Understanding the vernacular heritage to design sustainable habitats in Asni, Morocco

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ABSTRACT: The paper describes the results of the research and the three design workshops developed with the participation of students, teachers and researchers from University of Florence, in Asni, a rural municipality located forty kilometres from Marrakesh at the foot of the Atlas Mountains. The research activities aimed to deepen the relationship between heritage, architectural design and innovation, considering local building culture as key input to develop a new eco-compatible living system. The project of a new sustainable social housing starts from the comprehension of the traditional knowledge system to define new appropriate solutions, from the urban scale to architectural and constructive design, involving the participation of local people in the project through the mediation of local associations. The final objective is to identify sustainable strategies, forms and constructive solutions to meet the needs of the new inhabitants, preserving at the same time the building culture and the cultural landscape.

1 CONTEXT AND BACKGROUND

The rural municipality of Asni, which is located forty kilometres from Marrakesh at the foot of the Atlas Mountains, is organised into 53 small villages (*douar*), traditionally built in earthen and stone masonry.

As well as many rural municipalities of Morocco, Asni is in an accelerated process of transformation of its landscape, mostly caused by a gradual abandonment of the traditional urban and territorial organisation. The outcome is a disordered settlement having no specific relation with the context and its resources, which often results in constructions which present poor environmental, aesthetic and functional performances.

From 2005, the Department of Architecture of the University of Florence has worked in Morocco, carrying out cooperation projects and workshops involving students, teachers and professionals, both Moroccan and Italian (Lotti 2012, Mecca et al. 2009, Mecca et al. 2016). In the framework of the AMA/E Seminar (Architecture, Materials, Environment) we have developed activities, both theoretical and practical, through workshops in situ, to facilitate a better understanding of the local culture and traditional construction systems, while providing interaction with the communities.

The research and the workshops undertaken at Asni originated in collaboration with the Tiwizi and Matter of Act associations: the first works in the area of socio-economic development and for the conservation and valorisation of the landscape and of the cultural heritage; the Moroccan-Swiss

association Matter of Act, on the other hand, carries out campaigns and activities aimed at generating awareness and providing training and education regarding environmental issues.

Between 2015 and 2016 three residential workshops took place at Asni, in which approximately fifty students and ten professors and researchers participated, belonging to various disciplines: from technology of materials and building systems, to architectural composition, urban and landscape planning and design, hydraulics and social design (Eccheli & Giorgi 2016). The final objective of the research was that of identifying and experimenting with new architectural concepts able to foster and maintain an equal and sustainable development, capable both of ascribing value to the intangible heritage of humanity, and of building innovative economies and urban structures with an emphasis on low costs and low environmental impact.

2 RESEARCH AND DESIGN METHODOLOGY

Understanding the specificities of the places, as well as the environmental, social and cultural qualities that characterise them, was the first and essential step for identifying hypotheses for intervention on the territory, capable of preserving its identity with an emphasis on environmental, social, cultural and economic sustainability.

The approach to the project originates in assuming traditional knowledge, and through it, the local know-how related to the environment and to

architecture, as an element from where to begin the process of the project: to consider the signs – often worn down by time –, as well as the traces and the transformations of the territory, does not mean fixing them and ascribing to them an excessive dignity, but to use them as elements for defining the framework of the project from the point of view of a new cycle of development which may reflect the identity of the inhabitants and the *genius loci*.

The methodology adopted on field is that of co-design, or participative design, through the active involvement of all the actors which participate in the project (end-users, stakeholders, team, client). In a context in which identity references, when facing modernity and globality, are slowly crumbling, this approach permits building a process of appropriation of the project by the communities involved, thus guaranteeing its sustainability and, when possible, its replicability (Rizzo 2009).

The relationship with the local community was structured in several phases. During the initial phase an assessment was carried out, together with the associations, of the aims to be pursued and of the factors capable of favouring or limiting the path to be followed, especially from the environmental and socio-economic points of view. A mapping was also undertaken of projects and activities that are similar to, or connected in some way, to the identified topic.

