

ТИПОЛОГИЯ И АРХИТЕКТУРНЫЕ ОСОБЕННОСТИ ТРАДИЦИОННЫХ ЖИЛИЩ В ПУСТЫНЕ САХАРА (ПАТИО И ПОДЗЕМНЫХ ДОМОВ)

УДК 72.031.2:551.58(292.62)

DOI: 10.24411/1998-4839-2019-00008

Я.М. Бенюсеф*Российский университет дружбы народов, Инженерная академия, Москва, Россия***О.Ю. Сулова***Московский архитектурный институт (государственная академия), Москва, Россия***Аннотация**

Традиционная архитектура, полученная методом проб и ошибок на протяжении многих лет, по своей природе обеспечивает эстетические качества, адаптируясь к климату и экономике. Эта статья основана на исследовании докторской диссертации под названием «Особенности формирования архитектуры индивидуальный жилых зданий в условиях Сахары». Индивидуальные жилые дома в районе Сахары богаты разнообразием, типологией и различаются в зависимости от региона и образа жизни людей.

В статье анализируются два основных типа домов: с внутренним двориком и дом троглодитов, которые представляют разнообразие и богатство типологии индивидуального жилья в Сахаре. Традиционные индивидуальные дома в районе Сахары заслуживают изучения, так как они представляют собой прекрасный пример того, как местное население смогло успешно и долговременно решить экологические проблемы, начиная с окружающей среды, климатических особенностей и заканчивая наличием строительных материалов.

Общая организация традиционных домов соответствует центрированному образу жизни, который проявляется в общем дизайне дома и в важности внутреннего двора. Пустынное жилье всегда было эффективным с точки зрения климатической приспособленности, экономической целесообразности и долговечности.¹

Ключевые слова: типология, жилище, Сахара, внутренний дворик, жилища троглодитов

TYPOLOGY AND ARCHITECTURAL FEATURES OF TRADITIONAL DWELLINGS IN THE GREAT SAHARA (CASE OF PATIO AND UNDERGROUND HOUSES)

Y. Benyoucef*People's Friendship University of Russia, Academy of Engineering, Moscow, Russia***O. Suslova***Moscow Institute of Architecture (State Academy), Moscow, Russia***Abstract**

The traditional architecture has been achieved through trial and error through the years inherently provides the aesthetic qualities, the climatic adaptability, and the economic feasibility. This article is based on doctoral thesis research about the domestic architecture in the Great Sahara region. The Individual houses in the Saharan area have a rich diversity in typologies and vary according to the region and people's lifestyles.

¹ **Для цитирования:** Бенюсеф Я.М. Типология и архитектурные особенности традиционных жилищ в пустыне Сахары (патио и подземных домов) / Я.М. Бенюсеф, О.Ю. Сулова // Architecture and Modern Information Technologies. – 2019. – №4(49). – С. 98-107. – URL: https://marhi.ru/AMIT/2019/4kvart19/PDF/07_benyoucef.pdf
DOI: 10.24411/1998-4839-2019-00008

The article analyse two different types of houses, the patio house, and troglodyte house (underground house), which both represent diversity and wealth of individual housing typology in Sahara. The Traditional Individual Houses in the Saharan Area is worthy of study because it represents an excellent example of how local population was able to meet, in an excellent and sustainable way to the environmental challenges, starting from the environment and climatic features to the availability of the construction materials. The general organization of traditional houses corresponds to a centered way of life, which appears in the general design of the house and in the importance of the central courtyard. The Desert habitation has always been effective in terms of climatic adaptability, economic feasibility and durability.²

Keywords: typology, individual houses, Sahara, patio house, troglodyte house

Domestic architecture in the Saharan cities is representative of sociological norms with all its social values, doctrines and traditions. Traditional houses in the Saharan context contained many values of how people lived in that area and fulfilled their physical and social requirements as a unique character in their environment. The Great Sahara, is an illustrative example for vernacular architecture and a land of old humanity, of great historical thickness of human creations [1]. Every era, every nation, has left its imprint on the vast backdrop of the desert light trace with a very rich architecture [2]. The Saharan region has several kinds of house types that developed over various stages of Saharan region history.

