND - focusing on more on reuse of existing infrastructure and buildings, achieving environmental resources and social preservation
- CASBEE UD - approaching materials as resources to be saved and recycled but also as factors attributing other environmental sustainability and harmonized urban structure

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.1. London

The Greater London Authority (GLA), London Plan(2004)

Spatial development strategy (SDS) focusing on sustainability and spatial plan

Under the legislation of GLA Act 1999, the London Plan take account of three cross-cutting themes: economic, social, environmental.

It forms part of the development plan for Greater London.

32 London boroughs' local plans need to be in general conformity with the London Plan, and its policies guide decisions on planning applications by councils and the Mayor.

The Greater London Authority (GLA), London Plan(2015)

8 chapters: Context and strategy, Places, People, Economy, Response to climate change, Transport, Living places and spaces, Implementation, Monitoring and review

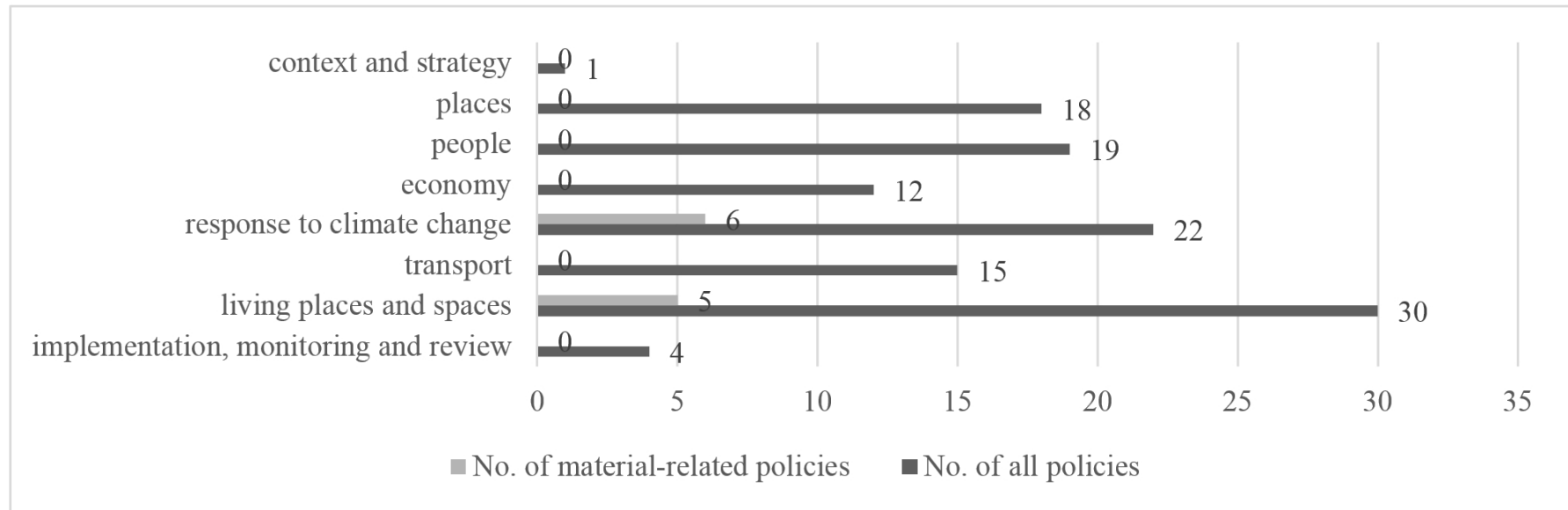
Of total 121 policies, 11 material-related policies

6 polices in Response to Climate Change + 5 polices in Living Spaces and Places

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.1. London

Figure 4. Ratio of Material-related policies in the London Plan (2015)



3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.1. London

Table 3. A List of material-related policies in the London Plan (2015)

Chapter	Topic	Policy	Description
Response to Climate Change	Mitigation	5.3 Sustainable design and construction	securing sustainable procurement of materials using local supplies where feasible
	Adaptation	5.9 Overheating and cooling	minimizing overheating and also meet its cooling needs
	Waste	5.16 Waste net self-sufficiency	encouraging the reuse of and reduction in the use of materials
		5.17 Waste Capacity	space for the storage of recyclable and compostable materials and waste
	Aggregates	5.20 Aggregates	re-use and recycling of construction, demolition and excavation waste (95% by 2020)
			extraction of land-won aggregates within London
Contaminated land and Hazardous substances	5.22 Hazardous substances and installations	managing hazardous materials	
Living Spaces and Places	Place shaping	7.6 Architecture	the highest quality materials the local architectural character
		7.7 Location and design of tall and large building	incorporating the highest standards materials
	Historic environment and landscape	7.8 Heritage assets and archaeology	conserving sympathetic to their materials
	Air and noise pollution	7.14 Improving air quality	not releasing toxics
	Protecting open and natural environment	7.19 Biodiversity and access to nature	positive gains for nature through materials

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.1. London

Table 4. A List of material-related items in Sustainable Design and Construction SPG (2014).

