

Neighborhood Sustainability Assessment in the New Developments of Tabriz (Case Study: Roshdieh)

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Abstract—Since, today in most countries around the world much attention is paid to planning the smallest unit in the city i.e. the residential neighborhoods to achieve sustainable urban development goals, a variety of assessment tools have been developed to assess and monitor the sustainability of new developments. One of the most reliable and widely used assessment tools is LEED-ND rating system. This paper whit the aim of assessing sustainability level of Roshdieh neighborhood in Tabriz, has introduced this rating system and applied it in the study area. The results indicate that Roshdieh has the potential of achieving the standards of sustainable neighborhoods, but the present situation is far from the ideal point.

Keywords—LEED-ND, Sustainable Neighborhood, New Developments, Tabriz.

I. INTRODUCTION

THE concept of sustainable urban development has been of a major issue of all academic and scientific communities in recent years [1]. Major debates and solutions around sustainable urban development are presented at the neighborhood scale. This is especially true in developing countries where the environmental crisis and issues are severe at the local scale [2]. In contrast to the theory of sustainable development at a global scale, ((Local Sustainability)) make changes in higher speeds and in an objective manner. When we speak about ((the sustainable society)) or ((the sustainable world)), it requires a level of abstraction that is meaningless to most people. In contrast, the local level is a level of social organization at which the negative consequences of environmental degradation are observed tangibly and Successful interventions and positive activities are clear. Finally ((the sustainable neighborhood development)) seems as the most important tool to achieve sustainable development in large scale [3]. One of the solutions of the modern urban planning to meet the needs of large cities has been building new residential townships. We can say that the general tendency in evolution of building residential townships has been keeping away from physical criteria and approaching social criteria and community norms. Currently, building these settlements and residing them have become an inevitable phenomenon, but this phenomenon has not been comprehensively assessed. With a look at some case studies and scattered researches about the residential townships in Iran, we can say that if community approach and criteria is used in organization, design and management of residential townships, they can be used as a new social- spatial unit for

remodeling and expansion of identity and integrity of the space in large cities and in achieving sustainable development [4]. Tabriz as one of the metropolises of the country is not excluded from this rule and development in the area has been mainly through the construction of residential townships in its border. Therefore studying the sustainable development consideration in the construction and development of these townships is the most pressing urban planning issues of this metropolis. Among the townships that have already spread in an extensive construction site, is Roshdieh neighborhood that has been selected as a case study of the present study in spite of the large uncertainties in the locating and development of it. The overall objective of this study is to evaluate sustainable urban development criteria in the Roshdieh neighborhood of Tabriz using LEED-ND rating system. For this purpose, this study firstly introduces the LEED-ND rating system and its criteria and scoring methods, and then assesses these criteria in Roshdieh in order to determine its sustainability level using GIS and field studies.

II. SUSTAINABLE NEIGHBORHOODS AND LEED-ND

Several planning academics have examined the issue of sustainable neighborhood development and have proposed widely differing approaches to promoting sustainable urban form. While there is a considerable agreement about a general definition of sustainable development, there is no consensus on what makes a neighborhood sustainable or how to measure the sustainability of urban form [5].

The Leadership in Energy and Environmental Design (LEED) rating system has become the most recognized green building rating system in North America, and is increasingly employed by countries around the world. However, planners have often argued that the LEED for new construction (LEED-NC) rating system lacks requirements for the location of green buildings. For example, a top scoring LEED building could be located in an area which requires building users to make long commutes by automobile. With this deficiency in mind, the US Green Building council (USGBC), the U.S Natural Resource Defense council and the congress for the New Urbanism came together to develop the LEED for Neighborhood Development (LEED-ND) rating system[6].

This rating system attempts to ensure that the location and design of all certified projects meet high levels of environmentally responsible and sustainable development [7].

LEED-ND Rating System is organized into three basic sections:

Smart Location and Linkage (SLL)—where to build

Neighborhood Pattern and Design (NPD)—what to build

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Green Infrastructure and Buildings (GIB)—how to manage environmental impacts [8].

The criteria for LEED-ND certification are broken into five main categories: Smart Location and Linkage, Neighborhood Pattern and Design, Green Infrastructure and Buildings, Innovation and Design Process, and Regional Priority. Each

category has several prerequisites that every project must meet to receive certification. Additional points can be attained in each category contributing to the project's final point total [7]. (See Table I for a complete breakdown of the LEED-ND credits).