Thereafter, the ideas generated were discussed with representatives of the institutions involved and with other stakeholders, among which the purchasers of the land that was the object of the second workshop. Further research was carried out, aimed at identifying external stakeholders interested in participating in the project. The proposals presented in the workshops and during the months of further in-depth analysis of the project, carried out in Florence, led to an Exhibition at Asni, in the framework of the Marrakech Biennale, and to the publication of a volume aimed to favour a larger involvement of the local community in the projects.

3 HABITAT, ARCHITECTURE AND BUILDING CULTURE

3.1 *Environmental and socioeconomic context*

Asni is situated in the region of Marrakesh-Tensif-El Haouz, inside the Toubkal National Park, between the plain of El Haouz and the mountains of the High Atlas, and includes altitudes that range from 1070 to 3700 metres above sea-level. The lush valley of Asni (Fig. 1), which follows a riverbed, alternates forests and agricultural fields, and is connected by a main road which links 18 villages located at high altitude, of which Asni is the main town, in terms of infrastructure – it has

Figure 1. Traditional settlement and modern expansions in the Asni valley. Credits: L. Dipasquale.

a large souk, health services and schools – and of geographical position.

The economy of the province is based mostly on agriculture and the mineral sector, and to a lesser degree on crafts and tourism. Although Asni is situated in a particularly rich and diversified geographical context, not lacking in resources, in terms of economic and social development the area presents high levels of poverty, and the living conditions for much of the population are harsh.

The region is populated by four Amazigh tribes that embraced Islam during the Arabic surges of the 8th and 11th centuries. The population of the prefecture of Asni (approximately 20,000 people) is experiencing growth, with a 38,67% of the population under 14 years of age, and a very high illiteracy rate that is close to 67%.

The climate of the region is semi-arid, with strong seasonal variations (temperatures between 4 and 47°C) and a relatively low rate of rainfall, situated approximately between 350 and 400 mm per year.

Rain, which is rare but intense, produces evident signs of hydric erosion both on the slopes, and especially in the riverbeds, which drain superficial effluence. Alluvial soil deposits on roads, the presence of temporary solutions for the disposal of excess water near raw earth dwellings and the thriving cultivation of annual and perennial species in the small fields, indicate the presence of a yet unsolved relationship with water, which is thus both a resource and a problem. The mountain slopes are divided up between families and tribes of the villages for pasture and cultivation. The fields are traditionally irrigated by diverting water from streams into canals.

As the situation is today, most of the water used for productive activities in Asni comes from wells dug in the stream bed of the river that crosses the valley, and which descends from the mountains of the High Atlas. With the use of small pumps, these wells feed modest reservoirs placed at a sufficient height, which serve the domestic water usage of the population. Some particularly eroded riverbeds reach small underground aquifers, which are then

partially exploited with rudimentary water intake devices.

3.2 *Habitats morphology*

The *douar*, which is how Berber settlements in the High Atlas are called, house between a dozen and a few hundreds of inhabitants, of Berber origin, traditionally organised as self-governed communities in accordance to the rules and regulations established by the Jemma, or community assembly, which decides upon social and economic questions, and in particularly rules regarding the distribution of property and crop rotation. These small settlements were traditional conceived as autonomous units, which originated from family ties. The *douar* has few basic services: a mosque, a Coranic school (*timzguida*), a threshing floor (*anerar*), occasionally a collective granary (*ighrem*), one or several shops for primary needs, and often a school (Terrasse 2010)

The *douar*'s urban fabric is traditionally compact, and adapts to the morphology of the land, distributing itself over terraced platforms that follow the contour lines of the terrain. The basic unit that forms the urban fabric is the courtyard house, usually of an approximately rectangular shape with a series of spaces distributed around the central patio. The courtyard houses in the valley of Asni were originally distributed only on one storey, yet new storeys have been added in order to house new members of the family (Fig. 2). The rooms, which traditionally house a family nucleus, are organised around the courtyard, often surrounded by a wooden portico. The central open space is envisaged for the carrying out of collective domestic activities, such as the preparation of food and the transformation of agricultural products. In the plains the courtyard tends to be larger, whereas on the slopes it is usually smaller, due to the need to adapt to the terrain.