This study is intended towards gaining knowledge about house typologies and characteristics of individual house types in hot-arid regions. The traditional houses in all the Sahara are for the most part built in raw brick that is called adobe and others from stones. The houses design, building materials, and construction system were distinguished for each region. This is due to the response to environmental and social, climatic factors. The architectural traditional mode of production was based on the existence of organizations and social structures in which the inhabitant controlled the production process of his housing. The research aims is to study the typology and the architectural features of individual houses, patio and troglodyte houses in the Sahara area and explore the diversity of traditional individual houses in hot-arid area.

The vernacular habitat has very often been a projection of the social ecosystem: through the management and prioritization of spaces in the dwelling. Indeed, the example of indigenous housing in Africa shows us very clearly the different forms that housing takes according to the social and cultural relations adopted by each society [3].

Traditional Saharan Houses

The study of ancient architecture and traditional habitat leads us to an understanding of methods and tools of climate adaptation in hot-arid climates. In desert climates in the past, builders had to rely on a number of techniques to optimize people s comfort in buildings' internal spaces [4].

According to Andre Ravereau, the desert cities offer the most complete example of an adaptation to environmental constraints, architecture and an urban friendly environment. The Saharan cities, presents an archetype adaptation to the natural ecosystem, this is manifested by the orientation studied in relation to the sun and prevailing winds, the use of natural elements, the densification of urban areas, the bioclimatic conception of the spaces and the rational use of architectural elements and the constructive methods [5], houses are also very often an expression of the social hierarchy.

² **For citation:** Benyoucef Y., Suslova O. Typology and Architectural Features of Traditional Dwellings in the Great Sahara (Case of Patio and Underground Houses). Architecture and Modern Information Technologies, 2019, no. 4(49), pp. 98-107. Available at: https://marhi.ru/AMIT/2019/4kvart19/PDF/07_benyoucef.pdf
DOI: 10.24411/1998-4839-2019-00008

The architectural character of individual houses distinguishes by its durability, simplicity, and adaptability [6]. Although it is practically impossible to find two identical houses in the traditional fabric [7], some basic characteristics allow us to form a general description of the Saharan houses. In the Saharan region there have been many types of houses, one of them purely African or Afro-Arab and the other solely Arab within this Saharan region of Africa for many centuries. These are traditional houses of sub-Saharan Africa and those of the Arabic country, based on the shared concept of courtyards (fig. 1). Residential patterns developed in Africa that are still in use today [8]. Both streams probably started with windowless, one-room, mud-brick dwellings.

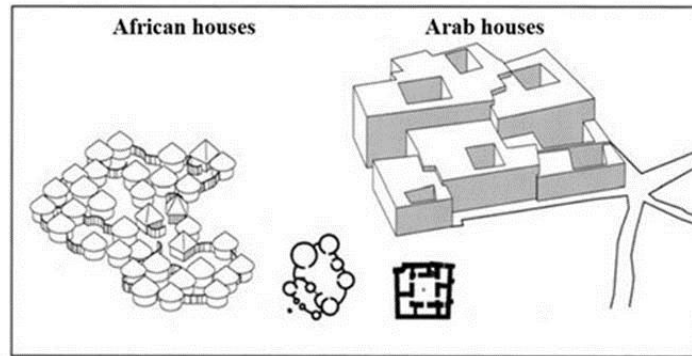


Fig. 1. Comparison of African and Arab settlement, Source: Steyn (2005)

The Sahara have a rich architectural and urban heritage. The traditional architecture, especially houses, evolved from the need to make life secure and comfortable in a region with a hot arid climate. The factors affecting the traditional house design vary greatly between social, cultural, spiritual, climatic, and environmental aspects.

This paper analyses two different types of houses in different cities (fig. 2), the patio house, and troglodyte house, which both represent diversity and wealth of individual housing typology in Sahara. Consequently, we find different kinds of houses, ones built inside the city and others outside as a summer houses which were mainly around palm tree farms. Given this information, we can mention two kinds of house typologies: *patio house and troglodyte house (underground house)*.