TABLE I
LEED-ND RATING SYSTEM

Smart Location And Linkage			27 Points Possible	Neighborhood Pattern And Design			44 Points Possible	Green Infrastructure And Buildings			29 Points Possible	Innovation And Design Process			6 Possible Points
Prereq1	Smart Location	Required		Prereq1	Walkable Streets	Required		Prereq1	Certified Green Building	Required		Credit 1	Innovation And Exemplary Performance	5	
Prereq2	Imperiled Species And Ecological Communities	Required		Prereq2	Compact Development	Required		Prereq2	Minimum Building Energy Efficiency	Required		Credit 2	Accredited Professional	1	
Prereq3	Wetland And Water Body Conservation	Required		Prereq3	Connected And Open Community	Required		Prereq3	Minimum Building Water Efficiency	Required		Regional Priority			4 Possible Points
Prereq4	Agricultural Land Conservation	Required		Credit 1	Walkable Streets	12		Prereq4	Construction Activity Pollution Prevention	Required		Credit 1	Regional Priority	4	
Prereq5	Floodplain Avoidance	Required		Credit 2	Compact Development	6		Credit 1	Certified Green Buildings	5		110 Total Points Possible			
Credit 1	Preferred Locations	10		Credit 3	Mixed-Use Neighborhood Centers	4		Credit 2	Building Energy Efficiency	2		Project Totals (Certification Estimates) Certified: 40-49 Points, Silver: 50-59 Points, Gold: 60-79 Points, Platinum: 80+ Points			
Credit 2	Brownfield Redevelopment	2		Credit 4	Mixed-Income Diverse Communities	7		Credit 3	Building Water Efficiency	1					
Credit 3	Locations With Reduced Automobile Dependence	7		Credit 5	Reduced Parking Footprint	1		Credit 4	Water-Efficient Landscaping	1					
Credit 4	Bicycle Network And Storage	1		Credit 6	Street Network	2		Credit 5	Existing Building Use	1					
Credit 5	Housing And Jobs Proximity	3		Credit 7	Transit Facilities	1		Credit 6	Historic Resource Preservation And Adaptive Reuse	1					
Credit 6	Steep Slope Protection	1		Credit 8	Transportation Demand Management	2		Credit 7	Minimized Site Disturbance In Design And Construction						
Credit 7	Site Design For Habitat Or Wetland And Water Body Conservation	1		Credit 9	Access To Civic And Public Spaces	1		Credit 8	Stormwater Management	4					
Credit 8	Restoration Of Habitat Or Wetlands And Water Bodies	1		Credit 10	Access To Recreation Facilities	1		Credit 9	Heat Island Reduction	1					
Credit 9	Long-Term Conservation Management of Habitat or Wetlands And Water Bodies	1		Credit 11	Visitability and Universal Design	1		Credit 10	Solar Orientation	1					
				Credit 12	Community Outreach And Involvement	2		Credit 11	On-Site Renewable Energy Sources	3					
				Credit 13	Local Food Production	1		Credit 12	District Heating And Cooling	2					
				Credit 14	Tree-Lined And Shaded Streets	2		Credit 13	Infrastructure Energy Efficiency	1					
				Credit 15	Neighborhood Schools	1		Credit 14	Wastewater Management	2					
								Credit 15	Recycled Content In Infrastructure	1					
								Credit 16	Solid Waste Management Infrastructure	1					
								Credit 17	Light Pollution Reduction	1					

The rating system has a total of 100 base points, while Innovation and Design Process credits provide an opportunity for up to 6 bonus points [9].

The last section “Regional Priority,” allocates additional points for credit topics that are deemed particularly important for specific geographical areas. The membership of the USGBC, CNU, and Smart Growth chapters in the U.S. collectively went through an extensive vetting process to select appropriate priority credits for each region. As this process has not been undertaken for areas outside the U.S., these Regional Priority credits are currently not available to all non-U.S. LEED-ND projects [9].

Depending on the number of points achieved, a project can attain basic certification (40-49 points), silver certification (50-59 points), gold certification (60-79 points), or platinum certification (80-110 points).