3.3 *Traditional building systems*

In the small villages scattered throughout the valley of Asni, the earth became architecture: small houses and fortifications are born from the mountain, are sculpted from its stone and its clay. The

Figure 2. Courtyard house. Credits: L. Dipasquale.

thick walls of the traditional constructions of Asni and the villages that surround it are made from rammed earth, adobe and stone (Fig. 3). The rammed earth walls are built on a stone base of changing dimensions according to the overall size of the building. This provides insulation from the ground and protection from the humidity produced by capillary action and rain. The base consists on two external wall facing and an interior filling nucleus which is composed of smaller elements and minute material. The elements in barely hewn stone, are organised in irregular rows and set with a mortar made of earth and gravel. Stone is also used for the parts of the buildings that required a more resistant behaviour: corners, lintels, buttresses, some times the entire first floor.

The rammed earth walls are usually between 60 and 80 cm wide. The walls are set with a humid mix of earth, gravel and small stones between a wooden frame that is fixed to the walls with further wooden elements. The earth that is placed in the framework is first ground, then rammed with the use of a heavy wooden maul with the purpose of compacting the clay and liberating it from some of the humidity before the process of desiccation sets in. Interior partition walls and raised sections are usually made of raw bricks placed on the wall using a header bond.

All wall types include reinforcement systems obtained with wooden devices placed inside the walls during the construction phase. These are circular or irregular beams with a maximum diameter of 10 cm, placed along the bearing wall. In some cases the beams can be seen alongside the walls, in others the wooden elements are in pairs, placed one on the inside and one on the outside of the wall and connected between them with additional transversal wooden elements. The resulting spaces between the beams are filled in with mortar or pieces of bricks. These circular reinforcement systems, although rudimentary, in the presence of pressure pushing outward work as an independent

Figure 3. External façade of a building in Asni with walls of stone, rammed earth and adobe. Credits: L. Dipasquale.

chain or hooping device, which contributes to the uniform distribution of loads on the various walls, and thanks to the elastic and tension absorbing features of the wooden sections, increase the lateral stability and the resistance in the joints between the walls (Dipasquale et al. 2016).

Floors and coverings are often made with trunks of local trees: juniper, pine, walnut and poplar. The wooden structure is traditionally covered by a layer of reed matting, which serves the purpose of distributing the load of the earthen screed, about 15 cm thick, and made of a first layer of dry earth and a second layer of humid earth; both traditionally rammed with a special punner. The covering is covered with two additional layers: one of twigs, placed orthogonally to the external wall, and a final one of earth, gravel and lime. The covering protrudes approximately 20–30 cm from the external wall in order to protect the earthen plaster of the wall from the effects of the rain.

Wooden logs are also used for the lintels of the openings and for the columns of the portico.

3.4 *Alteration of the traditional system and current trend*

The typological models and construction methods used in traditional architecture have been deeply altered over the past few decades: the comparison with Western models has derived in hybrid technological and typological solutions without any technical and regulatory control, and which depart from the building wisdom which had generated habitats with undeniable landscape and cultural qualities. In the Valley of Asni, traditional architecture has lost ground to the overbearing presence of more modern construction materials, such as cement and prefabricated construction blocks, which are used without a proper knowledge of their limits and possibilities of application. It is thus common to observe, spread out throughout the valley, buildings with impossible spans, daring additions, protruding reinforcing bars, cement blocks set with earthen mortar: a wide range of combinations, mostly questionable in terms of safety and insulation performance, and sometimes even dangerous from a structural point of view.

The lack of development plans has also caused serious problems from an environmental point of view, in particular regarding the management of water resources, including the almost total absence of a sewage disposal system and of an adequate management of grey waters, but also concerning garbage disposal, and other essential services (health, education, etc.).

Although the population often wishes to abandon the old earthen houses because they are associated with an impoverished and backward way of life, it is evident that the choice of living in small,

badly constructed buildings in reinforced concrete, that are not properly suited for local climate conditions, is mostly the result of a lack of alternatives and of the absence of a modern architectural culture. The blind introduction of extraneous technologies and ways of living, in the name of a progress which has often brought nothing more than new forms of poverty, risks endangering the fragile environmental balance.

