LIGHT IMPRINT NEW URBANISM – A FRAMEWORK FOR URBAN AND ENVIRONMENTAL SUSTAINABILITY

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Abstract

Light Imprint (LI) is a comprehensive strategy aiming to create urban forms that lie lightly on the land. It coordinates sustainable engineering practices and New Urbanism techniques, thereby offering different solutions for different transect zones. New Urbanism principles offer a better planning philosophy by minimizing the overall impact of the built environment compared to conventional suburban sprawl. LI, as a New Urban approach, integrates urban and engineering practices offering a framework for regional, neighborhood, and block scale development. Economic growth is ensured while preserving natural resources. LI protects biodiversity and reduces pollution and resource depletion. It addresses conservation of the two most critical global resources: energy and land.

Recent case studies show LI's focus on natural systems and environmental efficiency without compromising design priorities. Community connectivity and a superior public realm are the result. It also significantly lowers construction and engineering costs. Using sustainable engineering practices and LI urbanism, water quality in the watershed is ensured. Watersheds, which contain the human habitat, are essential for environmental sustainability; mankind must preserve services they provide. Those include water quality, water quantity, biodiversity, and assimilative capacity. By preventing disruption and damage in urban and suburban areas, LI precludes biodiversity loss and ecosystem changes.

Light Imprint New Urbanism (LINU) is a comprehensive planning and development framework that emphasizes sustainability, pedestrian–oriented design and increased environmental and infrastructural efficiency, while reducing a community's anticipated construction expenses by up to one third of conventional practices. On a regional scale, building compact urban entities reduces the stress and fragmentation of the watershed caused by roads, infrastructure and impervious cover. This strategy preserves the resources provided by the watershed and creates environmentally sustainable communities. On a community and building scale, Light Imprint development makes communities more economically vital by reducing infrastructure such as roads, public works and facilities. The implementation of light imprint methods also results in a smaller ecological footprint of individual buildings. The hydrological effects include decreased storm water runoff in terms of total volume, peak capacity and enhanced groundwater recharge, all of which are critical factors for sustaining stream flow and as a result a considerably lower flood and erosion potential due to induced changes of the environment.

Introduction

The past and current patterns of growth of many American cities are evidence that the energy and land consumption were not amongst the most important planning factors. Continuous and unregulated population growth, urbanization, and industrialization lead to consumption of excessive amounts of energy, resources and land and cause irreversible deterioration of the watersheds and the environment. While the major task of our society is to promote economic growth and equality, not less important is to promote methods for conserving energy and land, minimizing waste; protecting biodiversity and limiting the air and water pollution. The current planning principles promote suburban sprawl patterns and favor low-density development over creation of compact communities. A better planning philosophy is needed to create urban entities designed on the principles of energy and environmental sustainability. These principles implement compact and mixed use urban patterns, increased density and walkable urban areas as well technologies for reducing the imprint of built environment. Planning for sustainability should also focus on practices that limit the air, water, land pollution, reduce greenhouse gas emissions and climate changes, prevent disruption and damage in urban/suburban areas, loss of biodiversity, and ecosystem changes.

Green Urbanism (GU) is one alternative environmental approach promoted by landscape architects which emphasizes an increased percentage of open space within a development site, typically in the range of 60% or greater per project. Greenway fingers serve as the primary organizing spines for development, and storm water filtration mechanisms are placed outside of and around these green spaces. Green Urbanism developments offer far less connectivity, because streets are often terminated to prevent encroachment on greenway fingers. Three problems often arise in these developments. First, important connections are so disrupted that functional issues such as traversing the site become difficult. A second problem encountered is that land development issues make reserving significant open space impracticable. And finally, the increased requirement for open space may so reduce the amount of developable land that the project may not be economically feasible.