The Smart Location and Linkage section of LEED-ND centers on minimizing environmental impacts due to new developments and urban sprawl. This is done by choosing locations near to or in existing communities while protecting imperiled species, wetlands and other water bodies, agricultural lands, and by avoiding floodplain locations. Neighborhood Pattern and Design focuses on creating communities that are medium- to high-density, walkable, connected to nearby neighborhoods, and are aesthetically pleasing [10]. Green Infrastructure and Builders, is entirely devoted to decreasing the environmental impact caused by the construction and maintenance of buildings and infrastructure while encouraging their water and energy efficiency [11]. LEED-ND strives to create healthy and sustainable neighborhoods in which people from a wide range of economic levels and age groups can live and work together and have access to transportation, jobs, resources and education to promote healthier lifestyles.

III. NEW DEVELOPMENTS OF TABRIZ

New developments of Tabriz mainly include both planned and unplanned settlements including informal settlements and villages surrounding the city where have been located in the legal border of the city due to recent developments of the city. Planned developments of the city over the last few decades have been shaped in the form of Housing Projects, before the Islamic revolution of Iran and after it, in the form of Land Development Projects which have had significant impact on the development and increased density of Tabriz. Housing projects came into force to address the housing shortage and combat land speculation in Iran in the terms of urban land Act, in the 1980s. These projects in Iran included Vahdat, Golkar, Parvaz, Bakhtar and so on. The high percentage of residential land-uses and lack of amenities in the housing projects and social and cultural problems in these fabrics of the city, lead to the adoption of matter 67 of Land Law and the Land Development projects in the late 1980s. With the approval of Land Development Projects, the first land development plan of Tabriz following a contract between the Housing and Urban Development organization of the East Azerbaijan province and “Fan o honar” Consulting Engineers was prepared [12].

Specifications of some of Land Development projects of Tabriz are shown in the Table II.

TABLE II
LAND DEVELOPMENT PROJECTS OF TABRIZ

	Project name	Area (Hectar)	Housing Units		Date of contract
			Single unit housing	Apartments	
1	Baghmisheh1	142	800	2900	1996
2	Baghmisheh3	270	4092	480	1987
3	Eram	83	3479	260	1087
4	Zafaraniye 2	95	985	820	1986
5	ShahidYaghchian	90	—	3771	1987
6	Rezvanshahr	25	850	—	1991
7	Gharamalek	15	300	250	1987
8	Ravasan(Andishe)	400	7871	5200	1995
9	Beasat	20	—	1590	2001
10	Shahid Bakeri	25	720	—	1987
11	Vali ye Amr	40	600	200	-

In Fig. 1 location of these projects in Tabriz is illustrated.

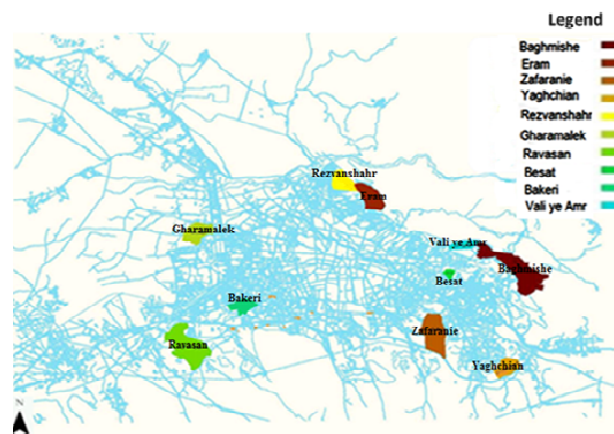


Fig. 1 Location of Land Development Projects of Tabriz

IV. INTRODUCING THE CASE STUDY

Baghmisheh town is located in the northeast of Tabriz with an area of approximately 267 hectares. This town is currently in the boundary of fifth sub-municipality of Tabriz and three sections of it named Baghmisheh 1, Baghmisheh 2 and Baghmisheh 3 are separated from West to East. The study area is located on the Baghmisheh 1 lands called Roshdiyeh which its distance from center of Tabriz (City Hall Square) is about 6 km and is approximately 144 hectares in area. The anticipated population to reside the Baghmisheh 1 is about 21,000. Currently, about 61 acres of these lands has been built which accommodate about 15980 people [13]. This area ends to steep mountains from the northeast, north and northwest and from the south is limited to the Baghmisheh gardens and agricultural lands (see Fig. 2).

