Journal of Engg. Research **Vol. 5 No. (6) March 2018 pp.** *1-14*

مؤشرات التخطيط الحضري في أساليب تقييم المباني المستدامة

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الخـلاصــة

وقد برزت أساليب تقييم البناء المستدام كوسيلة مقبولة جيدا لقياس المستوى المتصور للاستدامة وتوفير مبادئ توجيهية نحو أفضل الممارسات الحالية. التخطيط الحضري، من خلال اختيار المواقع ، ومعالجة الغطاء النباتي والموئل، والتفاعل الاجتماعي، والنقل، باعتبارها دورا هاما في مثل هذه الأساليب. تم استعراض المؤشرات المتعلقة بالتخطيط الحضري في أساليب التقييم المستدام الحالية بشكل شامل هنا.

Urban planning indicators in sustainable building assessment methods

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Abstract

Sustainable building assessment methods have emerged as a well accepted way to measure the perceived level of sustainability and provide guidelines toward the current best practice. Urban planning, through site selection, treatment of vegetation and habitat, social interaction, and transport, represents an important role in such methods.Indicators related to urban planning in current sustainable building assessment methods are comprehensively reviewed here.

Keywords: Sustainable building assessment methods;uUrban planning; eEnvironment protection;sSocial interaction;tTransport.

INTRODUCTION

Clear and widespread impact of climate changes on human and natural systems (IPCC, 2014) raises sustainable development to the level of absolute necessity in all spheres of human undertakings. Due to its vital socioeconomic importance, the construction industry and the built environment are two of the key factors of sustainable development in society (CIB, 1999, Dimitrijević, 2013).

Sustainable building assessment methods have emerged as a well accepted way to measure the perceived level of sustainability and enhance the commitment to best practice in the last 10-15 years (Adler et al., 2006), due to their simplified assessment processes that are determined by a choice of indicators, measurement scales, classification criteria, and aggregation technique.

Urban planning indicators have an important role in such methods, as the decisions on the land use determine the human connection with natural and built environment, housing and transportation patterns, and access to diverse services. The goal of this manuscript is to give a review of urban planning indicators in current sustainable building assessment methods. They can be roughly divided into indicators related to site selection, vegetation and natural habitat, social interaction, and transport, that are presented in more detail in the forthcoming sections.

LIST OF REVIEWED SUSTAINABLE BUILDING ASSESSMENT METHODS

A total of 16 sustainable building assessment methods have been selected for this review, whose basic data is given in Table 1. Although there exists many other assessment methods nowadays (see, e.g., Haapio and Viitaniemi (2008)), most of them are predominantly academic in nature. The focus here is on the well -established methods, supported by corresponding societies, used in reality to assess building sustainability, and for which enough information is available in the English language.

Table 1. List of reviewed sustainable building assessment methods.

Name	Country	Link
BCA Green Mark	Singapore	http://www.bca.gov.sg/greenmark/green_mark_buildings.html
CASBEE for Home	Japan	http://ibec.or.jp/CASBEE/english/
CEPAS	Hong Kong	http://www.bd.gov.hk/english/documents/index_CEPAS.html
CSH	United Kingdom	https://www.gov.uk/government/policies/improving-the-energy-efficiency-of-buildings-and-using-planning-to-protect-the-environment/supporting-pages/code-for-sustainable-homes
DGNB System	Germany	http://www.dgnb-system.de/en/
ESGB	China	http://neec.no/uploads/Evaluation20%standard20%for20%green20%buildings.pdf
ESTIDAMA	Abu Dhabi	http://estidama.upc.gov.ae/
Green Building Index	Malaysia	http://www.greenbuildingindex.org/
Green Globes	Canada	http://www.greenglobes.com/
Green Pyramid	Egypt	http://eg.saint-gobain-glass.com/download/file/fid/1246
GRIHA	India	http://grihaindia.org/
HK-BEAM Plus	Hong Kong	https://www.hkgbc.org.hk/eng/BEAMPlus_NBEB.aspx
HQE	France	http://www.behqe.com
LEED for Homes	USA	http://www.usgbc.org/cert-guide/homes
SBTool	International	http://www.iisbe.org/sbtool2012-
TQB	Austria	https://www.oegnb.net/en/tqb.htm

SITE SELECTION

Selection of the development site has a major influence on many important aspects of its environment, such as wildlife habitat, urban sprawl, need for cars, and the efficiency of land and infrastructure use. Destruction of wildlife habitat through urban growth represents the greatest threat to biodiversity of an area. Wildlife habitat is best preserved by reducing the use of open space (and, in particular, forested areas) for new developments and focusing instead on utilization of infill lots, reuse of existing structures, and minimization of development footprint.