Low Impact Development (LID) is another popular environmental development strategy adopted by some municipalities. The origins of LID are found in conventional suburban development and include stormwater management techniques that filter, store, and detain runoff close to water bodies, including open space conservation, buffers and grass rooftops (Unitest States Environmental Protection Agency, 2000). LID techniques can be applied to both conventional suburban residential development and commercial development and for new development, building retrofits, redevelopment, and revitalization. However, LID offers similar approaches to these different sorts of development. High density residential development, such as a typical suburban apartment complex, is thrown into the same classification as commercial development, such as a strip shopping center. This lack of differentiation between developments of different characters is one downfall of LID. Furthermore, LID suggests that instead of typical gridiron

layout, loops and lollipops patterns may result in reduction of total imperious surface area (Prince George's County, 1999), by up to 26%. Although LID introduces cost efficient strategies for stormwater management, LID prioritizes various environmental factors over urban planning principles and may as a result promote sprawl development patterns by ignoring such important requirements as connectivity, compactness, walkability, and mixed-use.

On-site design techniques, such as Best Management Practices (BMP) are used by LID for improving stormwater quality. Best Management Practices proposed by the EPA (Nisenson, 2005) typically focuses on engineering and water quality issues of stormwater runoff rather than planning and design for addressing methods for stormwater treatment. However, problems arise when Best Management Practices designed to solve suburban engineering issues are applied to more urban communities. For example, compact development suffers when BMPs dictate the need for storm water detention areas in front of, or beside buildings on site. This approach can harm a community's social connectivity and may even interfere with retail merchandizing needs and feasibility.

Compared to conventional engineering practices New Urbanist Conventional Engineering accommodates a broader range of development standards necessary for community-oriented design. In recent years, the development industry has begun to shift from the conventional suburban model towards the New Urban model, which advocates the development of compact, mixed-use, pedestrian friendly communities. Much of this shift has emerged from the need to better address environmental and community goals and to reconcile the development industry with land conservation organizations. The New Urban model allows residents to greatly decrease use of their cars, clearly yield environmental benefits, but such developments also have a great number of other environmental strengths. The U. S. Green Building Council (USGBC), which developed the LEED (Leadership in Energy and Environmental Design) Green Building Rating System, has recently recognized this fact. In partnership with the Congress of New Urbanism (CNU) and the Natural Resources Defense Council, the USGBC used the principles of New Urbanism to develop a new rating system, LEED for Neighborhood Development. The new system integrates the principles of smart growth, urbanism, and green building into the first national standard for neighborhood design and provides a high level of environmental benefits.

Light Imprint New Urbanism

The continuous expansion of the infrastructure of the human society increases the stress and impacts the natural, sustainable conditions of the watersheds. In order to analyze the degree of watershed deterioration caused by continuous expansion of the human habitat, one must understand the impact on the watershed caused by different development patterns: rural, suburban and urban human habitats. The impacts of urbanization on watersheds is mostly caused by impervious cover and results in elevated levels of water, air and soil pollution, deterioration of the ecosystem and decreasing biodiversity. The urbanization may cause elevated levels of lawn nutrients, urban pesticides, rooftop runoff, first flush of stormwater, contamination by heavy metals, suspended and deposited sediments, and biocontamination. The growth of the human habitat affects the watersheds quantitatively and qualitatively:

- **Integral**: The impact on the watershed depends on the composite effect of the urban zones within the watershed boundaries and comprising a human settlement. Thus, the effect will be cumulative and while highly urbanized areas will have a greater impact on local scale. However, on regional scale the impact will be less severe compared to sprawl development patterns. The principles of New Urbanism offer a better planning philosophy for minimization of the overall impact of the built environment.
- **Differential**: The impairment of a watershed is proportional to the urbanization intensity and the extent of built infrastructure, i.e., type of human habitat/urban zones: rural areas may have less impact on the watersheds compared to urban core areas. Nevertheless, the impact of the infrastructure can be reduced by applying a variety of techniques.

Maintaining the watershed in its natural condition is the key factor for ensuring continued quality services of the watersheds (expressed in preserved biodiversity, water quality and quantity, and assimilative capacity). The excessive land use and built infrastructure encouraged by sprawl causes fragmentation and increases the impairment of the services and resources provided by watersheds. The New Urbanism is a methodology that offers a comprehensive approach to better utilization of the natural resources, community development and creates pleasant and livable communities By prioritizing these design and planning issues, New Urbanist development offers multi-faceted environmental and community planning benefits, unlike more isolated environmental approaches.

