International Science and Technology Journal
المجلة الدولية للعلوم والتقنية
Volume 36 العدد
Part 2 المجلد
المجلة الدولية للعلوم والتقنية
International Science and Technology Journal
ISTJ

http://www.doi.org/10.62341/smaw1104

Received	**2025/03/15**	**تم استلام الورقة العلمية في**
Accepted	**2025/04/10**	**تم قبول الورقة العلمية في**
Published	**2025/04/11**	**تم نشر الورقة العلمية في**

WAYS TO IMPLEMENT SUSTAINABILITY IN TRANSPORTATION THE CITY- ZAWIYA (LIBYA)

Saddam Mohammed Alhadi Dabub
University of Zawia
Faculty of Natural Resources Engineering - Bir Al-Ghanam - Libya
s.daboub@zu.edu.ly

Abstract

The study focuses on the sustainable development of transportation infrastructure in the city of Zawia, Libya, and finding solutions to the problems of congestion and pollution within the city's urban area. The purpose of the study is implementing sustainable development of the transport infrastructure of the city of Zawia for in the strategy of sustainable development and the main plan to achieve the study objectives, the study followed the descriptive approach and relied on some previous studies. Then, it used the computer and the (Auto Cad) and (Sketchup) programs. The practical results of the work combine urban planning and architectural design aspects. Among the most important findings are the design of a tram route (as a form of sustainable urban transportation) linking the refinery's industrial area to the bus station located at the eastern entrance of the city. the reconstruction of the city center in the Martyrs' Square area by reorganizing traffic to reduce pollution the reorganization of pedestrian traffic in the Martyrs' Square area and making it safer by creating tunnels near important landmarks the design of tram stations equipped with independent power supplies from solar batteries the design of seat architectural forms, a column equipped with LED lighting, equipped with independent power supplies around the solar panels, the study recommends and the development of public transportation by relying on medium-capacity electric buses (up to 24 passengers) with the development of lanes for movement.

Keywords: sustainable development, transport, transport infrastructure, city, ways of sustainable development, Zawia.

International Science and Technology Journal
المجلة الدولية للعلوم والتقنية
Volume 36 العدد
Part 2 المجلد
http://www.doi.org/10.62341/smaw1104

طرق تطبيق الاستدامة في النقل مدينة الزاوية (ليبيا)

صدام محمد الهادي دبوب
جامعة الزاوية
كلية هندسة الموارد الطبيعية – بئر الغنم – ليبيا
s.daboub@zu.edu.ly

الملخص

تركز الدراسة على التنمية المستدامة للبنية التحتية للنقل في مدينة الزاوية بليبيا، وإيجاد حلول لمشاكل الازدحام والتلوث داخل المنطقة الحضرية للمدينة. تهدف الدراسة إلى تطبيق التنمية المستدامة للبنية التحتية للنقل في مدينة الزاوية بما يتماشى مع استراتيجية التنمية المستدامة والخطة الرئيسية لتحقيق أهداف الدراسة. اتبعت الدراسة المنهج الوصف التحليلي واعتمدت علي بعض الدراسات السابقة. وتم استخدام الحاسوب الالي وبرنامج (اوتو كاد) وبرنامج (سكتش اب). حيث تجمع النتائج العملية للعمل بين جوانب التخطيط الحضري و التصميم المعماري ومن اهم النتائج تصميم مسار الترام (كشكل من اشكال النقل الحضري المستدام) يربط المنطقة الصناعية للمصفاة بمحطة الحافلات الواقعة عند المدخل الشرقي للمدينة – إعادة إعمار وسط المدينة في منطقة ميدان الشهداء من خلال إعادة تنظيم حركة المرور للحد من التلوث. – إعادة تنظيم حركة المشاة في منطقة ميدان الشهداء وجعلها أكثر أمانا من خلال إنشاء أنفاق بالقرب من المعالم الهامة. – تصميم محطات الترام المجهزة بمصادر طاقة مستقلة من البطاريات الشمسية. – تصميم أشكال وعمود مزود بإضاءة ليد معمارية للمقاعد مزود بمصادر طاقة مستقلة بالألواح الشمسية وتوصي الدراسة بتطوير وسائل النقل العام بالاعتماد على الحافلات الكهربائية متوسطة السعة (حتى 24 راكبا) مع تطوير مسارات للحركة.