Chapter	The Mayor’s Priorities and Best Practice			
Resource management	2.3 Site Layout and Building Design	Reuse of existing building		
	2.4 Energy and Carbon Dioxide Emission	Use less energy	passive design measures	optimizing insulation
				minimizing cold bridging
				optimizing thermal mass
				using light colored materials
	2.7. Material and Waste	Design stage	the choice of materials	prefabrication
				deconstruction
				Managing existing resources;
				Using the BRE Green Guide to Specification
				Ensuring that materials are responsibly sourced
Sourcing materials from local sources				
Construction phase			demolition material	
			the waste hierarchy	
Occupation		historic material		
		storage for recyclables, organic, material and waste		
Adapting to climate change and greening the city	3.2 Tacking increased temperature and drought	Overheating	using materials with a high thermal mass	
	3.4 Flooding		Flood resilience and resistance of buildings in floor risk areas	using materials with high albedo surfaces
Pollution management – land, air, noise, light and water	4.3 Air Pollution	Protecting internal air quality	avoiding the use of materials particularly vulnerable to water	
	4.4 Noise	Detailed design considerations	robust materials specifying environmentally sensitive (non-toxic) building materials the careful choice of materials	

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.2. *New York*

The City of New York, PlaNYC (2007)

To address its long-term challenges including the forecast of 9.1 million residents by 2030, changing climate conditions, an evolving economy, and aging infrastructure
Comprehensive sustainability plan for a greener, greater New York

The latest version of PlaNYC (2011)

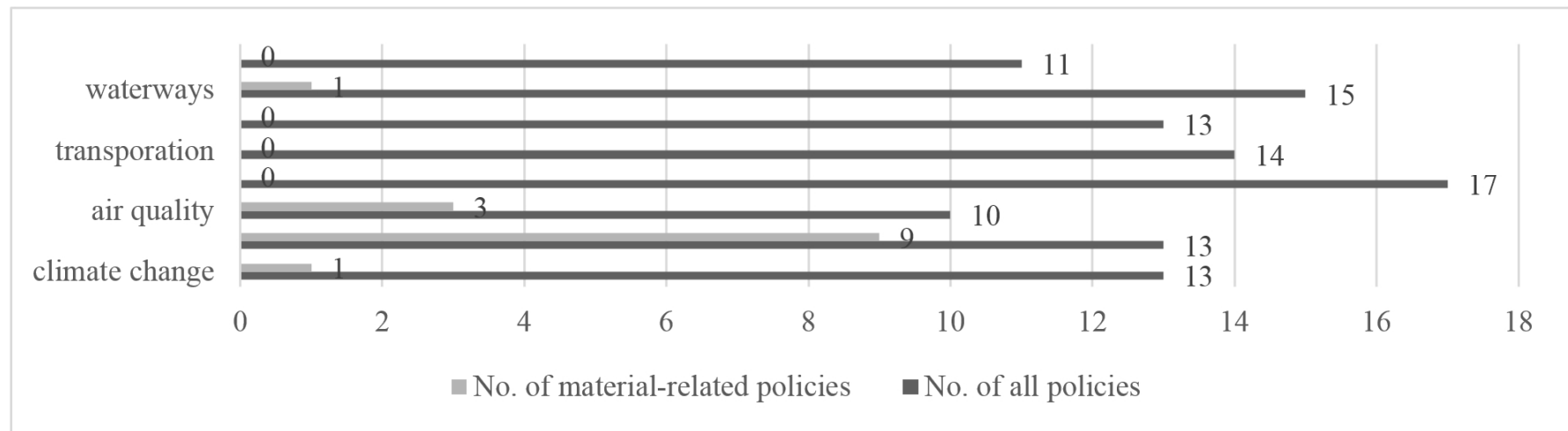
Launched 127 initiatives in ten categories: Housing and neighborhoods, Parks and public space, Brownfields, Waterways, Water supply, Transportation, Energy, Air quality, Solid waste, and Climate change.

Some of initiatives are related into materials, but the major issue is about managing waste in the city rather than about design and construction materials.