One of the greatest strength of the New Urbanism in the area of sustainability is the design of compact communities, which have a better performance on the regional scale for two important reasons. First, compact communities require reduced infrastructure, and second, they cause lower stress and fragmentation originating from impervious cover. The significance of compactness has been shown in a recent study by (Long, Tachiev, & Yaari, 2007), which analyzed 5 cities within the Miami Metropolis, including Coral Gables, Doral, Hialeah, Miami and Sweetwater. The study included 281 Census Blocks with population of 384,134 on 31,617 acres of land. For each census block the population density was determined by dividing population by area of census block and the area of roads per population was determined dividing the total area of roads per population (Figure 1), which resulted in a logarithmic trend.

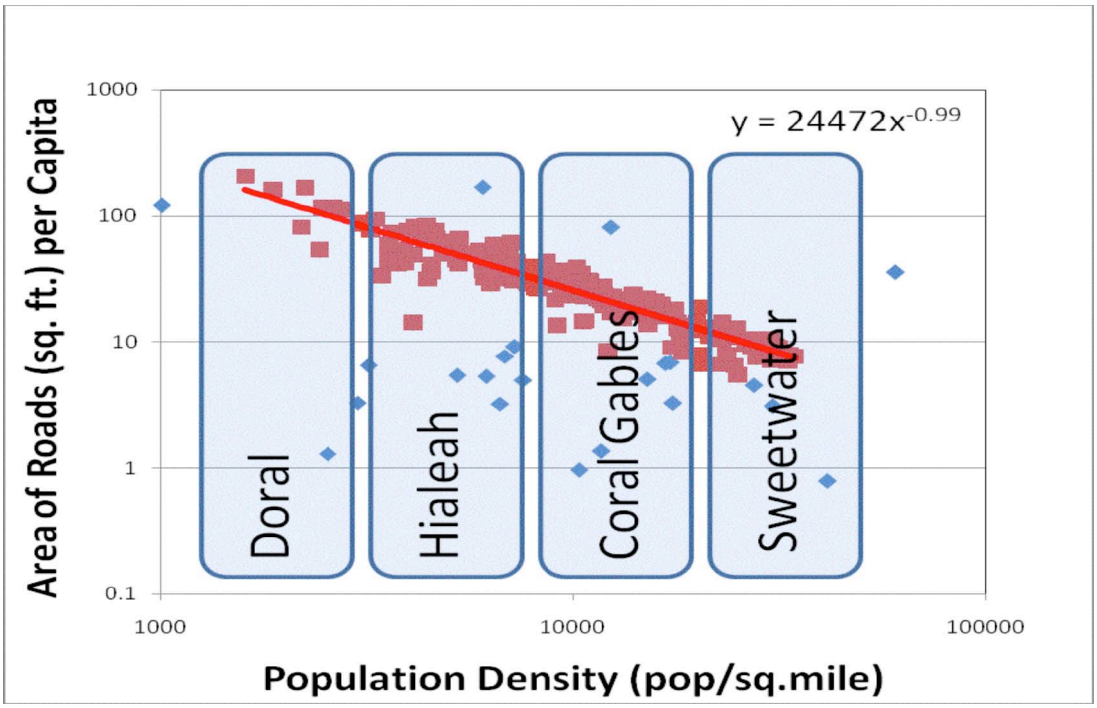

Figure 1 Effect of population density on road sharing

The figure illustrates the extent of infrastructure expressed in terms of roads needed per person as a function of the population density. The need for roads per person grows logarithmically as the density decreases. While not shown here, similar is the effect with other public works such as water, sewer and power lines. The New Urbanist developments are modeled after the best performing traditional communities and in addition to considerable reduction of infrastructure on regional scale, New Urbanist developments result in improved watershed protection by reducing the total impervious areas. The connected networks advocated in New Urbanist development create a symbiotic connection between built and natural environment and provide comprehensive environmental protection on regional, neighborhood and block scale (outlined in the Charter of the New Urbanism[1]). The Charter prioritizes diversity, walkability and connectivity, all of which contribute to the creation of sustainable neighborhoods. Leading planner Andres Duany, a principal of Duany Plater-Zyberk & Company, describes the layout of a typical New Urban community as an "open-mesh network" where a fine-grain system of connected streets mitigates traffic congestion and reinforces community connections.