.الكلمات المفتاحية: التنمية المستدامة، النقل، البنية التحتية للنقل، المدينة، سبل التنمية المستدامة، الزاوية.

Introduction

Unfortunately, modern scientific and technological progress is increasingly characterized by negative consequences for the natural environment, as a result of which human living conditions are significantly deteriorating, especially in large cities. Modern global processes of rapid urbanization of territories, technogenic

http://www.doi.org/10.62341/smaw1104

development of cities and their mechanization, accelerated growth of agglomerations with often spontaneous construction, ever-increasing harmful emissions into the atmosphere, pollution of water bodies and soil cover, destruction of flora and fauna, lead to the destruction of the integrity of the natural environment [1]. At the same time, undesirable processes occurring in the environment have a negative direct impact on human health, creating conditions unsuitable for their vital activity. In general, the 21st century is characterized by a rapid aggravation of a multifaceted environmental problem throughout the world [2].

The accompanying consequence of globalization and urbanization has been the emergence of a number of problems, such as: atmospheric pollution (emissions of harmful substances into the air and water environment), deforestation, soil degradation, climate change, extinction of flora and fauna, reduction of natural resources and various environmental disasters. In addition, since human activity negatively affects the current state of recreational resources, there is a need to protect these territories from the negative impact of social, economic and environmental factors operating in the environment.

The deterioration of the environment adequately affects people, worsening their living conditions and their health. The only way out of this difficult situation can only be the systematic implementation environmental protection measures. Proposed by the world community at the UN World Forum on the Environment (Rio de Janeiro, 1992), the Concept of Sustainable (Balanced) Development of Humanity is aimed at the gradual reorientation of the environmental protection mechanism from a nature protection strategy to an environmental quality management strategy, focusing on social and environmental priorities in economic development, and integrating resource and environmental security management mechanisms at all hierarchical levels: state, regional, local, and facility-level [3].

Research problem

The research problem revolves city's transport infrastructure the current conditions is considered the primary source of the environmental crisis and requires radical modernization. Therefore, the modernization of urban transport infrastructure in the context of sustainable development is the basis for the sustainable

http://www.doi.org/10.62341/smaw1104

development of the city and the avoidance of an environmental crisis in the city.

The importance of the research

The purpose of the study is to identify and fill in the content of promising ways to implement sustainable development of the transport infrastructure of the Libyan city of Zawia for their proposed inclusion in the sustainable development strategy and the Zawia master plan.

Objectives of the research

1-Study and analyze the current state of the problem study.
2-Identify a way to implement sustainable development of the transport infrastructure of the modern city.
3-Identify and propose measures to modernize the transportation infrastructure in the city of Zawia within the framework of sustainable development.

Research area location

The city of Zawia is located in the north-west of Libya, on the Mediterranean coast, 47 kilometres west of Tripoli (the capital of Libya) with a population of about 300 thousand inhabitants and is the fourth largest city in the country. Officially, the city of Zawia is known as Western Zawia, to distinguish it from White Zawia, the city of Al-Bayda in eastern Libya. Geographically located in northwest Libya, at longitude 12.43 east and latitude 32.45 north, 40 is bordered to the west by the city of Sorman and to the east by the city of Janzur, and is bounded to the south by the Nafusa mountain range, and is named Zawia due to its many Quranic memorials (religious centers of Islam). Figure 1 shows the geographical location of the study area [4].