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.2. New York

Figure 5. Ratio of Material-related policies in the PlaNYC (2011)



3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.2. New York

Table 5. A List of material-related items in PlaNYC (2011)

Category	Initiative		Description
Housing and Neighborhoods	Encourage sustainable neighborhoods	8. Increase the sustainability of City-financed and public housing	use of non-toxic building materials
Parks and Public Space	Ensure the long-term health of parks and public space	15. Incorporate sustainability through the design and maintenance of all public space	develop indicators to measure existing and new sustainability initiatives at DPR related to material resources
Waterways	Use green infrastructure to manage stormwater	9. Modify codes to increase the capture of stormwater	increase recycled materials within all new sidewalk construction.
Air Quality	Update codes and standards	9. Update our codes and regulations to improve indoor air quality	propose regulations to reduce exposure to toxics released by building materials
Solid Waste	Reduce waste	2. Increase the reuse of materials	to encourage and increase reuse of materials
	Increase the recovery of resources from the waste stream	3. Incentivize recycling	encourage businesses to recycle, and use recyclable and recycled materials through corporate challenges, partnerships, or recognition programs
		4. Improve the convenience and ease of recycling	increase recycling
		5. Revise City codes and regulations to reduce construction and demolition waste	require use of recycled content in building materials Require recycling of building materials
		6. Create additional opportunities to recover organic material	expand opportunities for communities to compost food waste
		7. Identify additional markets for recycled materials	explore expansion of designated plastics
	Improve efficiency of waste management system	11. Remove toxic materials from the general waste stream	expand Household Hazardous Waste collection program
Reduce the City government’s solid waste footprint	12. Improve the City government’s diversion rate	develop best practices that address solid waste reduction for procurement and incorporate into Environmentally preferable Purchasing	
Climate Change	Create resilient communities	13. Work with communities to increase their climate resilience	improve the access to publicly available data on the locations of hazardous material storage in flood zones throughout the city

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.2. New York

The High Performance Infrastructure Guidelines (2005)

To manage design and construction of streetscape and public right of way projects

About design and construction rather than overall city plan

Focusing on the seven dimensions: Site Assessment, Streetscape, Pavement, Utilities, Stormwater management, Landscape, and Construction practices

Presenting 53 Best Management Practices (BMPs), practical strategies and technical strategies and technical resources for sidewalks, roadways, utility projects, and their adjacent landscaped areas

Providing the specification of materials to achieve with references and introduce examples in NYC as the precedents

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.2. New York

Table 6. A List of material-related items in High Performance Infrastructure Guidelines (2005)

Dimension	Best Management Practices (BMPs)	Technical Strategies
Streetscape	SS.5. Increase and Improve Right-of-way Public Space and Green Areas	Incorporate seating and street furniture into public spaces and throughout streetscape
		Use environmentally preferable materials in streetscapes
	SS.7. Optimize Street lighting and Signaling	Use environmentally preferable materials and resources
Pavement	PA.3. Maximize Pavement Albedo	Develop a comprehensive, citywide plan to increase pavement albedo
		Consider using light colored aggregate in asphalt
		Consider using high-albedo asphalt coating
		Consider conducting chip-sealing on low volume roads:
		Consider painting sections of pavement with light-colored paint
		Consider using Portland cement concrete where possible
		Consider using a tinted asphalt or white binder
	PA.5. Use Reduced-Emission Materials	Application for Asphaltic Materials
		Application for Concrete Materials
		Application for Traffic Marking Coatings
		Application for Anti-Graffiti Coatings
		Application for Biobased Filter Fabric
	PA.6. Use Recycled and Reclaimed Materials	Develop a recycled and reclaimed materials program
		Applications in asphalt concrete
		Applications in PCC concrete
Applications in PCC cementitious materials		
Applications in pavement sub-base		
Construction Practices	CP.4. Implement a Waste Management and Recycling Plan	Regulate Management of C&D Waste in Contract Documents
		Employ creative waste management strategies
		Coordinate C&D efforts to reduce vehicular miles traveled

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.2. *New York*

Department of Design and Constructions (DDC) of New York City, Sustainable Urban Site Design Manual (2008)

Addressing landscape opportunities associated with building projects and offers an introduction to more environmentally, economically, and socially responsible urban site design practices for New York City capital projects

4 Topics : Maximize vegetation, Minimize site disturbance, Water management on urban sites, Materials in Site & Landscape Design

Each topic focusing on practical recommendations and marrying the unique site conditions encountered on many city projects with appropriate sustainable site design strategies

Highlighting applicable LEED strategies as well as local laws, rules and regulations

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.2. New York

Table 7. A List of material-related measures in the Sustainable Urban Site Design Manual (2008)