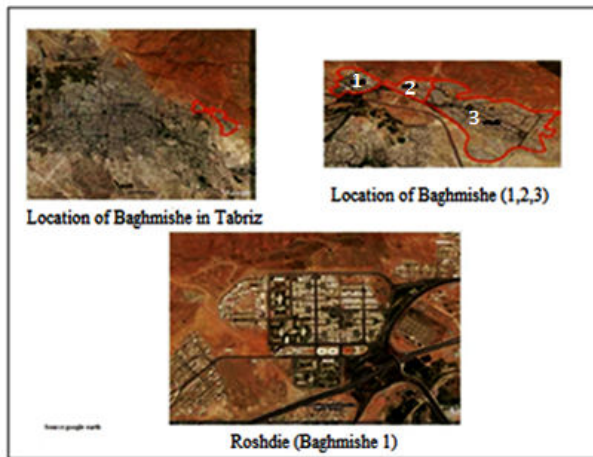


Fig. 2 Location of Roshdieh in Tabriz

V. ASSESSING THE CASE STUDY BASED ON LEED-ND RATING SYSTEM

LEED-ND rating system is developed in accordance with USA and Canadian regulations and conditions. Application of this rating system in Iran requires further studies. Many of the credits outlined in these rating systems are not applicable in Iran's condition and are in need of further evaluation for localization. With all these conditions in mind and constraints of this research, this paper selected 10 credits (36 points) of the Neighborhood Pattern and Design category for assessing the sustainability of the Roshdieh neighborhood. The neighborhood's score of these credits is as follows:

A. Walkable Streets (1-12 points)

The first NPD prerequisite aims to create street environments that promote walking, not only to reduce vehicle miles traveled, but also to enhance public health by reducing pedestrian injuries due to traffic and boost daily physical activity [14]. Roshdieh may do well with the walkable streets credit – all buildings have entries that face a street or green spaces, the tall height of the apartments at the west side of the neighborhood ensure at least a 1:3 building height to street width ratio, sidewalks are on all streets and the internal streets of the project are designed for low speeds, but because of narrow sidewalks in many parts of the site and unconnected sidewalks in some parts, neighborhood achieves 4 points under this credit.

B. Compact Development (1-6 points)

The Compact Development criteria is also intended to promote walking by improving public transportation efficiency and reducing vehicle miles traveled, as well as to conserve land [14]. It fulfills this by requiring that developments meet certain building density thresholds depending upon, if located in a transit corridor, the walk distance to public transportation, and if not in such a location, a specific density threshold [14]. In this paper residential density and nonresidential density have been considered for assessing this credit in the neighborhood. If residential density

exceeds 7 units in per 4000m² and nonresidential density is more than 50%, the neighborhood will achieve points of this credit. According to calculations, there are 3500 residential units in the neighborhood and the total built area of the neighborhood is about 61 acres, so residential density in per 4000 m² is 20.94 and medium non-residential density is more than 120 %. According to the Table III, the study area earns 3 points of this credit.

TABLE III
POINTS FOR DENSITY PER ACRE OF BUILDABLE LAND

Residential density (DU/acre)	Nonresidential density(FAR)	Points
>10 and ≤13	>7.5 and ≤1	1
>13 and ≤18	>1 and ≤1.25	2
>18 and ≤25	>1.25 and ≤1.75	3
>25 and ≤38	>1.75 and ≤2.25	4
>38 and ≤63	>2.25 and ≤3	5
>63	>3	6

DU=dwelling unit; FAR=floor-area ration



Fig. 3 Location of the neighborhood centers

C. Mixed-Use Neighborhood Centers (1-4 Points)

The third NPD credit intends to cluster together residential and a retail center in order to reduce dependence on the personal automobile [14]. To earn this credit, for projects less than 40 acres over 50% of residential units must be located within a 400 meters walk distance of at least 4 different existing or planned diverse uses, including one grocery store and for projects 40 ACRES OR greater (which includes our case study) Within each neighborhood center, the principal entries of the establishments must be within a 90 meters walk distance from a single common point that represents the center of the cluster (1 or 2 points) or within a 120 meters walk

distance (3 or 4 points) [14]. According to Fig. 3, more than 50% of dwellings are not within a 90 or 120 meters walk distance of neighborhood center establishments, so the neighborhood cannot earn points of this credit.