Fig. 2. The Great Sahara in the northern part of Africa. Source: Britannica, Modified by Author
The Patio house

The model of the patio house, is indeed one of the two great models of urban habitat known in history [9]. This type of house is considered to be a typical house in the Sahara, with its specific typology and characteristics spread not only throughout the Sahara, but throughout the Arab regions and the Mediterranean. The different size and shape of the patio are determined partly by the local building techniques and the climate and partly by the local traditional culture.

We can mention two examples, patio house in Ghardaia city, Algeria (fig. 3), and in the Medina of Fez, Morocco (fig. 5), in the most of dwellings, there is a shady courtyard "Patio", reliably protected from unfavourable factors of the external environment (fig. 4). In which the patio represents an effective response to hard weather conditions, due to the reduction of the external surfaces and the function of the patio as a source of light and ventilation. The patio is usually square in shape; it is often marked by the presence of four poles with arcades, which serve to cover galleries around it [10].

The general organization of traditional houses corresponds to a centered way of life, which appears in the general design of the house and in the importance of the central courtyard. Generally the entrance presented as a rectangular hole in the front wall about 1.70 m in height, 1.10 m to 1.20 m of wide [11]. The first floor provides the entrance and a living area, kitchen, and storage room add to that, the second floor provides a more open living area with arcades around a central courtyard. After sunset a violent drop in temperature changes the function of the roof terrace from parasol to sleeping area [12].

