



International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw,
Poland 00-773
+48 226 0 227 03
editorial_office@rsglobal.pl

ARTICLE TITLE

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PROVINCE, ALGERIA

ARTICLE INFO

Tartar Nassima, Toumi Fahmi. (2024) Challenges of Preserving Architectural Heritage Amid Social and Environmental Decline: A Call for The Official Classification of Ksar Negrine in Tebessa Province, Algeria. *International Journal of Innovative Technologies in Social Science*. 4(44). doi: 10.31435/ijitss.4(44).2024.3031

DOI

[https://doi.org/10.31435/ijitss.4\(44\).2024.3031](https://doi.org/10.31435/ijitss.4(44).2024.3031)

RECEIVED

11 November 2024

ACCEPTED

23 December 2024

PUBLISHED

30 December 2024

LICENSE



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CHALLENGES OF PRESERVING ARCHITECTURAL HERITAGE AMID SOCIAL AND ENVIRONMENTAL DECLINE: A CALL FOR THE OFFICIAL CLASSIFICATION OF KSAR NEGRINE IN TEBESSA PROVINCE, ALGERIA

Tartar Nassima

University Echahid Echeikh Larbi Tebessi Tebessa, Algeria.

Laboratory Architecture, City and Environment, University Hassiba Ben Bouali Chlef

Toumi Fahmi

University Echahid Echeikh Larbi Tebessi Tebessa, Algeria.

Laboratory Architecture, City and Environment, University Hassiba Ben Bouali Chlef

ABSTRACT

Ksar Negrine is a historic architectural landmark located in the Algerian desert, and it serves as a model for traditional cities. It was built using local materials such as clay and stone, relying on experience and innovative design to harmonize with the desert environment. The ksar consists of dwellings, a mosque, and a market, reflecting a comprehensive social, economic, and cultural development. The ksar enjoys a strategic geographical location in the heart of the palm oases and benefits from a water source that supports sustainable agriculture. Resources are distributed fairly among the residents, fostering social cohesion. However, the ksar has suffered from deterioration due to ongoing migration, lack of maintenance, and the impact of environmental factors such as sandstorms. With growing awareness of the importance of heritage preservation, there are now opportunities for its official classification, which would facilitate restoration efforts and transform it into a cultural and tourist center. This would help preserve its architectural identity and promote sustainable tourism.

KEYWORDS

Ksar Negrine, Traditional Cities, Classification, Architectural Identity

CITATION

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INTRODUCTION.

Mud architecture is an ancient building style that relies on the use of local materials and experimental design, where individuals learn from past mistakes and improve their techniques over time to meet daily life needs and adapt to the surrounding environment (Alani, 2017). In the Algerian desert, mud stands out as a fundamental material in traditional architecture due to its availability and ease of use, making it the ideal choice for the local community given its low cost and unique properties (Maliki, 2022). This architecture serves as evidence of human intellectual and cultural development, as well as the ability to adapt to a harsh environment characterized by heat and drought (Naima, 2014).

In the Algerian desert, as in the rest of the Maghreb region, mud architecture is embodied in ksars, religious buildings, and military structures, reflecting a long history and deep cultural traditions. These structures not only represent construction methods, but they also stand as living cultural heritage that reflects the daily lives of the people in the region, as well as their historical narratives (Swaiyat, 2020). Among the most prominent examples of this architecture are the Algerian desert ksour, which form unique architectural clusters made up of closely packed buildings, inhabited by a diverse ethnic and social community (Qanati &

Bounab, 2023). These ksour are characterized by their harmony with the harsh desert environment (Layachi, 2016), which significantly influences their design style (Sebti, Alkama, & Bouchair, 2013). Despite these challenges, the local inhabitants have been able to creatively utilize natural resources, helping to design buildings suitable for the dry climate.

Desert ksour reflect ancient cultural traditions and a spirit of cooperation among the inhabitants, characterized by the secure placement of structures and innovative water management techniques such as valleys and irrigation channels, which enhance community cohesion and its ability to adapt to climatic challenges (Capot-Rey, 1957). Despite the challenges these ksour face due to haphazard interventions that have contributed to the deterioration of their original structures (Belkassem, 2018), they still stand as a model of human resilience in adapting to their environment.