http://www.doi.org/10.62341/smaw1104

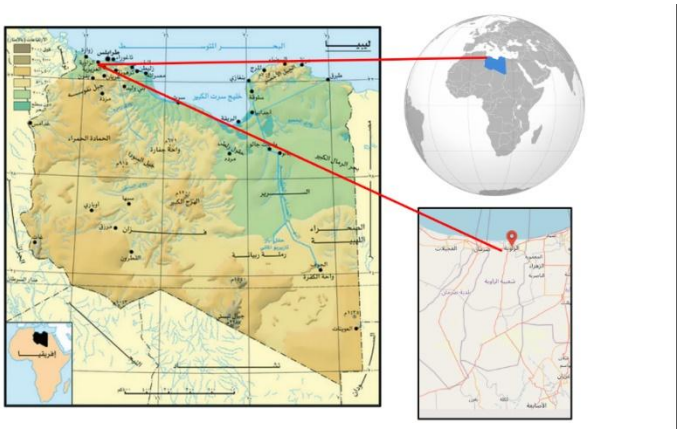

Figure 1. Geographical location of the study area [5].

Previous studies

Some studies have addressed sustainable urban development and sustainable urban planning:

1- Transport planning of cities and organization of transport and pedestrian flows in cities, as well as modeling of transport infrastructure were studied by E.V.Gavrylov, M.F.Dmitrichenko 2020.

2- Study (D.V. Zemov, 2019) General methodological issues in the field of urban planning were studied.

3- Study (Glybovets, 2015) General issues of architectural ecology and ecological urban planning were raised, as well as the connection between transport infrastructure and ecology in the city.

Study methodology

1- Study of sources on the research problem

2- Identification and analysis of existing problems in the transport infrastructure of the city.

3- Study of the experience of modernization of the transport infrastructure of modern cities in the context of sustainable development.

4- Sociological research: using a questionnaire survey of city residents to identify the problems of the city itself and problems in its transport infrastructure and to find out the attitude of citizens to them and to possible actions of the city authorities to eliminate them.

http://www.doi.org/10.62341/smaw1104

5- Experimental design: during the design of transport infrastructure facilities with their subsequent proposed implementation in the city of Zawia.

Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs [6]. The concept of sustainable human development was urbanized in the "New Urban Agenda" adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III). The conference took place in Quito from 17 to 20 October 2016, bringing together subnational and local governments, parliamentarians, representatives of civil society, indigenous peoples and local communities, the private sector, professionals and practitioners, the scientific and academic community and other stakeholders [7].

For Europe, common principles and strategies in the field of urban development policy are set out in the Leipzig Charter "European Cities on the Path to Sustainable Development", adopted at the informal meeting of ministers for urban development and territorial cohesion in the city of Leipzig on 24–25 May 2007. Sustainable urban development (Leipzig Charter) is a comprehensive concept in which transport infrastructure is recognized as one of the urban infrastructure elements and most in need of balancing with other areas of development of European cities [8].

Many city researchers assume that urbanization will improve other. human-nature-centric forms if a sustainable urban ecosystem is formed, which will be characterized by high reliability [3].

Transport is the main polluter of the environment and the source of the ecological crisis. And given that urban transport cannot be considered separately from its infrastructure, the transport infrastructure of Zawia City in the current conditions is considered the primary source of the ecological crisis and requires radical modernization. Therefore, the modernization of urban transport infrastructure in the context of sustainable development forms the basis for sustainable development and avoidance of ecological crisis in the city [9].

The Libyan city of Zawia is located on the Mediterranean coast, in the north-west of the country, on the Al-Jifara plain. not far from the site of an important oil field, the first and largest oil refinery in Libya. In addition to developed industry, thanks to large

http://www.doi.org/10.62341/smaw1104

groundwater resources, the city has a powerful agriculture - crop production and livestock. Zawia has a developed transport infrastructure. The city itself is bypassed by a transnational coastal highway. The city is characterized by many environmental problems, which together threaten Zawia with a multifaceted environmental crisis. Therefore, the city of Zawia needs to identify promising ways to modernize its transport infrastructure in order to achieve sustainable development.

The purpose of the study is to identify and provide content for promising ways to implement sustainable development of the transport infrastructure of the Libyan city of Zawia for their proposed inclusion in the sustainable development strategy and the master plan of Zawia.