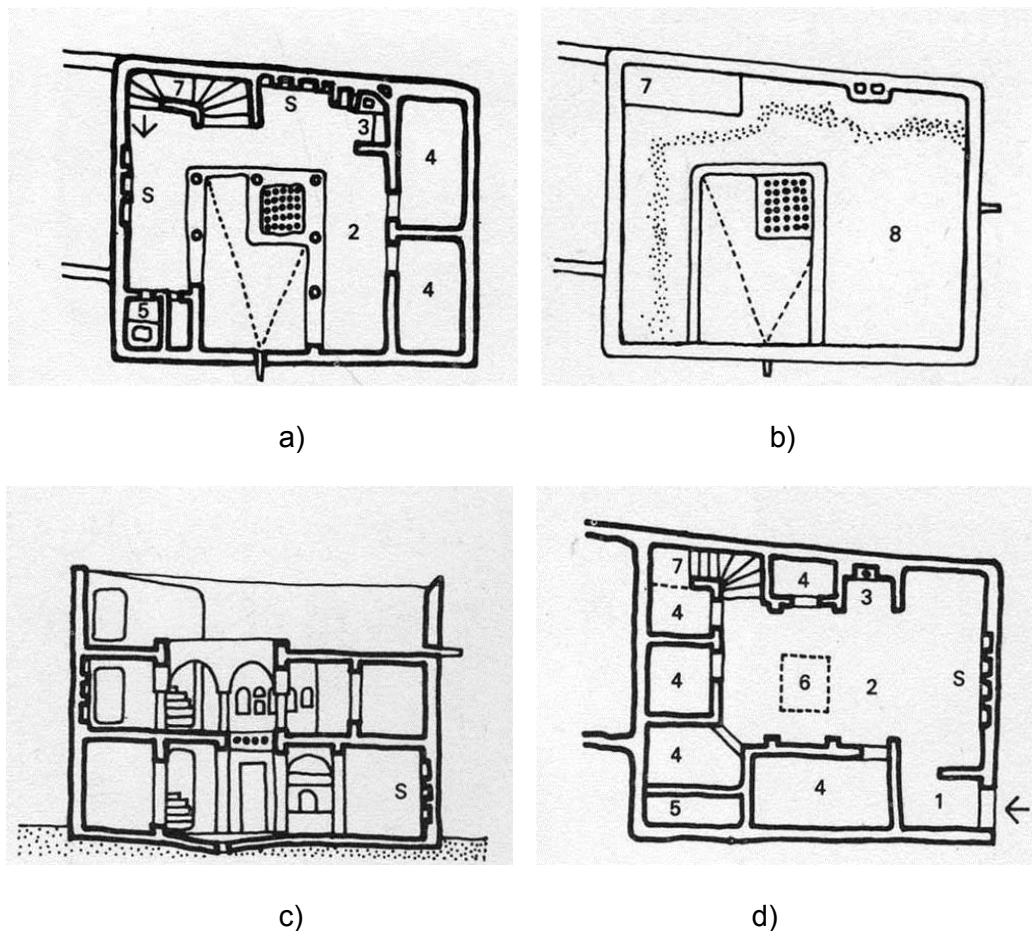


Fig. 3. Typical well-house plan in M'zab, Ghardaia (Algeria): a) First floor plan; b) Roof terrace plan; c) Ground floor plan; d) Section. (1. Entrance 2. living area 3. kitchen 4. Spare room 5. W.C 6. Roof light 7. Stair 8. Terrace). Source: David Etherton

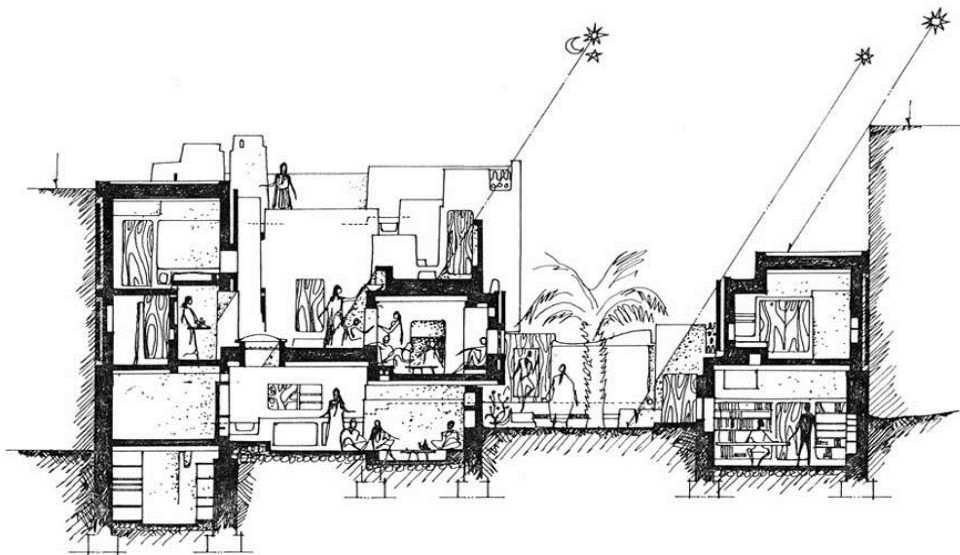


Fig. 4. Section of patio house in Ghardaia city (Algeria), Source: Andre Ravereau

The issue of privacy is a complex. It finds its place in the search for a psychological comfort in the house and, when it is defined, it is known by its sacred character. For the traditional Saharan house, this cultural vector is primordial and has always been decisive in the design [13].

Sundried brick “adobe” is used in the construction in the most of buildings. During the hot day, the heat flow from exterior to interior, the consequence is a minimization of temperature change inside the houses [1]. Building materials were the same for all most of cities in hot-arid areas. A hard quick-drying plaster processed from river silt was used for making building blocks, as mortar and for rendering. The external rendering of buildings is still applied in the traditional way with palm branches [12].