Infill lots are undeveloped or underdeveloped areas in an urban environment, whose immediate vicinity already contains necessary municipal infrastructure (water, sewage, roads, electricity, and telecommunications). Their use minimizes economical and environmental impacts related to the provision of infrastructure on site, and is also viewed as a remedy for urban sprawl (Brooks et al., 2011). It may, however, require additional extra effort to reach an agreement with both the local government and the nearby residents on the envisaged development. For example, the intent to extensively use land previously used as low-impact recreational area will inevitably lead to high social barriers and should be discouraged. On the other hand, restoration of environmentally contaminated brownfield sites that will make them habitable is usually highly encouraged.

Another opportunity to avoid the use of open space lies in renovation and reuse of the existing, structurally sound buildings. Adaptive reuse of buildings, that which intensifies their use or creates housing units within originally nonresidential buildings, has multiple benefits. Ecologically, it minimizes destruction of wildlife habitat and compaction of productive soil, reduces the need for raw materials, and also reduces construction waste. Economically, material and construction costs are initially lowered, although such savings may be offset if major upgrade or maintenance is required. Socially, adaptation of historic buildings reinforces connection to its past and may positively influence the identity of the community.

Open space may also be preserved by minimizing the development footprint, which, together with buildings, also includes parking lots and access roads. This can be done by designing smaller lot sizes and setbacks, making maximum use of the floor area or taking advantage of the vertical dimension of the building envelope, but with respect to the continuity of the streetscape.

Positioning of buildings on the site has to be performed by considering both the site›s impact to buildings and the impact of buildings to the neighboring properties. Building location on the site is influenced by the access to daylight and views, winter solar gain, natural ventilation, and acoustic issues. Concerning the neighboring properties, building location has to respect character of the streetscape, improve pedestrian linkages, prevent wind funneling, and avoid shading neighboring buildings and obstructing their access to daylight and views. Aligning buildings and roads with the existing contours on the site requires less intervention, reducing disruption to soil and leaving larger part of the site undisturbed. On larger sites, buildings can be grouped together in order to create landscaped area of a maximum size.

Needless to say, site conditions should be thoroughly evaluated before development so as to avoid areas prone to natural hazards such as flooding, landslide, or interface with the wildlife. Not only may that flood plains may be hazardous to humans and property safety, but they also provide valuable ecosystem functions serving as groundwater recharge areas. In the light of more frequent appearance of flooding due to climate change, more sustainable building assessment methods should pay attention to flood protection of buildings as already done in the Code for Sustainable Homes in the UK. Findings from a research project on flood resilience of buildings may be found in (Bowker et al., (2007), while the spatial aspects of flood protection have been discussed in (Ristić et al., (2011).

Table 2. Overview of indicators related to site location in sustainable building assessment methods.

	DGNB System	LEED for Homes	BCA Green Mark	CASBEE for Home	CEPAS	CSH	ESTIDAMA	ESGB	Green Building Index	Green Globes	Green Pyramid	HK-BEAM Plus	HQE	SBtool	GRIHA	TQB
Evaluation of existing site conditions	■				■		■	■				■	■		■	
Evaluation of the risk from hazards	■	■				■		■	■					■	■	■
Flood protection						■										
Restoration of brownfield sites	■	■						■	■	■	■	■			■	■
Redevelopment of existing buildings			■		■		■		■			■				■
Exterior design in harmony with neighboring buildings				■										■		
Promotion of compact development sites		■												■		
Promotion of development on lots adjacent to previously developed land		■														
Ensuring natural ventilation within the neighborhood				■	■			■						■		
Ensuring daylight access within the neighborhood					■							■				
Ensuring daylight access within the site					■											
Ensuring sunlight penetration within the site					■									■		
Preventing light pollution within the neighborhood (avoiding the use of reflective fenestration)					■			■		■						
Impact of tall structures on existing view corridors														■		
Preventing emergence of excessive wind velocities				■	■			■	■			■				