Many of these structures are witnessing erosion due to environmental factors such as sandstorms, climate fluctuations, pollution, and a lack of awareness about the importance of preserving this unique architectural heritage. Therefore, there is an urgent need to update scientific studies using modern technology, aiming to improve restoration methods and preserve these cultural landmarks.

The Ksar of Negrine is a notable example of traditional desert architecture in Algeria, reflecting the social, economic, and cultural integration of the local community. It was built using local materials and adopts a design that suits the desert environment. It includes residences, a mosque, and a market, and strengthens the cohesion among residents thanks to its strategic location in the middle of palm oases. Despite its deterioration due to migration and lack of maintenance, there is a great opportunity for restoration and transforming it into a cultural tourism center, contributing to the preservation of its architectural identity and promoting sustainable tourism.

From this perspective, the importance of this research lies in providing practical solutions to the challenges of preserving desert architectural heritage in Algeria. Algerian desert ksour, such as the Ksar of Negrine, are part of the cultural identity of the people in the region. Their study is not only about preserving architectural heritage but also about developing sustainable methods that integrate modern technologies with traditional techniques, which helps preserve these landmarks for future generations.

MATERIALS AND METHODS.

• Literature Review

A review of the literature related to Algerian desert ksour was conducted to understand the challenges of their deterioration and potential solutions for their protection. These studies included: Sebti et al. (2013), which addressed the impacts of modern transformations on traditional ksour in the Souf Valley region; Naima (2014), which emphasized the need to integrate environmental and social strategies in the preservation of ksour; Souikat (2020), who discussed the climatic effects on the architectural design of the ksour of Ouargla; Al-Ani (2017), who examined the relationship between language and architecture in desert ksour; and Malki (2022), who conducted a study on the structure and traditional building materials of the Taghit ksar in southern Algeria. Finally, grib (2022) reviewed the architectural and social composition of Ksar Negrine in a field study.

• Morphological Analysis

Morphological analysis was applied to examine the spatial division, architectural structure, and the relationships between urban units within Ksar Negrine. The evolution of the urban fabric of the ksar over time was analyzed, with a focus on cultural and social patterns that reflect the region's identity. The impact of the desert environment on the sustainability of the ksar was also studied.

• Field Investigation

A comprehensive field study was conducted at Ksar Negrine using photography to document its current state and analyze the erosion of architectural structures. Interviews were also conducted with local experts, including architects, local authorities, and residents, to gain insights into the causes of the ksar's deterioration and the social and environmental factors contributing to this. The interviews resulted in suggestions for developing effective restoration strategies and ensuring sustainability in preserving the architectural heritage, with a focus on transforming the ksar into a cultural and tourist hub.

This methodology combines engineering, social, and environmental analysis to ensure the preservation of the architectural heritage of Ksar Negrine and enhance its sustainability.

RESULTS.

1. Description of study area.

Ksar Negrine, a traditional desert settlement dating back five centuries, is located 2 km southeast of modern Negrine. Covering 2.5 hectares, it includes 150 dwellings, a mosque, shops, and religious areas. Built with local materials like mud and palm fronds, its architecture reflects a harmonious integration with the environment, showcasing Arab-Islamic design principles.