D.Mixed-Income Diverse Communities (1–7 Points)

Three options are possible under this credit, ((diversity of housing type)), ((affordable housing)) and ((mixed income diverse communities)). The first option indicates:

Diversity of housing types (1-3 points)

Include a sufficient variety of housing sizes and types in the project such that the total variety of planned and existing housing within the project achieves a Simpson Diversity Index score greater than 0.5, using the housing categories below. The Simpson Diversity Index calculates the probability that any two randomly selected dwelling units in a project will be of a different type.

$$\text{Score} = 1 - \sum (n/N)^2$$

where n = the total number of dwelling units in a single category, and N = the total number of dwelling units in all categories.

The total number of dwelling units for Roshdieh neighborhood and the dwelling types break down are shown in Table IV. The Simpson diversity index for this neighborhood is calculated as:

$$\text{Score} = 1 - [(1078)^2 + (3622)^2 / (4700)^2] = 0/4$$

Based on a point table provided by LEED-ND, the neighborhood cannot achieve a point under this credit.

TABLE IV
ROSHDIEH DWELLINGS BY STRUCTURE TYPE

Type of dwelling	Number of dwelling
Single housing	1078
Apartments	3622
Total	4700

E. Reduced Parking Footprint (1point)

Reducing the amount of parking in the area is considered in this credit. Reduced parking space can be used to build and extend sidewalks and pedestrian roots. Furthermore, lack of on-street parking lots can improve the view and landscape of the area, and thus the spatial quality of the area. To earn point of this credit, firstly all non-residential buildings should have none-fringe parking and secondly less than 20% of in the area should have been allocated to parking lots. In addition, no individual surface parking lot should be greater than 8000 m². Given that the old housing units of the neighborhood do not have garages and use one-street parking, the neighborhood cannot achieve points of this credit, too.

F. Street Network (1–2 Points)

Projects may earn up to 2 points by designing the street network with a high level of external and internal connections, a connection between over 90% of new internal cul-de-sacs,

excluding those areas where a connection is physically impossible [14]. In the study area because of gated alleys in the old fabric of the neighborhood, this credit is not scored.

G.Transit Facilities (1 Point)

Transit facilities in the neighborhoods encourage residents to use public transportation facilities and thus reduce dependence on personal vehicles. For achieving points of this credit, public transit stop shelters must be covered, be at least partially enclosed to buffer wind and rain, and have seating, illumination and signs that display transit schedules and route information. In the study area, there is only one bus stop at the southern part of the district, which had floor and benches, but it does not provide transit schedules, so the neighborhood cannot achieve points of this credit.

H.Access to Civic and Public Space (1 Point)

The importance of access to civic and public spaces is that it can increase the health and social capital in the community. To achieve points of this credit, civic or passive-use spaces, such as a square, park, or plaza, should be within a 400m walk distance of 90% of planned and existing dwelling units and nonresidential building entrances. Although, in the study area, Shahid Fahmide square was known as an active gathering place not only for Baghmishe residents but for all the region, with building Pasdaran highway, this space became an unusable space for people. Currently there are only two public spaces at the neighborhood which of them only a 16-hectare Roshdieh forest park at the North side of the neighborhood, can be considered as an active space. According to Fig. 4, more than 40% of the dwelling units are not within a 400 m walk distances of such spaces, thus the neighborhood cannot earn 1 point of this credit, too.