VEGETATION AND NATURAL HABITAT

Natural landscapes serve a multitude of functions in urban areas. First, they help in making local ecology more robust and diverse by providing habitat, creating soils, and recharging groundwater. They oxygenate the air, filter air particles, reduce noise pollution, and provide windbreak. They further provide people with views, recreational areas, sunshade, and bird song.

However, conventional urban landscapes in the forms of cultivated lawns, and ornamental shrubs and trees cannot be considered sustainable, despite their aesthetic appeal, as they often rely on plant species that require significant amount of maintenance, energy, water, fertilizers, and pesticides to survive. Such choice not only increases ownership costs, but does not provide viable habitat for local wildlife and may actually threaten the existence of native species, competing with them for resources.

The key to sustainable and low maintenance urban green areas, thus, lies in the use of native plant species. Native trees, shrubs, and ground cover are well suited to local rainfall conditions and nutrient levels, and require very little watering and fertilizing after initial planting. They are more resistant to naturally occurring diseases and insects in their environment, diminishing the need for the use of pesticides. They also provide habitat for local birds and animals that are already adapted to them in their environment.

The use of native species in landscaping should mimic natural habitat model in order to enhance wildlife survival, blend edges to existing adjoining vegetation, and decrease long-term maintenance costs. Such companion planting then attracts proper balance of birds, insects, and micro-organisms, which help to resist diseases and infestations, providing natural herbicides and pesticides. Care should only be taken to avoid planting allergy-causing species next to fresh air intakes.

Preservation of the existing native vegetation provides a cost-effective basis for landscaping. Setting aside a percentage of site›s area to be left undisturbed and clearing only the areas that will be actually used for driveways, parking areas, and building foundations helps preserve soil, water, and vegetation. Undisturbed areas stabilize soils and filter sediments from storm water runoff before they enter waterways, allowing rainwater to stay on site and recharge groundwater instead of running off site. Established trees, hedges, and shrubs that are retained on site moderate surface temperature, provide sunshade in summer, channel summer breezes and block cold winds in winter, stabilize soils, intercept air pollutants, and provide habitat for local wildlife. Particularly, old trees contribute to the site›s unique character and may also serve as neighborhood landmarks.

To protect trees and their root systems during construction, all excavations, equipment, and debris should be kept away from trees at a distance twice the size of the canopy from the tree trunk. Trees and plants that must be removed due to interference with construction works, can often be reused for landscaping on site or donated to be replanted off site, provided they are either replanted as soon as possible or have their root ball properly protected and watered until replanted.

The use of vegetation is a simple and helpful mean to combat urban heat island issues. Heat islands are created when concrete and asphalt urban surfaces absorb and reradiate solar radiation. The problem can be approached directly by using lighter colored materials with high solar reflectance (for roofs and walls) or porous materials whose lower density reduces their heat storage capacity (for pavements). Reducing the amount and size of parking areas has an additional benefit of forcing the decrease in the number of cars used.

On the other hand, planting deciduous trees and vines on walls can reduce summer solar gains on south and west elevations of buildings and paved surfaces by providing the shade, while still allowing the benefits of winter solar gains. If properly situated, buildings may benefit from the existing trees on site. When planting new trees, care should be taken to plant only trees that do not shade building roofs when full grown, so that they do not interfere later with an eventual installation of solar collectors on roofs. Note that vegetation cools the air not only by providing shade, but also through the evaporation of water from leaves, so that it provides summer cooling benefits even when not providing direct shades.

Creation of heat islands on low slope roofs can be prevented by installing green roofs (Sekulić et al., 2013). The green roof plants should be selected to be self-sustainable without the need for irrigation, fertilizers, or pesticides, such as native grasses interspersed with wild flowers. In addition to reducing building solar heat gain, green roofs may detain over 50% of rainwater from a typical storm, thus reducing the immediate loads placed on sewer systems after a rainfall.