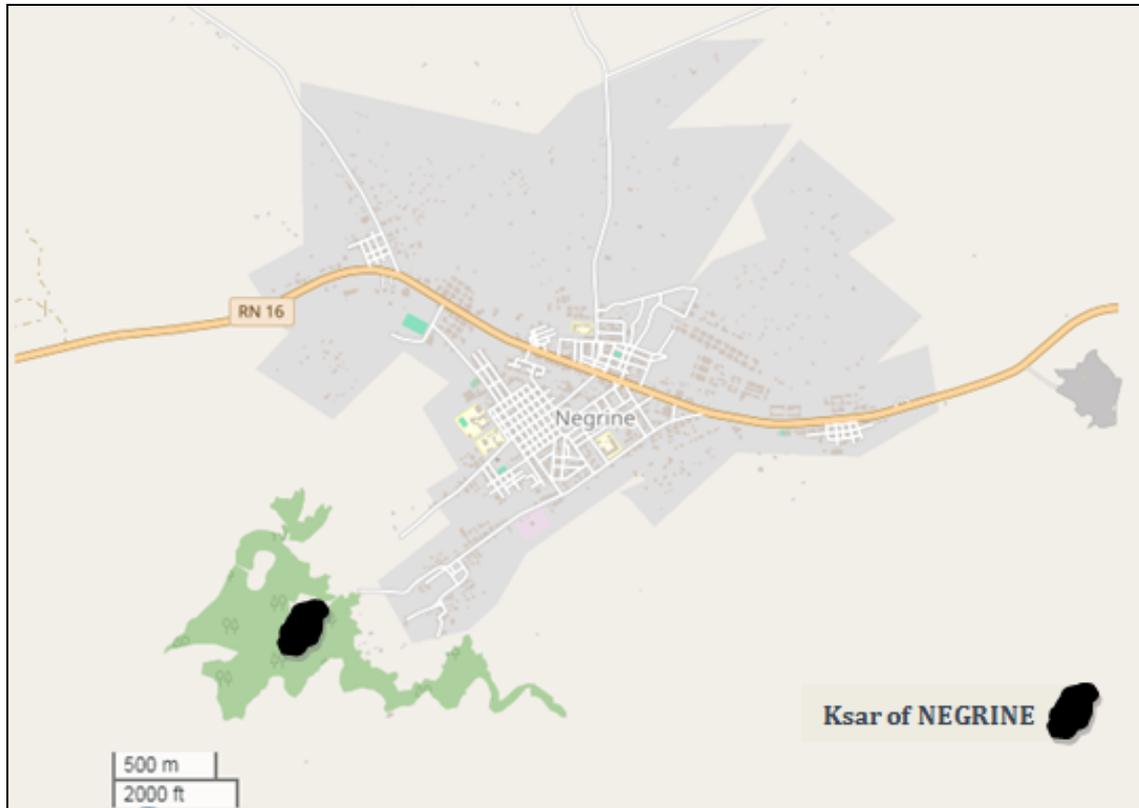


Fig. 1. Location of Ksar Negrine in relation to the city
(<https://www.openstreetmap.org/#map=14/34.48732/7.51697>+ Processed by the Researchers, 2024).

2. Qualifications of Ksar Negrine

Through the analysis of geographical, economic, social, and religious factors, several qualifications can be inferred that distinguish Ksar Negrine, making it a successful model for sustainable traditional cities in a desert environment. These qualifications include:

- **Geographical Qualifications:**

- **Strategic Location:** The ksar is located at the center of five palm oases and orchards, providing a moderate climate that ensures comfort for the inhabitants, in addition to its proximity to groundwater sources, which enhances agricultural sustainability.
- **Access to Water:** The ksar is situated near a permanent water stream, ensuring a reliable water supply for the inhabitants in the desert environment.

- **Economic Qualifications:**

- **Sustainable Agriculture:** The ksar benefits from abundant water for irrigation, promoting multi-layer farming and animal husbandry as the main activities of the population.
- **Resource Management:** Fair distribution of water and resources among the tribes enhances economic justice and makes the ksar a central point for local trade.

- **Social Qualifications:**

- **Social Cohesion:** An organized tribal structure, where each tribe has its own designated area, promotes cooperation among the inhabitants and ensures social stability.
- **Social Interconnection:** The distribution of resources between the tribes contributes to the stability of social relationships and strengthens cooperation among individuals.

- **Religious Qualifications:**

- **Religious Institutions:** The mosque within the ksar serves as an important religious center, strengthening religious and cultural bonds, and forms a fundamental part of the community's identity.

- **Environmental Qualifications and Sustainability:**

- **Use of Local Building Materials:** The ksar was constructed using local clay and stone, enhancing environmental sustainability and maintaining moderate temperatures inside the buildings.
- **Environmental Organization:** The design of the ksar is harmonious with the surrounding environment, promoting the sustainability of natural resources through water distribution and focus on perennial agriculture.

- **Security Qualifications:**

- **Spatial Structure:** The division of the ksar into separate quarters for each tribe, with special gates, enhances security and ensures order during times of danger or attacks.