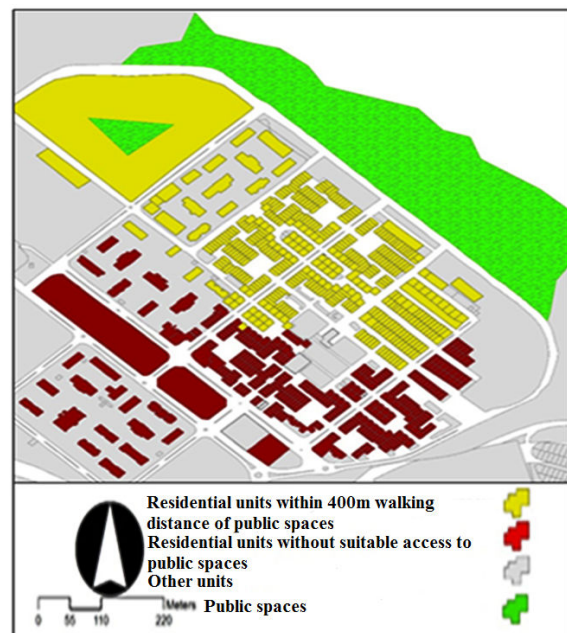


Fig. 4 Location of the neighborhood centers

I. Access to Recreation Facilities (1 Point)

Access to public spaces has the same intent as the previous criteria. In this case in addition to access to active open spaces, access to recreation and sport facilities is considered. To earn points of this credit outdoor recreation facilities(like sports fields and playgrounds) with an area of at least 4000 m² and indoor recreational facilities of at least 200 m², should be within a 800 m walk distance of 90% of new and existing dwelling units and nonresidential building entrances. In the study area there is a not indoor or outdoor sports field, but there is a forest park with an area of about 16 acres in the north side of the neighborhood, which is equipped to recreational and sports facilities. According to Fig. 5, more than 90% of dwelling units of the area are within 800m walk distance of this park, thus the neighborhood gains 1 point under this credit.

J. Neighborhood Schools (1 Point)

The main intent of this credit is promoting community interaction and engagement by integrating schools into the neighborhood. To earn points of this credit at least 50% of the dwelling units should be within 800m walk distance of an elementary or middle school building entrance or within a 1600m walk distance of a high school building entrance [14]. There are 2 elementary schools and one middle school at the neighborhood center. As it is shown in Fig. 6, almost all the dwellings are within 800m walk distance of these facilities, so the neighborhood gains 1 point of this credit.



Fig. 5 Location of the neighborhood centers



Fig. 6 Access to educational Facilities

VI. CONCLUSION

Although the Baghmisheh project is one of the most successful land development projects in Tabriz and urban design and planning principles of it has many strengths, including compact development, and mixed land uses. There are some weaknesses that impede the achievement of sustainable development goals in this area, as of 33 points considered to assay the design principles of this neighborhood, it achieved only 9 points. One of the main weaknesses of the neighborhood is dependence of residents on private vehicles and not having enough access to public transportation, which in the long run, would increase the traffic and air pollution in the area and diminish residents' especially elderly and people with less mobility's access to other parts of the city. In the early stages of development of the neighborhood, there had also been little consideration about Walking and biking as low-cost, healthy and environmentally friendly alternative options of transportation. Currently, there is not any biking route or parking facility and many barriers like narrow sidewalks, poor quality walking surfaces, on street parking, lack of designed routes for waking and so on discourage people from walking. Currently, the only dedicated walking route is health road in the Roshdieh neighborhood which is unusable to many people especially elders because of its high slope. The other point with this route is that it is designed for recreational purposes and not as transportation route, so it cannot contribute to residents use of non-motorized transportation. The other problem of the neighborhood is gated

alleys in the central parts of the neighborhood that in addition to be a barrier to social mix, decrease neighborhood's permeability and people's tendency to walk and bike. Lack of affordable housing is another weakness point of the neighborhood planning policies that hinders communities with different income to reside in the neighborhood. Lack of neighborhood center facilities or land-uses that meet the people's daily needs like grocery stores and so on is one of the problems of the neighborhood that has to be solved in a short term due to the increased construction and population of the neighborhood. Regarding the above problems of the neighborhood, taking these measures is recommended to reinforce environmental quality and residents' wellbeing:

- Prioritizing sports, culture, entertainment and leisure projects in the new developments of the neighborhood.
- Designing specific walking and biking routes inside the neighborhood and including required facilities to encourage people to use it.
- Establishing public transportation routes and stations inside and outside the neighborhood and providing residents easy access to different parts of the neighborhood and the city.
- Establishing new neighborhood centers to meet residents' daily needs and decrease trips to other parts of the city.
- Removing gates of the central parts of the neighborhood to increase neighborhood's permeability and encourage social contacts.
- Considering affordable housing policies in new developments to encourage social mix.
- Giving concessions to residents for employment in the business units of the neighborhood in order to realize the sustainability and reduce the inter-urban trips.

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