According to the purpose of the study, the following tasks were set:

1) To study and analyze the current state of the problem and identify promising areas of research.
2) To identify and provide forms for implementing sustainable development of the transport infrastructure of a modern large city.
3) To identify measures and propose the implementation of a fragmentary, priority modernization of the transport infrastructure of the city of Zawia in the context of sustainable development.

Practical significance of the results obtained. Measures (as implementers of the routes) were determined and a fragmentary priority modernization of a number of components of the transport infrastructure of the city of Zawia was proposed in terms of sustainable development, namely:

– It was proposed to begin the development of a public transport network, for which a tram route was designed (as a type of ecological urban transport), which will connect the industrial area of the oil refinery and the international bus station, located diametrically on the opposite outskirts of the city of Zawia.

– The reconstruction of the city center in the area of Independence Square was carried out in the form of a reorganization of traffic by introducing one-way traffic on parallel streets around the city park.

– It was proposed to reconstruct, increase the territory of the city park by joining two adjacent blocks with an abandoned territory and to carry out its improvement according to the principles of landscape design as a recreational and leisure center for users.

http://www.doi.org/10.62341/smaw1104

– It is proposed to clear away a safe pedestrian traffic in the Independence Square area safe by installing underground passages near significant objects (bank, hotel, mosque, shopping arcades, etc.).

– The location of an international bus station on the eastern outskirts of the city of Zawia near the transnational highway has been determined and designed.

– Control points at the tram terminals and small architectural forms of tram stops with autonomous power supply from solar panels placed on the roofs of buildings have been designed.

– Small architectural forms of park landscaping have been designed in the form of combined elements: two benches, a pole with LED lights, equipped with 24- hour autonomous power supply from solar panels, which simultaneously serve as protection from the sun, and an equipped workplace with sockets for gadgets and for connecting to the Wi-Fi Internet network.

– It is proposed to place electric charging modules for electric cars in parking lots and near significant buildings.

– In the future, it is proposed to develop public transport based on medium-capacity electric buses (up to 24 passenger seats) with the laying of routes for the most popular movements of users.

The research materials can be used to develop regulatory documents and new methods for modernizing individual components of the transport infrastructure of a modern city in conditions of sustainable development.

The results analysis of the research topic makes it possible to the direction of the work and the obtained results, their adequacy and compliance with the simultaneous confirmation of the trinity

"**topic** $\Rightarrow$ **research progress** $\Rightarrow$ **obtained results**" of the key aspects of the entire study.

The basic terms of the research topic under consideration are "path", "sustainable development", "transport infrastructure", "city" and the specific place of development and implementation of measures the Libyan city of Zawia. This research presents the results of the semantic analysis of these words. In particular, a path is a road to a specific destination (the process of implementing a specific action plan, achieving a goal), a place or space along which something or someone moves. a direction of movement that relies on approaches and takes into account operating factors. direction, method of any

http://www.doi.org/10.62341/smaw1104

purposeful activity, development (as changes in states over time) of something (for example, the course or course of some process).

"Methodological recommendations for the implementation of sustainable development of the transport infrastructure of a modern city" developed practical recommendations for the modernization of the transport infrastructure of a modern city in the context of its sustainable development.

The extension of the concept of sustainable development to urban planning has had a strong impact on the design of the transport and road network, modifying it. Let us only point out the appearance in theory and practice of new terms “sustainable streets”, “livable streets”, “living streets”, “naturalized streets capes”, “context sensitive design”, which is due to the growth of productive interest in the problems of ecology, landscape design and improvement of urban areas, organic integration of streets into the urban environment, preservation of architectural heritage, architectural monuments, ensuring safe and comfortable conditions for the movement of pedestrians and cyclists [10].

Modernization of transport infrastructure involves the reconstruction (design) of the street and road network and the organization of road traffic, which are the most complex and relevant issues of both the theory and modern practice of developing the city's transport infrastructure in conditions of sustainable development.