Properly treating soil on the site during construction is essential for later successful landscaping. The soil compacted by construction activities is less able to absorb water, resists plant root penetration, lacks the porosity needed for adequate aeration, and may become lifeless as a consequence (BuiltGreen Washington). Soil compaction may be minimized by establishing a single construction access road, stabilized by crushed rock or concrete, and limiting the use of heavy equipment use to the access road and the building footprint.

The top layer of the soil is the most valuable, and should be separated during excavations for reuse in the final landscaping. Its erosion from wind and water can be prevented by covering it with mulch or fencing it with compost barriers or silt retention berms. Soil disturbed during construction can be amended by compost up to 30cm in depth in order to restore its environmental functions—-stable provision of nutrient sources, metal binding, and provision of beneficial organisms.

Finally, the current ecological function has to be taken into account when selecting development sites and locating buildings, in order to avoid development on ecologically sensitive areas, such as flower rich grassland, wetlands, watercourses, and riparian areas. Such areas provide essential cover, feeding, nesting, and breeding habitat for many wild species, act as natural groundwater recharge areas, and buffer the storm water runoff. They are most easily protected by leaving a vegetated buffer zone at least 30 meters wide along their borders. The same approach should be taken on smaller scale as well-vegetated areas can be provided as buffer strips around any paved area, especially parking lots, as they help to filter storm water runoff and prevent harmful particulate matter from vehicular transportation from being washed to water systems. Wetlands and riparian areas should also be protected from sediment using compost slope mulching or silt retention berms.

Table 3. Overview of ecological indicators in sustainable building assessment methods

	DGNB System	LEED for Homes	BCA Green Mark	CASBEE for Home	CEPAS	CSH	ESTIDAMA	ESGB	Green Building Index	Green Globes	Green Pyramid	HK-BEAM Plus	HQE	SBtool	GRIHA	TQB
Preservation of trees existing on the site		■	■	■	■		■	■		■	■			■	■	
Buildings setback for street side tree planting					■											
At least 80% of timber used on site is reclaimed, reused or responsibly sourced						■										
Percentage of the site area dedicated to greenery			■	■				■	■			■	■			
Greenery design in harmony with local townscape				■												
New plants are mostly native species		■		■	■	■	■	■	■	■				■		
Shading exterior surfaces by greenery (trees, facade greening, green roofs)	■	■		■	■	■		■	■	■		■		■		■
Ensuring high albedo of exterior surfaces				■	■	■			■	■		■		■		
Reduced covering with concrete or asphalt				■											■	
Protection of soil during construction	■	■		■			■				■		■		■	
Prevention of topsoil erosion		■								■					■	
Reuse of excavated soil on site													■			
Maintaining the original topography		■		■				■								
Retention of habitat for birds and small animals (development on sites of low ecological value)		■		■	■	■	■		■	■	■	■		■	■	
Maintaining biodiversity on site												■	■			
Protection of water systems on site		■						■	■	■					■	
Protection of wetlands and riparian areas														■		
Removal of ecological features only when low ecological value is adequately confirmed						■										
Measuring change in ecological value of the site						■	■									

SOCIAL INTERACTION IN URBAN AREAS

Indicators related to urban social interaction within sustainable building assessment methods are generally governed by the New Urbanism principles. Driven by the advent of cheap automobiles, urban planning after World War II shifted toward single function municipal zoning that segregated residential from commercial and industrial development, and focused on the low-density single-family housing as the preferred housing option for the growing middle class (Congress for the New Urbanism, 2013). This physical separation of places where people live from where they work and where they shop led to higher impact on land consumption, indispensable reliance on cars, greater travelling needs, and greater air pollution, and also to greater social segregation.

A pPrimary solution to these problems lies in refocusing planning to diversification of housing, mixed uses, and walkability. Increased diversity of housing choices makes living in the community affordable to a wider range of population. Development of local community cores that satisfy weekly commercial and social needs reduces travelling needs, provides these amenities with a stable customer base, and generates jobs for people living in the community. High density of mixed uses increases the probability for basic amenities to be provided within the 300–-500m range, which positively influences the switch to walking.