Chapter	Strategy	Specific techniques and descriptions
Water Management on Urban Sites	Stormwater Management	Hardscape techniques - porous pavements/ permeable pavers
	Light-colored Paving and Hardscape	Light colored pavement types
Materials in Site & Landscape Design	Strategies for Incorporating Recycled Materials	Planning : survey the existing site
		Design: target key items
		Construction documents: follow DDC's required specifications
		Construction phase : monitor
	Specific Techniques and Material Descriptions	Coal fly ash recycled
		Blast furnace slag recycled
		Plastics recycled
		Rubber recycled
		Glass recycled
		Metals recycled
Organic Waste recycled		
Asphalt recycled		
Concrete and masonry recycled		

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.3. Tokyo

Bureau of Urban Development, City Planning Vision for Tokyo (2001, Rev.2009)

Future vision of city and strategic directions of urban policy

Greater importance on the perspectives of the environment, greenery and cityscape

The Master Plan for City Planning (2004)

Official plan to define the urban development policy, the disaster prevention policy and the development and maintenance policy of urban residential areas

Future vision of the city

Foundation for drafting individual city plans as obligatory

Bureau of Environment, Tokyo Metropolitan Environmental Master Plan (2008), and Guidelines for consideration regarding urban planning (2008)

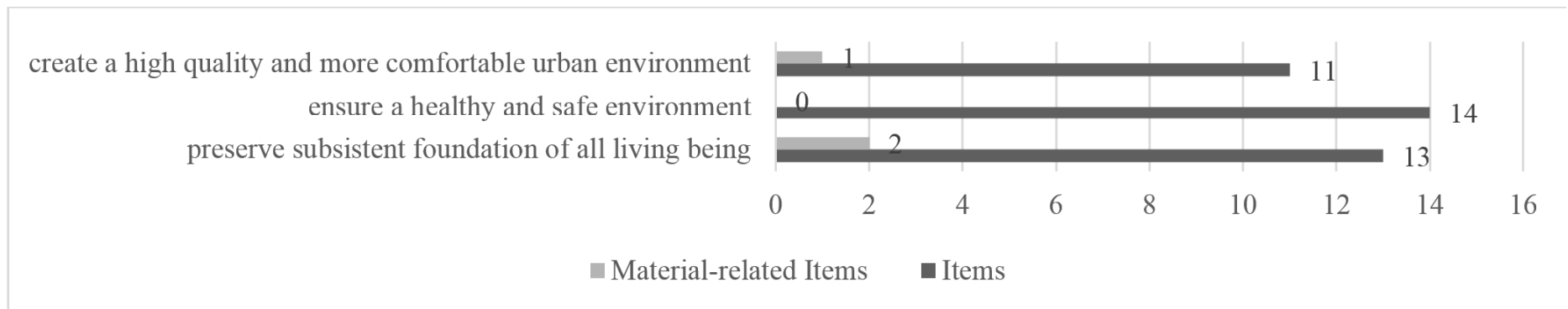
To promote commitment to climate change, increase and conservation of green areas in the city, recycled use of resources, a better air quality, and a solution to negative legacy of the environment, including soil contamination

Listing measures under three major sectors, organized as: Creation of a high quality and more comfortable urban environment (QC); Ensuring a healthy and safe environment (HS); Preservation of subsistent foundation of all living being (PF)

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.3. Tokyo

Figure 6. Ratio of Material-related items in the Tokyo Metropolitan Environmental Master Plan.



3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.3. Tokyo

Guidelines for consideration regarding urban planning

Aiming to present the items for urban planning that private and public companies should consider at the phase of planning and implementation.

Functioning as a checklist to assess the environmental system.

Organized in three parts: common items for consideration applicable to the urban planning, major items considered on the basis of regional characteristics of each zone of Tokyo and major items for consideration on the basis of each characteristic of the various operations involving urban planning

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.3. Tokyo

Table 8. A List of material-related measures in Guidelines for consideration regarding urban planning.

Part	Sector	Common consideration item		Approach
Common items for consideration regarding urban planning	PF	Prevention of generating waste & promotion of recycling of waste	Use of resource recycling Suppression of generating waste and appropriate treatment of waste Promotion of recycling resources and by-products in addition to using reproduced materials	Consideration of long-life in architectural planning and use of highly durable materials and construction methods Adoption of highly variable specifications Use of recyclable materials Active utilization of reproduced materials Thorough separation of by-products at the construction and reuse of by-products For temporary installation, selection of reusable materials, and consideration of structure and use
	HS	Prevention and reduction of air pollution	Air pollution caused by factories and workplaces – measures for PM, NOx & VOC Prevention of scattering asbestos	Measures to prevent impacts on the surroundings by air pollutants at construction sites Inhibiting emission of VOC in outdoor painting, and using low VOC paint Prevention of dust during construction work and conducting research and optimal shatterproof measures of asbestos in demolition and renovation
		Reduction of environmental risk caused by chemicals, soil pollution and water pollution	Proper management of chemical materials and risk communication	Introduction of equipment to reduce emission of chemicals including VOC and to reduce environmental risk
	QC	Mitigation of heat island effect	Greening Covering measures Attention to the wind corridor	Greening of artificial ground, green wall, and spaces Pavement types, pavement materials with high water retentivity and less thermal storage pedestrian pavement types ensuring adequate ventilation
Landscape, historical and cultural heritage		Attention to landscape Consideration of historical and cultural heritage	Consideration of building forms, skylines as well as colors.	