Further supporting the concepts of urban sustainability, there are newly developed techniques for "Light Imprint New Urbanism" (LINU), which aim to "lie lightly on the land" by coordinating engineering practices and New Urbanist design practices. It enables developers to consider environmental and preservation factors without compromising design priorities such as connectivity and the public realm. Like all New Urban planning, LINU respects site terrain and topography while it prioritizes public civic space. Additionally, LINU offers a range of cutting-edge environmental strategies for differing landscapes and urban conditions. LINU planning

[1] http://www.cnu.org/cnu_reports/Charter.pdf

introduces a tool set that deals with stormwater run-off through natural drainage, conventional engineering infrastructure, and innovative infiltration practices. These tools are to be used collectively at the sector, neighborhood, and block scale. The combination of tools are adjusted according to the appropriateness of their use in each transect zone.

This toolset not only offers a great range of environmental benefits, but can also significantly lower construction and engineering costs. By using different tools in each transect zone, LINU is not limited to a single approach for environmentally sensitive development. Rather, it offers a range of context-sensitive design solutions that ultimately work together on the community level. Thus LINU reduces infrastructure on the neighborhood scale in terms of roads, public works and facilities. On the block scale, the implementation of light imprint methods results in reduced ecological footprint of individual buildings and reduced stormwater runoff.

Griffin Park, a DPZ-designed traditional neighborhood development in Greenville, South Carolina, offers one example of Light Imprint New Urban development. While there have been numerous studies comparing Conventional Suburban Develoment (CSDs) with Traditional Neighborhood Development (TNDs), there have been few comparing standard TNDs to "Light Imprint" TNDs. The DPZ Charlotte office recently took on such a project, using Griffin Park as a case study. Griffin Park is situated at the highly traveled crossroads of West Georgia Road and Fork Shoals Road, fifteen miles southwest of downtown Greenville. The area has been heavily developed as the city has expanded, and much of the land surrounding the site has been developed into conventional housing subdivisions. Griffin Park will offer an alternative to this sprawl development, and will give residents a chance to live in a more community- oriented atmosphere with public space, recreational offerings, and retail within walking distance of their homes. When completed, Griffin Park will include more than one thousand single-family homes as well as large-scale retail offerings. The majority of the retail activity will be within the town center at the major intersection, which was originally zoned for big-box retail development. The big-box components have been re-designed to be integrated with a pedestrian-scaled Main Street, lined with smaller-scaled retail establishments and live/work units. This Main Street development spine will connect the various neighborhoods, each of which will have its own smaller community center featuring a plaza or a square. Additionally, each neighborhood will have a unique landscape character and design adhering to the site's topography and natural features. Beyond Griffin Park's town center, larger single-family houses are interspersed with townhouses and carriage houses along streets designed for pedestrian activity. Many of these streets follow the curves of the Reedy River, preserving the site's wetlands and providing a buffer to nearby development. The town plan also preserves green space by including public civic spaces such as parks, playgrounds, trails, and sports areas. By preserving open space as well as serving as an example of compact, mixed-use development, Griffin Park is envisioned as a precedent for how the Greenville area can accommodate further growth.