The reconstruction (design) of the street and road network includes: a set of measures to improve the organization and functioning of the city center: construction of new roads (streets), increasing the width of the carriageway of streets, expansion and reconstruction of individual streets and traffic junctions, creation of permanent parking lots, construction of multi-level parking lots using underground space and the first floors of buildings, with maintenance services, construction or arrangement of electric vehicle charging stations, laying bicycle paths, construction of elevated and underground pedestrian crossings, laying routes for public electric transport, construction of new depots for public electric transport, creation of logistics centers at the exits from the city, outside its borders, construction of ecological multi-level overpasses and bridges at intersections, ecological road clothing (covering), organization of lighting of streets and roads with wireless lamps with renewable energy sources (solar batteries).

http://www.doi.org/10.62341/smaw1104

Road traffic is the main process of providing transport services direct movement of cars, people and goods on the roads. And since transport services are produced directly in road traffic, the main task is to improve its quality, which is integrated Ly determined by a set of such properties as safety, environmental friendliness, economy, sociologically. That is, road traffic contains emergency, environmental, economic and social threats [11].

Measures to organize road traffic include: reducing the need for citizens to move by transport due to pedestrian accessibility of the necessary objects, organization of continuous transport; organization of a system of streets with one-way traffic, rational distribution of the carriageway by directions of movement, priority use of electric transport in the central part of the city; circular traffic at intersections, optimization of traffic light regulation; arrangement of “car-free zones”, implementation of a complex of technical and architectural-planning solutions and measures for "traffic calming"[12].

Both of these areas are interconnected and interdependent. Therefore, they are not used separately, but only in a complex manner, taking into account the real conditions and factors of the urban area under study.

"Urban planning aspects of the prospective implementation of sustainable development of the transport infrastructure of the city of Zawia " provides a description of urban planning proposals - as possible priority ways to implement sustainable development of individual components of the transport infrastructure. These are the following measures (as implementers of the ways):

– Determination of the location and entrances to the international bus station on the eastern outskirts of the city of Zawia near the transnational highway (Figure 2).

– Organization of logistics centers on the eastern and western outskirts of the city near the transnational highway for unloading heavy-duty road trains and organizing the delivery of goods to retail establishments by light-duty ecological transport - electric cars (Figure 2).

http://www.doi.org/10.62341/smaw1104

Figure 2. Tram route, bus station and logistics centers of Zawia

– Initiating the development of a public transport network, for which a tram route should be laid (designed) (as a type of ecological urban transport), which will connect the industrial area of the oil refinery and the international bus station, located diametrically opposite the outskirts of the city of Zawia (Figure 3 and 4).

http://www.doi.org/10.62341/smaw1104

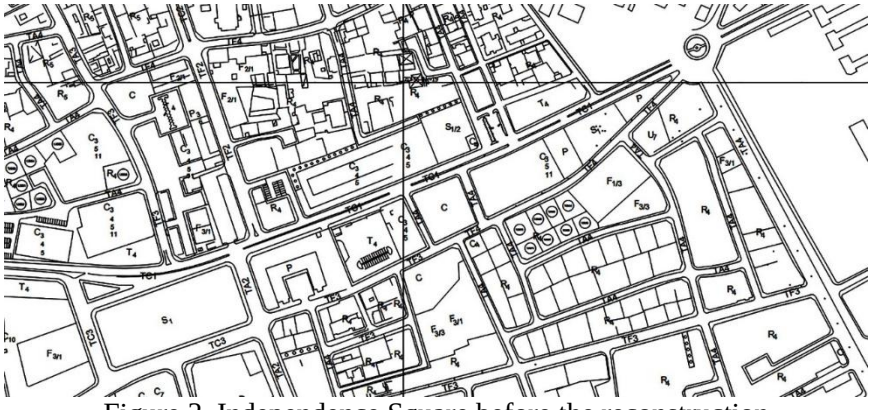

Figure 3. Independence Square before the reconstruction
[Urban Planning Authority].

Figure 4. Tram route on Independence Square
[Urban Planning Authority- Author].

– Reorganization to ensure pedestrian safety in the Independence Square area by installing underground passages near significant objects (Figure 5).