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.3. Tokyo

Table 8. Cont.

Sector	Zone	Items		
Consideration on the basis of regional characteristics of zones	Regional	CCR	Redevelopment and refurbishment to highlight the regional environmental features Measures against surface coverings with pavements, buildings and asphalts causing increased heat and energy use. City planning and architecture in consideration of microclimate and thermal environment Environmental improvement of sufficiently utilizing the regional characteristics	
		UER	Improvement of disaster prevention at the dense residential areas with wooden houses	
	PF	CCR	Prevention of generating waste & promotion of recycling of waste	
		TBW		
	HS	CCR	Reduction of environmental risk caused by chemicals, soil pollution and water pollution	
		TBW		
		SCC	Prevention and reduction of air pollution	Measures to prevent impacts on the surroundings by air pollutants at construction sites
	QC	CCR	Creation of green spaces and waterfront environment Preservation and restoration of natural environment, biodiversity and ecosystem Mitigation of heat island effect Preservation and revitalization of historical and cultural heritage	On-site greenery, installation of green roofs and green walls Greening in the dense area with wooden houses Preserving the region-specific landscape by utilizing historical, cultural buildings and townscapes and residential areas with waterfront and rich green areas
		TBW	Creation of green spaces and waterfront environment Preservation and restoration of natural environment, biodiversity and ecosystem	Use of natural blocks and rockworks for seawalls and waterfront development

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.3. Tokyo

Sector	Operations	Items	
Consideration on the basis of various operations	PF	Transportation Canals, river and other	Long-term life and use of vehicle facilities and pavements Use of reproduced or recyclable materials such as recycled crushed stone Use of materials with less impact on the environment Improvement of recycling ratio of materials and reduction of waste
		Commercial and Business Housings and Residential Factory / Recreational	High thermal insulation / Use of CFC-free insulation material Separated collection of insulation materials with Freon during demolition of a building for reduction of greenhouse gas Use of reproduced or recyclable materials such as recycled crushed stone Use of materials with less impact on the environment Improvement of recycling ratio of materials and reduction of waste
		Site/Landfill & Port / Quarrying	Reduction of volume, construction by-product by reuse and recycling
		Waste & Sewage treatment Energy Supply	Use of CFC-free insulation material Separated collection of insulation materials with Freon during demolition of a building for reduction of greenhouse gas Use of reproduced or recyclable materials such as recycled crushed stone Use of materials with less impact on the environment Long use of buildings with long-term life to save resources and reduce wastes
	HS	Transportation	Reduction of emission of NOx, SPM Implementation of low-noise pavement and road greening Consideration of exterior materials and paint of elevated roads and buildings
		Canals, river and other Commercial and Business Housings and Residential Factory / Recreational Site / Quarrying / Waste & Sewage / Energy / Landfill & Port	Efforts in resource recycling and proper treatment of waste disposal with responsibility Consideration of exterior wall materials and paints
		QC	Transportation
	Canals, river and other		Seawall with high permeability and planting to regenerate water circulation
	Commercial and Business Housings and Residential Factory / Recreational		Minimizing the pavement in asphalt or concrete Implementation of pavement with water retentivity / Active greening Use of architectural materials and paints in consideration of heat island effect
	Site / Landfill & Port		Minimizing artificial surface coverings for better rainwater infiltration Minimizing the pavement in asphalt or concrete Implementation of pavement with water retentivity
Waste & Sewage / Energy	Minimizing the pavement in asphalt or concrete Implementation of pavement with water retentivity / Active Greening Use of architectural materials and paints in consideration of heat island effect		

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.4. Seoul

2030 Seoul Master Plan (2014)

Focusing on five main emerging issues

Comprehensive plan ranging over various disciplines including society, economy, environment, energy, transportation, infrastructure, culture and welfare

Landscape Design Guideline Manual (2012)

Setting up targets and strategies according to characteristics of landscape types in four categories

Material-related strategies in this manual are related to historical and cultural atmosphere and harmonization with historical resources and their unique features.

