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

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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*
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 |
|---------------------------|-------------------|---------|-----------|
| Assessment Criteria       | Categories        | Q       | Categories | Q       | Categories | Q       |
| Governance                | Smart Location and Linkage | 14 (P5, C9) | Environment: Resource | 4 |
| Social and economic wellbeing | Neighborhood Pattern and Design | 18 (P3, C15) | Environment: Nature | 4 |
| Resources and Energy      | Green Infrastructure and Buildings | 21 (P4, C17) | Environment: Artifact | 1 |
| Land Use and Ecology      | Innovation and Design Process | 2 (C2) | Social: Impartiality / Fairness | 2 |
| Transport and Movement    | Regional Priority Credit | 1 (C1) | Economy: Traffic/Urban structure | 4 |
|                           |                   |         | Economy: Growth potential | 3 |
|                           |                   |         | Economy: Efficiency/Rationality | 3 |
| No. of Items              | 5                 | 40      | 56 (P12, C44) | 3(9) | 29 |
| 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

| Part              | Criteria                  | BREEAM Communities                                      | LEED ND                                      | CASBEE UD                                      |
|-------------------|---------------------------|----------------------------------------------------------|----------------------------------------------|------------------------------------------------|
| **Environmental** |                           |                                                          |                                              |                                                |
| Resources         | Existing Infrastructure   | Recycled Content in Infrastructure                       | Resources recycling-Construction-Wood Material |                                                |
|                   | Existing Buildings        | Solid Waste Management Infrastructure                    | Resources recycling-Construction-Recycled Material |                                                |
| Health Safety     | Low Impact Materials      |                                                          | Resources recycling-Operation                |                                                |
|                   | Sustainable Buildings     |                                                          |                                              | Environmentally friendly 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   | Updatability and expandability: piping and wiring material |                                                |
|                   |                           | Historic Resource Adaptive Use                           |                                              |                                                |
| 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 |                                                |
|                   |                           |                                                          | Consideration for harmonization of exterior material and color |                                                |
| 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

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.

![Circles of Sustainable Materials](image)
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

| 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) |
| | Contaminated land and Hazardous substances | 5.22 Hazardous substances and installations | extraction of land-won aggregates within London |
| Living Spaces and Places | Place shaping | 7.6 Architecture | the highest quality materials |
| | | 7.7 Location and design of tall and large building | the local architectural character |
| | Historic environment and landscape | 7.8 Heritage assets and archaeology | incorporating the highest standards materials |
| | Air and noise pollution | 7.14 Improving air quality | conserving sympathetic to their materials |
| | Protecting open and natural environment | 7.19 Biodiversity and access to nature | not releasing toxics |
| | | | positive gains for nature through materials |
### 3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

#### 3.1. London

| Resource management | Chapter | The Mayor’s Priorities and Best Practice |
|---------------------|---------|-----------------------------------------|
|                     | 2.3 Site Layout and Building Design | Reuse of existing building |
|                     | 2.4 Energy and Carbon Dioxide Emission | Use less energy |
|                     | Design stage | |
|                     | 2.7. Material and Waste | |
|                     | Construction phase | demolition material, the waste hierarchy, historic material |
|                     | Occupation | storage for recyclables, organic, material and waste |
| Adapting to climate change and greening the city | 3.2 Tackling increased temperature and drought | Overheating, using materials with a high thermal mass, using materials with high albedo surfaces |
|                     | 3.4 Flooding | Flood resilience and resistance of buildings in flood risk areas, avoiding the use of materials particularly vulnerable to water |
| Pollution management – land, air, noise, light and water | 4.3 Air Pollution | Protecting internal air quality, robust materials, specifying environmentally sensitive (non-toxic) building materials |
|                     | 4.4 Noise | Detailed design considerations, the careful choice of materials |

**Table 4.** A List of material-related items in Sustainable Design and Construction SPG (2014).
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, the City of New York launched PlaNYC (2011) - a 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

| Category                        | Initiative                                      | Description                                                                 |
|---------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------|
| Housing and Neighborhoods       | Encourage sustainable neighborhoods             | 8. Increase the sustainability of City-financed and public housing           |
|                                 | Ensure the long-term health of parks and public space | 15. Incorporate sustainability through the design and maintenance of all public space |
| 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                                          |
|                                 | 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                     |
|                                 | 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 |
|                 | **SS.7. Optimize Street lighting and Signaling**                                                 | Use environmentally preferable materials in streetscapes                              |
|                 | **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                                     |
|                 |                                                                                                | Consider using alternative soil stabilization resins                                |
| Pavement        | **PA.5. Use Reduced-Emission Materials**                                                        | Application for Asphalitic 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                                                  |
|                 |                                                                                                | Non-pavement applications                                                           |
| Construction    | **CP.4. Implement a Waste Management and Recycling Plan**                                      | Regulate Management of C&D Waste in Contract Documents                              |
| Practices       |                                                                                                | 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                           | Coal fly ash recycled                                                    |
|                                  | and Material Descriptions                     | 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.

- create a high quality and more comfortable urban environment: 1 Material-related Item, 11 Items
- ensure a healthy and safe environment: 0 Material-related Items, 14 Items
- preserve subsistent foundation of all living being: 2 Material-related Items, 13 Items
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 |
|------|--------|---------------------------|----------|
| 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

| Sector | Zone | Items |
|--------|------|-------|
| Regional | CCR | Redvelopment 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. |
| | TRW | |
| SCC | CCR | Prevention and reduction of air pollution. |
| | TRW | 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. |
| | TRW | 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. |
| QC | TBW | Creation of green spaces and waterfront environment. Preservation and restoration of natural environment, biodiversity and ecosystem. |
| | | Use of natural blocks and rockworks for sea walls and waterfront development. |
### 3. Material Criteria in Urban Design Guidelines: London, New York, Tokyo and Seoul

#### 3.3. Tokyo

| Sector | Operations | Items |
|--------|------------|-------|
| 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 Canals, river and other Commercial and Business Housings and Residential Factory / Recreational Site / Quarrying / Waste & Sewage / Energy / Landfill & Port | 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 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 Commercial and Business Housings and Residential Factory / Recreational Site / Landfill & Port | Greening structures including vacant lots, sidewalks, buffer zones, walls and etc. Implementation of cool pavement with water retentivity and ground surface covering to mitigate the thermal environment Seawall with high permeability and planting to regenerate water circulation 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 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     | Materials in harmony with surrounding landscape resources and regional features                                                                                                                               |
| Inner/Out Four Mountain Axis  | Avoiding materials standing out and disturbing the harmony such as luminous materials                                                                                                                          |
| Base of Historical Characteristics | For exterior space, use of natural materials and adoption of qualities and colors in harmony with surroundings                                                                                       |
| Waterfront Axis               | For outdoor advertising, use of materials in harmony with the building and surroundings                                                                                                                          |
| North-South Green Axis        | Bright and light materials                                                                                                                                                                                        |
|                               | For the podium facing main streets, use of various materials to vitalize the streetscape                                                                                                                        |
| Seoul City Wall 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                                                                                                                       |
|                               | 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

| 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
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