Figure 2 Master plan of Griffin Park, left image represents Conventional TND Master plan and the right image represents Light Imprint TND Master Plan

The figure above compares the master plan before and after the application of light imprint engineering. Landscape architect Guy Pearlman and designer Patrick Kelly, both of the DPZ Charlotte office developed the LINU model for Griffin Park to create an environmentally sensitive community, preserve mature tree stands, and lower the construction costs for the first development phase. The conventional TND engineering plan is engineered for both county review and bidding purposes; it reaches an extensive level of detail. The light-imprint engineering plan is based on many of the variables developed in the conventional plan. Added consideration, however, is given to environmental and preservation factors. Those factors enhance the overall value of the community and lower the total cost of construction. Environmental strategies at Griffin Park included the introduction of rain gardens and a tree protection fence. The introduction of these elements allowed for the development's underground piping system as well as curbs and gutters to be downsized thereby lessening the environmental impact of the development and saving significant sums on construction.

In order to achieve the desired goals of the light-imprint TND plan, a tree protection fence is introduced in the erosion control phase to protect the existing mature trees. That strategy results in a 27% cost increase when compared with the conventional proposed method. Yet, a cost saving between the two methods was found in the storm water management phase. A 50% cost savings would be achieved by the following simple actions: 1) Omission of curb and gutter in strategic areas; 2) Reduction in the amount of pipe required as well as reduction in their lengths and size; 3) Reduction in the need for inlets to underground pipes; and 4) The introduction of smaller rain gardens throughout the community to replace the one large retention pond.

Figure 3 Engineering infrastructure of Griffin Park, left image represents Conventional TND Master plan and the right image represents Light Imprint TND Master Plan

The figure above shows the engineering infrastructure for each of these plans. The introduction of rain gardens also adds aesthetically pleasing natural areas and neighborhood recreation areas. Rain gardens would remove a greater amount of pollutants from runoff before the pollutants could reach the Reedy River. The rain gardens permit groundwater recharge, thus contributing to the restoration of the natural water cycle. Also, there are two road pavement issues that reduce costs. First, building 24 feet wide roads instead of 26 feet wide roads results in a significant reduction of land coverage and paving costs. Second, substituting crushed stone in place of asphalt-paved alleys saves over 20% in development costs. Significant attention and improvement in water quality can be achieved by permeable pavements.

Implementing the light-imprint engineering method results in over 30% cost savings in actual construction dollars for the first phase. That cost saving is in addition to the added value realized by the preserved mature trees and communal rain gardens. Municipalities reviewing New Urban communities are often interested in embracing the New Urbanist approach; however, their governing bodies may be conservative regarding acceptance of different standards. Problems arise when designers attempt to overcompensate with standards and design. This overcompensation, or "gold plating," of infrastructure has adverse effects on the ability to successfully implement a New Urban community. Project delays and additional infrastructure cost can ultimately prevent the implementation of a good community development. Light Imprint New Urbanism offers a more manageable alternative by coordinating innovative engineering practices with the New Urban design approaches in specific transect zones. This strategy will ease implementation - which is crucial, given that currently only a limited number of New Urbanist practitioners have significant implementation experience – and also offer great environmental benefits. In order to have the Light Imprint approach embraced by advocates of New Urbanism within municipalities and the development and building industry, it is important to have the Light Imprint model presented as a comprehensive strategy which supports the New Urbanist design of street and lot layout along with other standard practices for common infrastructure elements including water and sanitary sewer.

Figure 4 Proposed reductions of pavement and curb and gutter.

For Light Imprint New Urbanism, engineering hydrology becomes critical. The surface and subsurface infrastructure can remove both the soluble and fine particulate pollutants that occur within urban runoff. However, soil analyses are needed to verify that soil is in compliance with rain garden absorption requirements and to confirm that smaller pipe size is sufficient for the system. Even though a comprehensive approach works best when applying the Light Imprint model, it is also important to make sure some of the technical issues work within the framework of good engineering practices. The LINU strategy of allowing more storm water surface sheet-flow across pervious surfaces to encourage onsite absorption and to reduce the typical number of drain inlets and length of drainage pipe. This technique is good, but users should still apply the rule-of-thumb of a 400 linear feet maximum distance from a drain inlet using curb and gutter. Additional ways for reducing the infrastructure includes sheet flowing the stormwater through the filtration landscaping directly into existing natural drainage systems, thus eliminating swales

for some lots and streets along the neighborhood perimeter. Roof water can be piped into the storage area directly, adding areas from which the flow can be attenuated.