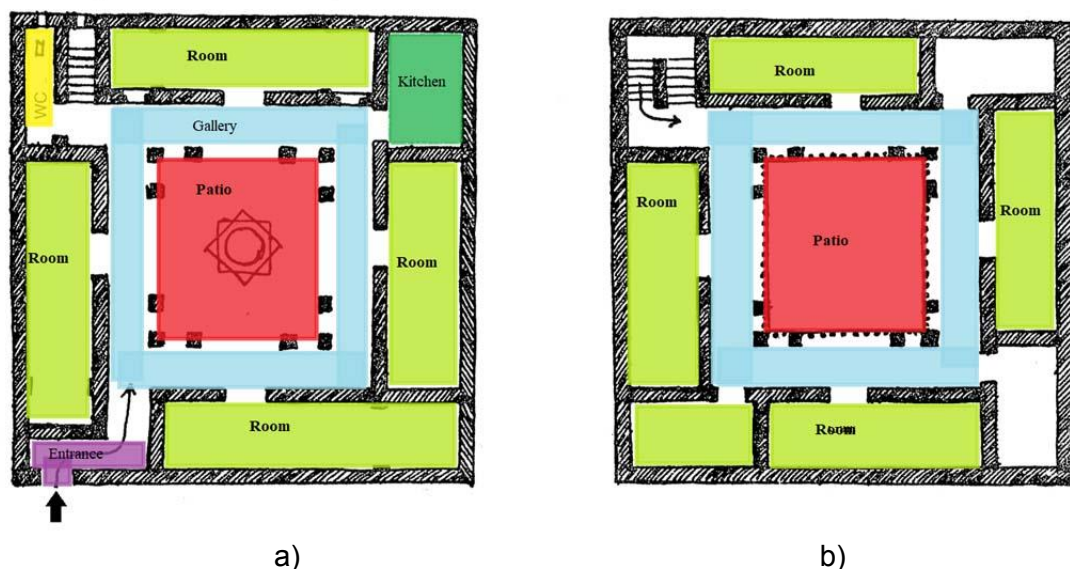


Fig. 5. Traditional house plan in Fez, Morocco: a) First floor; b) Second floor. Source: T. Burckhardt

It would be possible to differentiate the patio of the courtyard from a more central position and by a functional role that is more complex and especially social as a place for habitat and family

life [14]. "Patio" is a typical space of the Saharan houses, the patio is defined by a perimeter gallery (fig. 5) present at each floor, which creates a transit area between the central courtyard (patio) and the private rooms. The Patio plays a very important role in the building because it ensures illumination and ventilation. Its importance is also expressed by the presence of very rich architectural details and decorations [15].

The troglodyte house (underground house)

Troglodyte houses are usually dug in sedimentary or volcanic rocks in different regions and climates. This type can be different from one region to another. As an example, we can mention Matmata village in south Tunisia as an excellent illustration of Troglodyte houses (fig. 6). It is the most famous Berber village of southern Tunisia.



Fig. 6. a) General view of the Matmata village; b) view on the courtyard of Matmata house, Matmata, Tunisia. Source: Zohra Bensemra. Modified by Author

Matmata is known for its troglodyte houses carved into the Dhahar Mountains and still inhabited today. These dwellings, in some cases go back as far as 250 years and were dug out by people from the mountains areas where they were living for safety reasons.

The general organisation of Matmata house contains a living room as well as additional rooms, a kitchen, bathroom, courtyard, and granary, (fig. 7). The houses are sometimes formed around a large and circular well. Around this well constitutes the central courtyard, occasionally with an entirely excavated room [16].

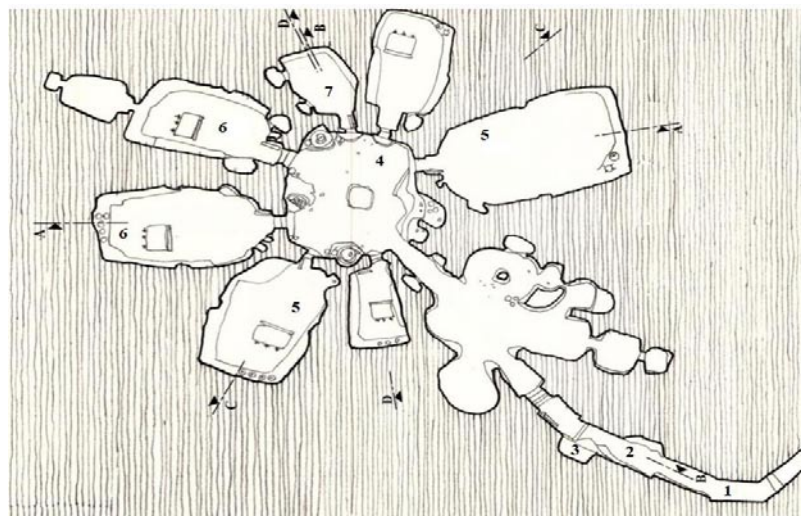


Fig. 7. House troglodyte plan in Matmata (Tunisia): 1. Main entrance, 2. Skifa, 3. Niche, 4. Courtyard "Patio", 5. Main bedroom, 6. Bedroom, 7. Granary. Source: Andre Louis. Modified by Author

In general, the second floor is intended for storage (Granary). Passive climatization techniques in desert lands are various and this special underground habitation design allows light to penetrate the underground rooms while maintaining freshness in the warmth of summer. In areas where these are inhabited by completely sedentary populations, the furnishing is clearly careful and comfortable [17]. Although the indoor temperature of these dwellings is not constant throughout the year.