Walking does not only contribute to a healthier lifestyle, but have social benefits of exposing people to the community, encouraging interaction among its residents, and promoting the feeling of belonging to a place. Ensuring walkability of a neighborhood is a simple matter of urban design. The first task is to reduce visual separability of buildings on either side of the street by reducing their setbacks. Outdoor gathering, socializing, and interacting places, such as courtyards and, sitting or dining areas, have to be created immediately adjacent to pedestrian routes. They should be designed with sufficient public outdoor furniture and, weather protection like awnings and windbreaks, and should be conveniently accessible by public transit. Ease of orientation is ensured by visual simplicity, memorable landmarks, maps and signs that lead people to destinations, and outlooks along the view corridors. Connectivity of the street network should be improved with a clear hierarchy of boulevards, alleys, and narrow streets, which provides alternative paths to each destination and links neighborhoods in a continuous system. Recent examples of planning walking-friendly neighborhoods may be found in (Đukić and Vukmirović, (2012).

Recreation facilities, both active for sports and passive for picnics, further enrich social interaction in the community. They have to meet the needs of different generations, from children to teenagers to adults to seniors, and to thoughtfully incorporate seating and sheltered areas. Vacant or underutilized lots provide an option to realized, small, pocket parks (Sheltair group, 2004). If well integrated into walkways, they provide excellent opportunities for informal meeting in a pleasant environment and significantly contribute significantly to the community appeal.

Table 4. Overview of social interaction indicators in sustainable building assessment methods

	DGNB System	LEED for Homes	BCA Green Mark	CASBEE for Home	CEPAS	CSH	ESTIDAMA	ESGB	Green Building Index	Green Globes	Green Pyramid	HK-BEAM Plus	HQE	SBtool	GRIHA	TQB
High walkability index of the site		■								■		■				
Increase in the connectivity of street network														■		
Proximity to commercial amenities (supermarkets, restaurants, banks, post, hairdresser, etc.)	■	■			■		■		■							■
Proximity to schools and kindergartens	■	■					■		■							■
Proximity to medical provision	■	■					■		■							■
Proximity to public administration and social services	■	■			■		■		■							■
Proximity to places of worship		■					■		■							
Proximity to cultural facilities	■	■														■
Proximity to major employment center		■														
Centralization of amenities	■						■									
Proximity to sporting and recreational facilities	■	■			■		■					■				■
Provision of public parks and playgrounds	■	■							■					■		■
Provision of community gardens and urban agriculture						■				■				■		
Provision of common spaces (open or closed) on site					■											
Provision of relaxation areas on site													■	■		
Provision of shaded walkways on site	■		■		■				■				■			
Provision of water features on site	■															
Shading of open spaces on site	■															
Community involvement in design and construction issues					■									■		
Funding for public art as a percentage of construction costs	■															
Adequate nighttime illumination of outdoor spaces	■			■									■	■		
Elimination of dark spots and recess spaces					■											
Provision of fences and access barriers to the site					■											
Maintaining good sightline between street and buildings				■												

TRANSPORT

Despite giving freedom to choose choosing departure time and providing convenient transport of smaller cargo, automotive transportation negatively affects many aspects of urban environments: roads and parking areas consume most land of all transportation means;, automobiles are the most energy-inefficient way of transport, and due to the use of fossil fuels, they are also the largest and most widespread source of urban pollution. Streets clogged with private cars significantly deteriorate livability in urban areas, while traffic collisions present a considerable threat to human safety. Traffic is also the main source of noise in cities (Hogan and Latshaw, 1973). To some extent this is fought by the use of noise buffers (roadside walls and screens) and white noise strategies (such as the sounds of water from fountains) that reduce the perception of traffic sounds.

Air emissions of automotive transportation, besides CO2, include a variety of other harmful gasses and particulate matter, which introduce toxins to humans and the environment and disrupt natural processes. Localization of this pollution consists in planting trees and multilayered vegetative canopies along the streets at close distance to help capture air pollutants and particles. Nevertheless, these particles are washed away during rainstorms and snow melts from the roads and parking areas into soils and water systems, which causes further pollution away from the source.