Based on these factors, Ksar Negrine is considered a model for sustainable traditional cities in the desert environment. It integrates its distinctive geographical location, sustainable economic activities, cohesive social organization, and environmentally adaptive architectural design to ensure its sustainability and prosperity over the ages.

3. Morphological Analysis of Ksar Negrine

Ksar Negrine is a traditional urban model in the Algerian desert, reflecting an architectural, social, and religious integration. The ksar was analyzed based on several key elements that influence its design, spatial distribution, and social interactions:

- **Spatial Segmentation:**

- The ksar is divided into public spaces (the square, mosque, market) where the community performs social and religious activities, and private spaces (the dwellings), which are separated by narrow, winding alleys. This organization promotes social interaction while maintaining privacy.
- The four main streets that intersect at the center of the ksar facilitate movement between different areas and reflect a balance between privacy and collective activities.

- **Geometric Structure:**

- The ksar features an irregular structure adapted to the desert environment. The buildings are oriented to reduce the effects of heat and cold, using materials like clay and lime to ensure a moderate internal climate.
- The streets and alleys are designed to facilitate the movement of people while preserving privacy and maintaining a steady flow of movement.

- **Relations Between Urban Units:**

- The mosque serves as the spiritual and social center of the ksar, while the market functions as its economic hub. The street connects these units and facilitates social and commercial interaction.
- The relationship between public units (mosque and market) and residential units is characterized by a balance between privacy and social interaction.

- **Historical Evolution:**

- The ksar has evolved over time in response to social and religious needs, starting with the mosque as a religious center, around which the urban fabric gradually expanded.
- Social and economic transformations have influenced the shape of the market and the organization of residential neighborhoods, reflecting a gradual evolution of the urban fabric.

- **Local and Cultural Patterns:**
 - The ksar reflects the cultural and religious identity of the inhabitants through the use of local materials such as clay and lime, which align with the desert environment.
 - The organization of the dwelling enhances privacy while encouraging social activities in the squares and mosques, reflecting the city's cultural values.
 - **Social Functions:**
 - The ksar includes residential, commercial (such as markets and traditional shops), and religious functions (the mosque). These functions are integrated in a way that reflects a balance between daily life and social activities.
 - Trade in the market is an essential part of the economic activity, while the mosque is not limited to worship but also serves as a center for social interaction.
 - **Human-Place Interaction:**
 - The dwellings are designed to provide privacy and comfort through narrow alleys and architectural designs that offer a balanced environment for daily activities.
 - The streets facilitate social interaction without infringing on individual privacy, reflecting a controlled interaction between the inhabitants and their environment.
 - **Sustainability and Resilience:**
 - Ksar Negrine demonstrates resilience in adapting to environmental challenges by using local building materials that maintain moderate internal temperatures, which enhances sustainability.
 - The design allows for adaptation to social and technological changes without significantly impacting the privacy or functions of the buildings.
 - **Temporal Analysis:**
 - The temporal development of Ksar Negrine reflects the economic and social changes that the region has undergone. Transformations in building style and urban planning show a flexible response to evolving needs across the ages.
- Ksar Negrine is considered a unique architectural and cultural model that embodies the interaction between humans and their geographical and social environment, integrating historical and cultural aspects with environmental and social needs.