Architectural materials shall be considered for its quality to suit historical surroundings and its durability.

Urban Development Sustainable Building Environment Assessment Guideline (2011)

Criteria for evaluation are organized in 7 sectors with 41 items, covering land use, transportation, energy, ecological environment, resource cycling, water cycling and indoor environment

Material items include thermal insulation, environment-friendly architectural materials, recycled wastes, permeable pavement and materials with low-emission of VOC and asbestos.

Material is recognized as a part of surfaces and buildings in specific measures to achieve goals of energy, water, and indoor environment.

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.4. Seoul

Table 9. Material-related Objectives and Strategies to achieve the theme of Safe City with Life Alive.

Objective	Strategy
Eco-city led by parks	Reinforced Controllability of Urban Climate: Eco-friendly urban surfaces, mitigated heat island effect, monitoring system of climate change
	Preservation and recovery of natural ecology inside the city and improved functions for the public interest
	Improved Quality and Optimization of Urban Living Environment
Resource circulation city with energy efficiency	Expansion of resource recycling

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.4. Seoul

Table 10. Material Qualities specified in Landscape Design Guideline and Checklist.

Zone	Material Qualities
Urban Core Landscape Zone Inner/Out Four Mountain Axis Base of Historical Characteristics	Materials in harmony with surrounding landscape resources and regional features Avoiding materials standing out and disturbing the harmony such as luminous materials For exterior space, use of natural materials and adoption of qualities and colors in harmony with surroundings For outdoor advertising, use of materials in harmony with the building and surroundings
Waterfront Axis	Bright and light materials For the podium facing main streets, use of various materials to vitalize the streetscape
North-South Green Axis	Use of soft materials in harmony with green landscape Avoiding materials standing out and disturbing the harmony such as luminous, transparent, reflective materials For the podium facing main streets, use of various materials to vitalize the streetscape
Seoul City Wall Axis	Use of natural and soft materials in harmony with Seoul City Wall Use of materials considering the lapse of time embedded in Seoul City Wall Use of natural materials such as stone, brick and wood Avoiding rapidly deteriorating materials Avoiding materials standing out and disturbing the harmony such as luminous, transparent, reflective materials Use of homogeneous roof materials with qualities and colors in harmony with Seoul City Wall at buildings visible from the wall

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.4. Seoul

Table 11. Material Criteria in Urban Development Sustainable Building Environment Assessment Guideline

Sector	Items
Energy	Thermal Insulation
Resource Cycling	Environment-friendly architectural materials Recycling of wastes and reduction of wastes
Water Cycling	Permeable Pavement
Indoor Environment	Materials with low-emission of VOC and asbestos

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.5. Research Summary

General differences between Seoul and other three cities

London, New York and Tokyo

- Urban master plans and design guidelines in close associations to set up criteria sectors, to describe requirements and to specify measures, evenly in infrastructure, landscape and building materials