– Reconstruction of the city center in the Independence Square area in the form of traffic reorganization (Figure 6).

– Reconstruction and expansion of the city park area by joining two adjacent blocks with a neglected area (Figure 7,8).

– Placement of electric charging modules for electric cars in parking lots and near significant buildings.

– Promising development of public transport based on medium-capacity electric buses (up to 24 passenger seats) with the laying of routes for the most popular movements of citizens.

http://www.doi.org/10.62341/smaw1104

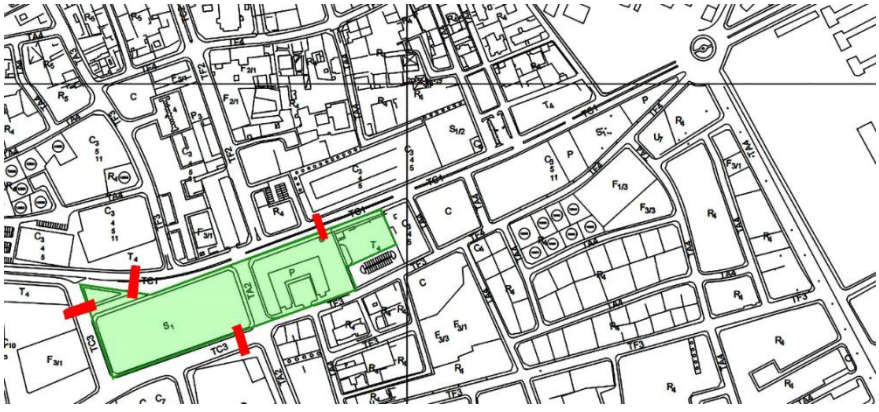

Figure 5. City Park with underpasses after reconstruction
[Urban Planning Authority- Author].

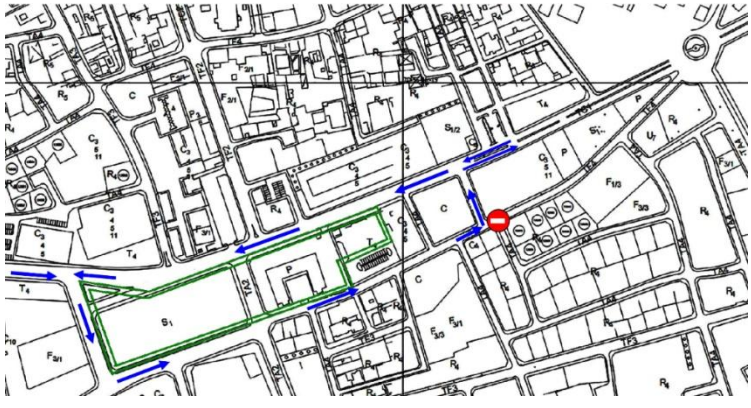

Figure 6. Organization of one - way traffic on Independence Square
[Urban Planning Authority- Author].

Figure 7. General plan of the City Park after reconstruction:
(1) – fountain. (2) – parking lot. (3) – roadway. (4) – underpass.

http://www.doi.org/10.62341/smaw1104

Figure 8. City Park after reconstruction.

"Architectural and design aspects of the prospective implementation of sustainable development of the transport infrastructure of the city of Zawia " provides a description of project proposals - as possible priority ways to implement sustainable development in the form of individual architectural objects of transport infrastructure. These are the following objects (as implementers of the routes):

– Architectural design of an international bus station on the eastern outskirts of the city of Zawia near the transnational highway (Figure 9).

Figure 9. Visual image of the bus station.

– Design of small architectural forms of tram stops with autonomous power supply from solar panels and two poles with energy-saving LED lights as seen in Figure 10.

http://www.doi.org/10.62341/smaw1104

– Design of small architectural forms for park improvement in the form of connected elements as Figure 11: two benches, a pole with LED energy-saving lights, equipped with 24- hour autonomous power supply from solar panels, which simultaneously serve as protection from the sun, and an equipped workplace with sockets for gadgets and for connecting to the Wi-Fi Internet network.