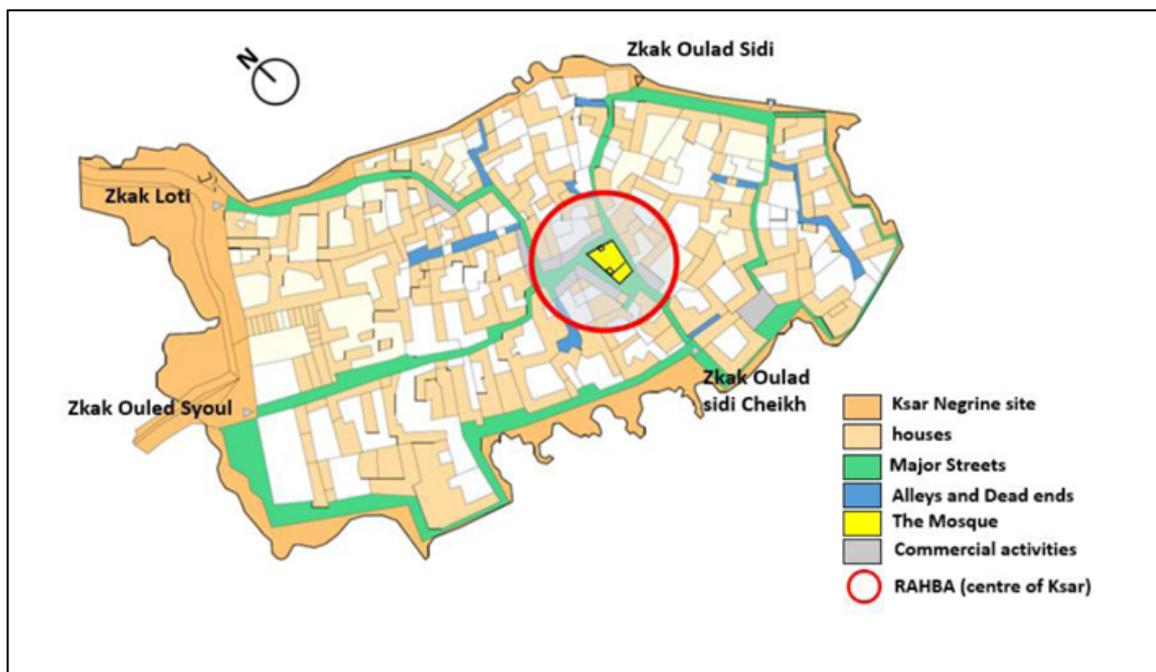


Fig. 2. Spatial Composition of Ksar Negrine (Municipality of Negrine, 2011).

4. Architectural and Technical Diagnosis of Ksar Negrine

The architectural and technical diagnosis of Ksar Negrine aims to understand the current condition of the buildings, identify the causes of their deterioration, and propose solutions for their restoration. This diagnosis covers several aspects related to structural, environmental, social, and economic factors.

- **Examination of Building Condition**

Field work confirmed that Ksar Negrine suffers from cracks and fractures in its walls, as well as partial collapses in some buildings. These issues result from several factors, including:

- **Ground subsidence** due to the erosion of foundations caused by groundwater.
- **Erosion** caused by sandstorms.
- **Climatic effects**, where excessive humidity and heavy rainfall have weakened the clay materials and reduced the durability of mud bricks.



Fig. 3. Condition of Some Buildings in the Ksar of Negrine (Researchers, 2024).

- **Morphological Analysis**

The morphological structure of Ksar Negrine is characterized by organic expansion, relying on narrow and winding alleys, which complicates maintenance and restoration. The traditional architectural styles, such as clay roofs and walls made from local materials, contribute to the buildings' vulnerability to harsh environmental factors.

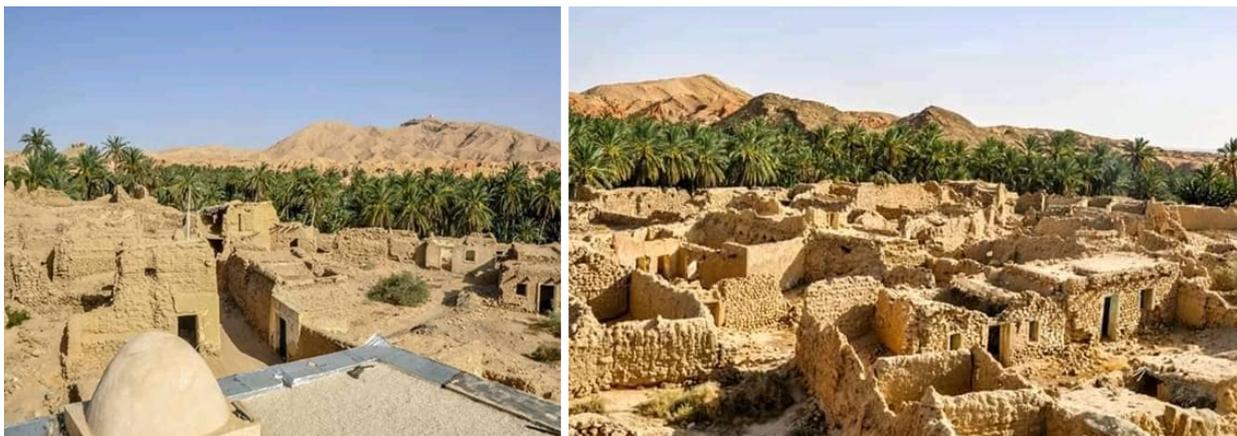


Fig. 4. Morphological features of Ksar Negrine (Researchers, 2024).