The Surface area of the housing is approximately 800 m² depends from said house to others with two floors. Individual rooms were scooped into the soft rock to build an atrium dwelling which had a few excavated rooms of 4 m to 10 m high as illustrated in (fig. 8) [18]. Despite the heat outside, the public spaces and the rooms isolated by meters of earth, are always comfortable [19].

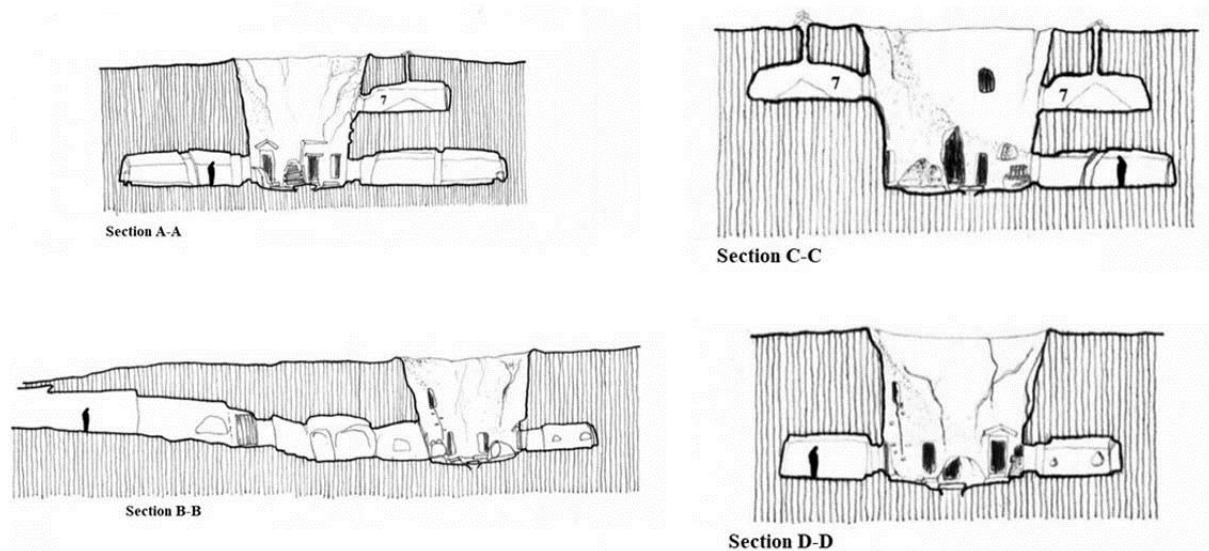


Fig. 8. Sections of Matmata house. Source: Andre Louis

The vigour of the centrality in the houses “Patio”

The essential feature that emerges clearly from the study of all the houses of the city is the vigor of the centrality: this central part is so characteristic, so deep, that it is present in all the types of houses of the city. It is a personalized space, provided with memory and keeping its role, even if the city and the society knew a development and a modernization. It is a versatile place that gathers and distributes spaces. It can receive almost all the activities of the house: sleeping, eating, housework, parties.

These characteristics respond to specific physical and climatic conditions: relatively high temperature, sunshine. They also correspond to a social organization that strongly expresses the intimacy of the family through the introverted character of the dwelling. From the architectural point of view, these spaces regulate the composition of the house, they ensure the inner distribution and order the overall geometric configuration [20].

Discussion

The general organization of traditional houses corresponds to a centered way of life, which appears in the general design of the house and in the importance of the central courtyard. The patio houses and underground house is in a way the result of a meeting between human, social and cultural needs with architectural, urban, climatic and environmental solutions. Desert habitation has always been effective in terms of adaptation to the harsh conditions of the terrain and climate.