Seoul

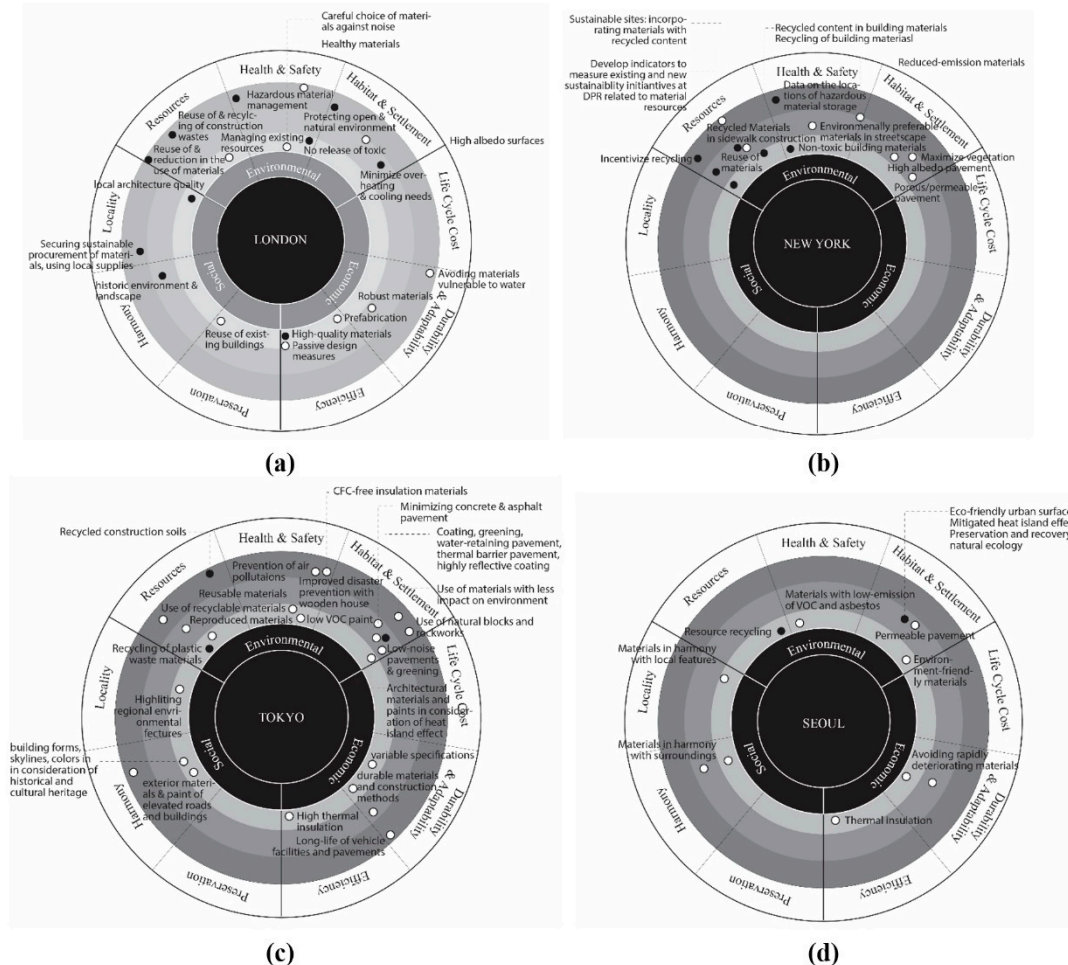
- no green certification system for urban development, which can be the basis to set up the urban design guidelines with detailed measures
- All of Seoul's top Master Plan, and urban design guidelines as well as district-level master plans and guidelines show inconsistent aims and sectors for sustainability assessment

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.5. Research Summary

To compare urban guidelines of each city with green certification rating systems: Analysis uses the proposed circle of sustainable materials as a study protocol.

Figure 7. Urban Design Guidelines in Circle of Sustainable Materials
(a) London. (b) New York. (c) Tokyo. (d) Seoul
(●: Top-level master plan; ○: Supplementary design guideline)



3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.5. Research Summary

Top Master Plans

London and New York: Top master plans include detailed material criteria

Tokyo and Seoul: Towards their big city visions without specifying detailed criteria for materials

London Plan

Covering many sustainability issues of materials but without clear distinction of material uses among infrastructure, landscape and building

More sustainability issues than BREEAM Communities, in Habitat & Settlement, Locality and Harmony

PlaNYC

Emphasizing Resources and Health & Safety

Supplementary guidelines involving more criteria in Habitat & Settlement in addition to Resources and Health & Safety

Only environmental issues in materials

The material techniques and specifications are described in most details among urban design guidelines.

Urban Design Guidelines of Tokyo

Specifying material requirements as per regions and project types, as well as materials at different scales of urban design

Without items as a preservation strategy

Seoul

Least items for sustainable materials in its urban guidelines

Not involving the material selection and uses in infrastructure

No strategy and measure to develop and implement resource recycling

3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

3.5. Research Summary

- London and New York have detailed material criteria in their top master plans.
- Tokyo has supplementary urban design guidelines specifying most sustainability issues in materials.
- Most of items in material criteria interact with green certification rating systems.
- Similarly to green certification rating systems, Life Cycle Cost isn't integrated in material criteria in none of urban design guidelines.

4. Conclusions

The circle of sustainable materials is proposed

as a tool for comparative analysis of green certification rating systems, and urban design guidelines of London, New York, Tokyo and Seoul

In the tool, evaluation criteria includes

three major sectors of environment, economy and society to embrace the concept of sustainability.

Materials are categorized

into building materials, landscape materials and infrastructure materials to cover all of material elements available in urban developments.