- **Use of Materials**

Traditional materials like clay and lime are not sufficiently resistant to extreme climatic changes, especially humidity and heavy rainfall. The wood used in internal finishes is also weak, which exacerbates the deterioration of the buildings.



Fig 5. Measuring Wall Moisture Levels Using a Hygrometer (Scientific Field Trip, 2023).

- **Environmental and Climatic Factors**

Ksar Negrine is exposed to harsh climatic conditions that affect its structure. Summer temperatures are high, and winter humidity, coupled with heavy rainfall, contributes to the decay of clay and wooden materials. Additionally, sandstorms contribute to air quality degradation, as evidenced by a high air quality index of 134 recorded on November 8, 2024, which accelerates surface erosion and damages walls and structures. Furthermore, the sandy soil and high groundwater levels weaken the clay foundations.



Fig. 6. Measuring the Air Quality Index (Plume Labs Android App, 2023).

- **Social and Economic Analysis**

Ksar Negrine has seen a significant decline in population due to ongoing migration in search of better economic opportunities, leading to the cessation of social and religious activities. This is evidenced by the departure of the mosque imam in 1994, marking a symbolic end to the mosque's social and religious role. As the population migrated, maintenance efforts were neglected, leading to the accumulation of cracks, foundation deterioration, and damage to facades.

- **Structural and Technical Factors**

Traditional construction in Ksar Negrine relied on local materials like clay and wood, which were suitable for the local environment in the past but are no longer capable of withstanding current climatic challenges. Therefore, the ksar requires restoration using modern conservation techniques compatible with traditional materials, while preserving its original architectural identity.

- **Historical and Cultural Factors**

Ksar Negrine holds significant cultural and religious value, but it suffers from a lack of coordination between local authorities and the community in efforts to preserve it. Unlawful activities, such as random encroachments, have distorted the ksar's structure and resulted in the loss of many of its original elements.

- **Temporal Analysis**

Since the 1980s and 1990s, Ksar Negrine has suffered from gradual deterioration due to migration and the decline of social and economic activities. Land use changes have also led to neglecting the ksar, turning it into an abandoned historical site. This has had negative effects on its architectural structure, especially with the increasing urban growth in surrounding areas.

DISCUSSION.

The study's findings indicate that Ksar Negrine has experienced noticeable deterioration due to a combination of environmental, social, and economic factors. Mass migration, which began after independence and peaked in 1994, contributed to the abandonment of the ksar by its residents and the loss of its role as a social and religious center. This led to a decline in maintenance efforts and the use of materials from the ksar in modern buildings, further damaging its architectural structure. Furthermore, the initial lack of awareness regarding the importance of preserving this heritage contributed to its deterioration, though over time, there has been a growing recognition of the ksar's value as part of the local cultural identity.

Despite this shift in awareness, preserving the ksar requires effective actions, primarily formal designation as a heritage site to secure financial support from relevant authorities. Such a designation can enhance funding and provide opportunities for collaboration with specialists in restoration. Restoring the ksar is not just a historical duty, but an opportunity to achieve sustainable development by integrating heritage preservation with cultural tourism. Opening the ksar to visitors can raise heritage awareness and boost the local economy, but this requires joint cooperation between the local community, authorities, and cultural associations to ensure its preservation for future generations.

CONCLUSIONS.

In conclusion, Ksar Negrine is an important heritage landmark that reflects the region's history, and it must be preserved through joint efforts between the local community, authorities, and cultural associations. Official designation of the ksar as a heritage site can contribute to securing the necessary funding for restoration using modern techniques that respect its traditional character. Additionally, its integration into cultural tourism programs can increase awareness of heritage and contribute to the region's sustainable development. Restoring Ksar Negrine is not only about protecting our history but also an opportunity to develop the local economy and strengthen the region's identity.

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