Figure 10. Tram stop.

Figure 11. Multifunctional solar-powered lights.

http://www.doi.org/10.62341/smaw1104

– Design of four underpasses on Independence Square.

"ICT and VIM model of the design object"

The project implementation is described using computer technologies using a number of different software tools, in particular, the All plan CAD. The software tool used provides comprehensive processing of all architectural, design, technological, economic and other information about architectural objects during the architectural design process.
The architectural and construction object is designed as a single whole and is presented as a single digital BIM model. The use of computer-aided architectural design technologies based on All plan CAD accelerates project development and allows you to automatically obtain detailed plans and a three-dimensional model with the corresponding design documentation.

Results

-Designing a tram route (as a form of sustainable urban transportation) connecting the refinery's industrial zone to the bus station located at the eastern entrance to the city.

-Reconstructing the city center in the Martyrs' Square area by reorganizing traffic to reduce pollution.

-Reorganizing pedestrian traffic in the Martyrs' Square area and making it safer by creating tunnels near important landmarks.

-Designing tram stations equipped with independent power sources from solar batteries.

-Designing architectural forms for benches equipped with independent power sources from solar panels and a column equipped with LED lighting.

-Reducing congestion in the urban area of the city.

Conclusion

The effective implementation of the concept of sustainable development in the field of transportation requires the development of an integrated transportation sustainability system that meets the current and future needs of beneficiaries. This system is based on developing government partnerships with all stakeholders, primarily the beneficiaries of these projects. Libyan public administration bodies can benefit from successful international experiences in the field of transportation sustainability, while taking into account local specificities.

http://www.doi.org/10.62341/smaw1104

Recommendations

-Improvement of the planning of the street and road network and organization of transport movement in accordance with sanitary and hygienic requirements for protecting the population from adverse acoustic effects and chemical pollution from vehicles.

- creation of lanes for bicycle and pedestrian traffic, as well as conditions for the movement of the population with reduced mobility, when designing, building and reconstructing the street and road network.

Reference

[1] Ali, Zain Al-Abidin.2000. Principles of urban transport planning: Safaa Publishing and Distribution, Amman.

[2] Aljad Reyad Rajab Mohammed, 2019. Features of European influence in urban planning and architecture of residential buildings in Libya in the 2nd half of the 20th–early 21st centuries: Author's abstract. dissertation .... candidate of architectural sciences. 18.00.01 – Theory of architecture, restoration of architectural monuments.

[3] Criteria and indicators of sustainable development. Ecology. Indicators of Sustainable Development: Guidelines and Methodologies, United Nations publication, 2007 Third Edition.

[4] Abdul Salam Muhammad Al-Faqih. 2015. Inventory of the vegetation cover surrounding the University of Zawiya: The Libyan Journal of Science.

[5] https://www.embassyoflibya.ca/pages/about-libya-ar

[6] Amani Abdel Aziz Fakher.2008. Environmental Sustainability and Economic Growth in Developing Countries.

[7] D.V. Zemov. 2019 General methodological issues in the field of urban planning were studied.

[8] Dorofeeva. Kh. M. 2016. Main parameters of sustainable of transport infrastructure: Scientific Bulletin of State University. Series Economic Sciences. – Issue 21 Part 1. – Kherson, KHSU.

http://www.doi.org/10.62341/smaw1104

[9] Farouk Abbas Haidar. 1994 Urban and Rural Planning: Cairo, Sustainable Urban Development: URL: http://habitat3.org/the-new-urban-agenda.

[10] Glybovets. 2015 General issues of architectural ecology and ecological urban planning were raised, as well as the connection between transport infrastructure and ecology in the city- Transport planning of cities and organization of transport and pedestrian flows in cities.

[11] Horev A.E. 2010. Fundamentals of the theory of transport systems: textbook. manual. A.E. Grieving -St. Petersburg 214p.

[12] Igor Solukha.2015. STREETS AND ROADS OF POPULATED AREAS. DBN V.2.3-5-2001