The Patio plays a very important role in the building because it ensures illumination and ventilation. The patio characterizes a type of habitat that is urban rather than rural. The underground building has a thermal energy efficiency and can be a solution for the sustainable development in hot-arid area. For building energy performance, the ancient techniques of using the earth as temperature moderator against harsh climate has impressive potential to become a solution against the energy inefficiency of heating, ventilation in houses.

Conclusion

The patio house in this area is the most effective and adaptive house with the intrinsic qualities of adaptation to the desert climate and the convergence of buildings in the desert areas is the result of the prevailing hot climate. On the thermal level, we can say that the patio is one of the architectural elements of a bioclimatic design to achieve quality comfort in a home. The troglodyte houses values nature, we can mention there is no distinction between the house and the natural environment. This allowed the well-being of the inhabited and the respect of the natural atmosphere.

While sustainable development is the ultimate goal to be achieved, the impact of underground houses should be weighed carefully along the common dimensions of sustainable development in terms of Environment, Society and Economy. The study suggests that, from the synthesis of the article, we can say that the model of central courtyard houses could be developed in a way that would contribute towards much more compact, low-energy and socio-cultural values, climatic adaptability, economic feasibility and durability.

Sources of illustrations

Fig. 1. Available at:

http://scholar.ufs.ac.za:8080/xmlui/bitstream/handle/11660/5548/struct_v12_n2_a6a.pdf?sequence=1&isAllowed=y (accessed on: 06.11.2019).

Fig. 2. Available at: <https://www.britannica.com/place/Sahara-desert-Africa> (accessed on: 07.10.2019).

Fig. 3. Available at: <https://adamachrati.com/2014/01/16/traditional-homes-in-the-mزاب-valley/> (accessed on: 06.10.2019).

Fig. 4. Available at: <http://www.aladar-assoc.fr/portfolio/la-villa-m/> (accessed on: 06.11.2019).

Fig. 6a. Available at: <https://www.afriquedesigndaily.com/les-derniers-habitants-des-maisons-souterraines-de-djebel-dahar/> (accessed on: 06.11.2019).

Fig. 6b. Available at: <https://www.afriquedesigndaily.com/les-derniers-habitants-des-maisons-souterraines-de-djebel-dahar/> (accessed on 08.10.2019).

Fig. 7. Available at: https://issuu.com/souhirhabouria/docs/rapport_m_moire (accessed on: 06.11.2019).

Fig. 8. Available at: https://issuu.com/souhirhabouria/docs/rapport_m_moire (accessed on: 05.11.2019).

References

1. Benyoucef Y.M., Razin A.D. Consideration of Climatic Conditions in the Design of Dwellings in the Sahara Desert. RUDN Journal of Engineering Researches, 2018, Issue: vol. 19, no. 4, pp. 471-481. Available at: <http://journals.rudn.ru/engineering-researches/article/view/20-598>
2. Côte M. Signatures Sahariennes: Terroirs et territoires vus du ciel. Aix en Provence: Presses universitaires de Provence, pp. 1, ISBN : 978-28-539-9833-8.
3. Melioui F. Tabet Aoul K. L'habitat Espaces Et Repères Conceptuels, Courrier du Savoir, no.°01, Novembre 2001, pp. 59-64.