It is thus of uttermost environmental and social importance to reduce the use of high impact, low occupancy vehicles. At the first instance, this can be supported by taking appropriate measures when designing parking areas. Reducing the amount of available parking spaces encourages people to consider alternative transport means, especially if care is taken that the site is well integrated with into them. Dedicated parking areas, closest to entrances, should be provided for high occupancy vehicles, such as buses and carpools. In addition, the visibility of parking areas and garages should be reduced, so that they do not become predominant features of the site. Traffic calming measures, which physically alter the road layout or its appearance (such as lane narrowing, speed bumps, or access restrictions), present further incentives to reduce the use of private cars. Promotion of the use of electric vehicles through the installation of charging stations helps decrease pollution from air emissions or at least to relocate it, depending on the fuel used to obtain local electricity mix.

Further incentives have to be provided in urban planning for the use of public transport, in which, by using lower impact, higher occupancy vehicles puts less burdenfewer burdens on the environment. Despite being a necessary mobility option for seniors and children alike, it also meets expanded mobility needs of modern society through provision of long-distance transport. Further social benefits include the possibility for people to read, talk, or even nap during transport instead of focusing on the traffic. On a site level, the use of public transport is promoted by providing safe and convenient walkways to public transit stops and locating buildings up to a 500m walking distance from the existing public transportation stops.

Bicycling ideally complements public transport and presents an alternative to it at shorter distances. Its local promotion requires provision of lock-up facilities and storage areas, possibly supported by convenient changing facilities and showers. Even wider promotion may be established by community-level bicycle sharing programs, which overcome the ownership and home storage issues. Certainly, promotion of bicycling is bounded by vertical gradient of the site, as it is most comfortable at a gradient of up to 2.5%.

Table 5. Overview of green transport indicators in sustainable building assessment methods

	DGNB System	LEED for Homes	BCA Green Mark	CASBEE for Home	CEPAS	CSH	ESTIDAMA	ESGB	Green Building Index	Green Globes	Green Pyramid	HK-BEAM Plus	HQE	SBtool	GRIHA	TQB
Safe pedestrian access to local public transport	■	■	■		■		■	■	■		■	■	■	■	■	■
Connection to long-distance public transport (airports, railways, ports)	■										■					
Electric vehicle charging stations	■		■										■			
Minimization of the number of parking spaces, with dedicated spaces for high-occupancy vehicles					■							■		■		
Sufficient quantity of parking spaces	■															
Well-lit and close parking spaces for women and families	■															
Provision of safe bicycle paths									■				■	■		
Covered bicycle storage and parking areas	■		■		■	■	■		■				■	■		■
Provision of bicycle repair facilities	■															
Well-lit and close bicycle parking areas	■															

CONCLUSIONS

Indicators related to urban planning in a number of current sustainable building assessment methods have been reviewed here. Data from Tables 2–-5 point out a handful of well established global indicators that appear in most of the reviewed assessment methods. The most common site indicators are evaluation of site conditions and risk of natural hazards, restoration of brownfield sites, and reuse of existing buildings, while the most common ecological indicators are preservation of existing trees, planting of native species, use of greenery for shading, and retention of habitat for birds and small animals. From the social point of view, the most important indicators are, quite expectedly, concerned with the proximity to the most needed amenities in everyday life,: commercial services, schools, medical services, public administration, recreational facilities, public parks, and playgrounds, but also with the shading of walkways in the neighborhoods. When it comes to transport, the most important indicators are provisions of safe and, convenient pedestrian access to public transport,and bicycle storage, and parking areas. A majority of the indicators are, however, specific to smaller number of methods, as "one size fits all" approach cannot be applied to planning policy. This is also in line with the suggestion of McKenzie (2004) that sustainability indicators become most useful when determined in response to sustainability issues on the local level.

ACKNOWLEDGEMENT

This paper is a part of research conducted through the Scientific projects “Spatial, environmental, energy and social aspects of developing settlements and climate change – mutual impacts” (TR 36035 and ON174033), financed by the Ministry of Education and Science of the Republic of Serbia from 2011 to 20185.

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Submitted: 04/04/2016
Accepted : 14/03/2017