Field supervision and on-going maintenance issues are also a major factor to consider. Additional supervision is needed to make sure the rain gardens are constructed properly. Proper design assures that water does not bypass the drainage area. The use of proper materials and installation, including perforated drainpipes must and rain garden plant material which is indigenous and water tolerant ensures long lifetime of the installation. In addition, the installation should be compatible with the desired community character and maintenance program. If pervious road surfaces are being considered for alleys, lanes, and streets without curb and gutter, then measures are needed to stabilize the road and alley shoulders to prevent soil erosion and tire rutting.

Another example which will provide the Low Country with a viable alternative to suburban sprawl is Habersham, SC located south of Charleston. The town is positioned along an inlet less than a mile from the intercoastal waterway. With its sizable town center, Habersham will serve as the urban hub for surrounding villages. The architecture of the project respects the local vernacular, taking into account the expert methods employed by traditional designs for ventilation and cooling. These logical methods, forgotten or ignored by conventional builders, are

mandated by the architectural codes that accompany the plan.

Figure 5 No curb LINU boulevard in Habersham, SC

The building types are designed and located on the plan according to their levels of urbanism. Along with the different street sections, the broad assortment of building types will provide a varied and authentic environment. This permits a single development to capture a wide variety of home-buyer market segments. In addition, the compatibility ensured by the code maintains high property values and the flexibility of switching to the most marketable building product without redesigning the entire plan. Winner of the 2004 Platinum Award in the Best in American Living (BALA) Competition, sponsored by Professional Builder magazine and the National Association of

Home Builders.

Figure 6 A built example of light imprint storm drainage, Habersham, SC

The LINU is still an exception rather than the norm. Designers and developers may not be able to implement all Light Imprint elements right away, but they could implement LINU in incremental stages as certain components are approved. Due to the pace of development and the need for projects to succeed, it is especially important to plan for incremental implementation. A comparison between the two engineering methods based on erosion control measures, storm water infrastructure, and pavement width and materials for the first phase of the development of 42 acres and 174 lots shows about a 30% lower cost for the LINU method. For Griffin Park, the LINU case study for the first phase was compelling enough to lead the development team to apply LINU techniques even after the construction had started. The case study also convinced us to work with local stakeholders and approval agencies to holistically apply the LINU approach for the next phases. The application of the LINU methods based on transect zones can be further applied to reduce the impact on watersheds on a larger regional scale.

Conclusion

Griffin Park is a traditional neighborhood development designed by Duany Plater-Zyberk & Company which offers one of the first examples for LINU development. The first phase of construction offered an opportunity to document the evolution of this environmentally sensitive community; which lies lightly on the land by coordinating engineering practices and New Urban design techniques; preserves mature tree stands; and lowers the construction and engineering costs without compromising design priorities such as connectivity and the public realm. The LINU strategy allowed more storm water surfaces to encourage onsite adsorption and to reduce the typical number of drain inlets and the length of the drainage pipe system. The introduction of rain gardens allowed for enhanced natural biodegradation of pollutants from runoff.

Additionally, the lots and streets along the neighborhood perimeter did not need most of the swales since a portion of the storm water was sheet flowed through the filtration landscaping directly into existing natural drainage systems. These techniques allow best protection of the watershed hosting this development by maintaining the land in its natural condition and minimization of the impervious cover. The most compelling factor for using the LINU design principles is the improved affordability of the community by an overall decrease in construction costs. The Light Imprint development strategy resulted in a 27 percent cost increase, with the introduction of tree protection fences. Yet, a 50 percent cost savings occurred with: 1) The reduction of curbs and gutters; 2) The reduction in the number of storm water pipes and inlets; 3) The reduction in pervious pavement in alleys and streets; and 4) The introduction of rain gardens. The Light Imprint New Urbanism framework enhances existing urban sustainability practices and promotes preservation of watersheds on a large regional scale. The design of this community gives and example of solving the most difficult planning and engineering question about how to preserve and restore the natural resources and services derived from the watershed while ensuring human well-being.

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