4. Ahmet V. Vernacular Climate Control in Desert Architecture, *Energy and Buildings*, 15-16, 1990/91, p.809-815.
5. Layachi A. The archetypes of landscape and sustainable design in the ksar of Kenadsa, *ITU AIJZ*, vol. 13, no. 3, November 2016, p.79-91.
6. Al-Zubaidi, Maha S.S. The sustainability potential of traditional architecture in the Arab world - with reference to domestic buildings in the UAE. Doctoral thesis, University of Huddersfield, 2007. Available at: <http://eprints.hud.ac.uk/id/eprint/965/1/mahaalzubaidifinal-thesis.pdf>
7. Sriti L., Tabet-Aoul K. Evolution des Modèles D'habitat et Appropriation de L'espace Le cas de L'architecture Domestique dans les Ziban, *Courrier du Savoir – no.°05*, Juin 2004, p. 23.
8. Steyn G. African courtyard architecture: Typology, art, science and relevance, Department of Architecture, Tshwane University of Technology, p.112. Available at: http://scholar.ufs.ac.za:8080/xmlui/bitstream/handle/11660/5548/struct_v12_n2_a6a.pdf?sequence=1&isAllowed=y
9. Samir A. Les Maisons À Patio, Continuités historiques, adaptations bioclimatiques et morphologies urbaines, ICOMOS, France, 2011, p. 282.
10. Abdeldjebar L. The archetypes of landscape and sustainable design in the ksar of Kenadsa, *ITU AIJZ*, Vol 13, no. 3, November 2016, pp. 79-91.
11. Bousquet C. L'habitat mozabite au M'Zab, *Annuaire de l'Afrique du Nord*, Center national de la recherche scientifique; Centre de recherches et d'études sur les sociétés méditerranéennes (CRESM), Paris, CNRS, 1988, pp. 257-269. Available at: http://aan.mmsch.univ-aix.fr/volumes/1986/Pages/AAN-1986-25_29.aspx
12. Achrati A. Traditional Homes in the M'Zab Valley. Available at: <https://adamachrati.com/2014/01-/16/traditional-homes-in-the-mزاب-valley/>
13. Hadj Mohamed N, Madani M. Renouveau des espaces habités spécifiques aux régions sahariennes, l'exemple de Béchar, *REMMM*, 138, 2015. Available at: <https://journals.openedition.org/remmm/8914?lang=en>
14. Samir A, Les Maisons À Patio. Continuités historiques, adaptations bioclimatiques et morphologies urbaines, ICOMOS, France, 2011, p. 282.
15. Baglioni E, Rovero L, Tonietti U. Drâa valley earthen architecture: construction techniques, pathology and intervention criteria, *J. Mater. Environ. Sci.* 7 (10) (2016) 3499-3508.
16. Naceur B. L'architecture Traditionnelle en Tunisie : L'habitat Rural, *RehabiMed*. Available at: <http://www.rehabimed.net/Publicacions/Seminaris/Rehabilitacio%20i%20turisme%20sostenible/1.%20Introduction%20%20la%20rehabilitacio%20de%20l'architecture%20traditionnelle/1.3%20L'architecture%20traditionnelle%20en%20Tunisie.%20L'habitat%20rural.pdf>
17. Traditional Mediterranean Architecture, European commission MEDA-EUROMED heritage, CORPUS, 2002, p. 64. Available at: https://issuu.com/asociacionrehabimed/docs/corpus_eng
18. Saqaff A. Alkaff, S.C. Sim n, M.N. Ervina Efan. A review of underground building towards thermal energy efficiency and sustainable development, *Renewable and Sustainable Energy Reviews*, vol 60, 2016, pp. 692–713.

19. Souhir H. Relecture d'un habitat troglodytique à Matmata, université de Carthage, 2016, p.53. Available at: https://issuu.com/souhirhabouria/docs/rapport_m_moire
20. Hadj Mohamed N, Madani M. Renouveau des espaces habités spécifiques aux régions sahariennes, l'exemple de Béchar, REMMM, 138, 2015. Available at: <https://journals.openedition.org/remmm/8914?lang=en>

ABOUT THE AUTHORS

Yassine Mohammed Benyoucef

Postgraduate Student, Department of Architecture and Construction, Academy of Engineering, Peoples' Friendship University of Russia (RUDN), Moscow, Russia
e-mail: b.yassine@mail.ru

Suslova Olga

Ph.D. in Architecture, Professor, Chair of Construction of Buildings and Structures, Moscow Institute of Architecture (State Academy), Moscow, Russia
e-mail: ollgasuslova@yandex.ru

ОБ АВТОРАХ

Яссин Мохаммед Бенюсеф

Аспирант, департамент архитектуры, Инженерная академия, Российский университет дружбы народов, Москва, Россия
e-mail: b.yassine@mail.ru

Суслова Ольга Юрьевна

Кандидат архитектуры, профессор кафедры «Конструкции зданий и сооружений», Московский архитектурный институт (государственная академия), Москва, Россия
e-mail: ollgasuslova@yandex.ru