4. Conclusions

Overview of material criteria in green certification rating systems and urban planning guidelines

To summarize current system features and their weakness as balanced material assessments for the sustainable urban development

(1) All of green certification rating systems:

- Evaluating Resources, Preservation and Durability & Adaptability for sustainable materials in common
- Pursuing balanced concept of sustainable materials in environment, economy and society

(2) All of urban design guidelines for London, New York and Tokyo:

- Sharing the directions and strategies for sustainable materials with green certification rating systems
- More specific and more various measures

(3) Structures of design guidelines, detailed material requirements and approach in different scales varies depending on cities

(4) Concept of Life Cycle Cost

- Hard to be incorporated in any green certification rating systems and urban design guidelines
- #### **Preservation**
- Commonly shared item in certification rating systems
 - Not required in urban design guidelines of all the discussed cities

References and Notes

1. James, P.; Magee, L.; Scerri, A.; Steger, M. B. *Urban Sustainability in Theory and Practice: Circles of Sustainability*; Routledge: London, UK, 2015.
2. Trade Press. Pharos Project. <http://www.solaripedia.com/713/136/material.html> (accessed Apr 29, 2015).
3. Solaripedia. Pharos Project Readies New Environmental Assessment Tool. <http://www.facilitiesnet.com/green/article/Pharos-Project-Readies-New-Environmental-Assesment-Tool-Facilities-Management-Green-Feature--9647> (accessed Apr 29, 2015).
4. National Institute of Building Sciences. Building Materials and Furnishings Sustainability Assessment Standards. <http://www.wbdg.org/resources/sustainabilityassessments.php> (accessed Apr 29, 2015).
5. Rodriguez, S. I.; Roman, M. S.; Sturhahn, S. C.; Terry, E. H. Sustainability Assessment and Reporting for the University of Michigan's Ann Arbor Campus. http://css.snre.umich.edu/css_doc/CSS02-04.pdf (accessed Apr 29, 2015).
6. Buchanan, P. *Ten Shades of Green: Architecture and the Natural World*; Architectural League of NY: New York, USA, 2006.
7. BRE. *BREEAM Communities Technical Manual SD202 - 1.0:2012*; Hertfordshire, UK, 2014.
8. Congress for the New Urbanism Natural Resources Defense Council; Council, U. G. B. *LEED 2009 for Neighborhood Development*; US Green Building Council: Washington DC, USA, 2009.
9. Institute for Building Environment and Energy Conservation *CASBEE for Urban Development Technical Manual (2014 Edition)*; JSBC, Ed.; IBEC: Tokyo, Japan, 2015.
10. Greater London Authority (GLA). The London Plan official website. <http://www.london.gov.uk/priorities/planning/london-plan> (accessed Apr 22, 2015).
11. Greater London Authority (GLA). The London Plan: The Spatial Development Strategy for London Consolidatee with Alaterations since 2011(2015). <http://www.london.gov.uk/priorities/planning/london-plan/further-alterations-to-the-london-plan> (accessed Apr 22, 2015).
12. Greater London Authority (GLA). Sustainable Design and Construction Supplementary Planning Guidance(SPG)(2014). <http://www.london.gov.uk/priorities/planning/consultations/draft-sustainable-design-and-construction> (accessed Apr 22, 2015).
13. The City of New York. plaNYC official website. <http://www.nyc.gov/html/planyc/html/home/home> (accessed Apr 22, 2015).
14. The City of New York. PlaNYC : Progress Report 2014. http://www.nyc.gov/html/planyc2030/downloads/pdf/140422_PlaNYCP-Report_FINAL_Web.pdf (accessed Apr 22, 2015).
15. The City of New York. plaNYC 2011. http://www.nyc.gov/html/planyc/downloads/pdf/publications/planyc_2011_planyc_full_report.pdf (accessed Apr 22, 2015).
16. The City of New York. High Performance Infrastructure Guidelines (2005). <http://www.nyc.gov/html/ddc/downloads/pdf/hpig.pdf> (accessed Apr 22, 2015).
17. The City of New York. Sustainable Urban Site Design Manual (2008). http://www.nyc.gov/html/ddc/downloads/pdf/ddc_sd-sitedesignmanual.pdf (accessed Apr 22, 2015).
18. Yang, J.-S.; Kim, I.-H.; Hwang, H.; Kwon, M.-R. *A Comparative Study on the Operational Systems of Master Plans in World Cities -London, Berlin, New York, Tokyo-*; Seoul, Korea, 2010.
19. Bureau of Urban Development - Tokyo Metropolitan Government. Planning Tokyo's Urban Development. <http://www.toshiseibi.metro.tokyo.jp/eng/pdf/2014-1.pdf> (accessed Apr 5, 2015).
20. Bureau of Urban Development - Tokyo Metropolitan Government. The City Planning Vision for Tokyo. http://bdi.re.kr/program/researchreport/download.asp?idx=317&file=391_061106.pdf (accessed Apr 5, 2015).
21. Tokyo Metropolitan Government. Tokyo Metropolitan Environmental Master Plan. [https://www.kankyo.metro.tokyo.jp/en/attachement/Master-Plan\(Outline\).pdf](https://www.kankyo.metro.tokyo.jp/en/attachement/Master-Plan(Outline).pdf) (accessed Apr 5, 2015).