4 DESIGNING NEW SUSTAINABLE HABITATS

4.1 *Sustainable principles leading the design of new habitats*

To design new buildings with traditional materials, techniques and styles, yet innovative in terms of application and of performance, and based upon current needs and requirements, means giving life to habitats that are more sustainable from the environmental, social, cultural and economic points of view (Correia et al. 2014).

In continuity with the local traditional housing models, the typological choice is that of the courtyard house. The courtyard is traditionally the space for sharing, socialisation and household labour. The structure of the courtyard house, articulated with intermediate spaces of transition such as loggias and galleries, complies with functional needs, responding to the growing necessity for indoor/outdoor transitional living activities, and with making the house flexible, transformable, and possibly expandable (Aguilar et al. 2014).

A dwelling courtyard outlay leads to more efficient housing design, lowering the cost of cooling since its morphology ensures the natural ventilation of living spaces thanks to the air convection property. The presence of shaded places causes beneficial air movement due to the fact that the heated air in the sunny areas, which is less dense, creates a vacuum that draws cooler air into the dark zones. Lodges and galleries provide valuable shade during the day, while the terraces are inhabited in the evening, when the temperature drops below that of the inside (Dipasquale et al. 2014).

The volumes of different courtyard houses can be wedged and the perimetral walls can be shared between bordered buildings, so that the thermal energy loss by external surfaces is reduced, determining benefits also in the winter season.

An interior private space outdoors finally encourages autonomy and self-sufficiency by the possibility of integration of production areas such as gardens, domestic livestock, and spaces for any type of manual activities that need open space.

This efficient system can be enriched with other passive energy features that we can find in vernacular

buildings, such as choosing rather small and few windows, high ceilings, as well as local and environmentally friendly materials, such as earth and stone.

From an environmental point of view, energy consumption in terms of the life-cycle of a building can be considerably reduced if construction materials come from the immediate surroundings. The capacity for thermal inertia of materials such as earth and stone favour the maintenance of indoor temperatures. Likewise, the good thermohygrometric properties of raw earth, in particular its capacity to balance the humidity of interior spaces, and the capacity of earthen plasters to serve as a filter for some noxious agents, including electro-magnetic waves, contribute to enhance the comfort of the interior spaces of the buildings.

From a socio-economic point of view, building with local materials has a strategic value since it favours the integration of local resources, understood both as know-how and procedure competences, and as crafts directly or indirectly linked to the construction. The result is a re-appreciation of manual labour, which thus becomes an opportunity for development with positive effects on the local communities.

4.2 Design proposals for new habitats

Well aware of the positive effects of the re-discovery of a local building culture, we approached the new context of Asni with the purpose of putting into action our various competences and committed to obtain design results with a level of innovation and interest such as to generate both short-term and medium-term impacts on the local community.

The need to re-give identity to the place and to find characteristic features in the architecture appeared as an important issue since the first meetings with the members of the associations, as well as the need to study the possible interventions in terms of environmental protection (from the erosion of the ground

and water conservation, to the disposal of rubbish) that can be easily put in practice and replicated.

The site where the first workshop took place, in April 2015, is a plot of land destined to social housing where, at the moment of our intervention, the basic urbanization and division into lots had already been carried out. Not being able to modify the layout of the development since it was partially built, the project focused on the re-configuration of the single blocks of buildings and on the development of typological models which are centred on the courtyard house as theoretical model, and local materials for the development of evolved building systems to be adapted to the requirements derived from the master plan and from consultations with the local communities (Fig. 4).

On this occasion, a work group focused the activities related to the project on the sustainable management of water resources for containing erosion, the stabilisation of slopes and water collection. To this purpose a series of terraces were built with the help of weirs which permit slowing down the flow of water for controlling superficial effluence and protecting from hydric erosion, and canalisation and water storage for taking advantage of excess water during floods, as well as Rain-water harvesting techniques for collecting water at the housing level.

The second workshop took place in October, 2015, in an area approximately 2 km away from the centre of Asni. The land was purchased by an association of owners as an investment, with the intention of building houses, a hotel, sports facilities and a school. Students came up with three master plans which adapt to the morphology of the terrain through terracing systems and valorise the surrounding landscape. The housing model was devised within large green and farmable areas, thus re-proposing the integration of productive and residential activities. The project envisaged a variety of building typologies, differentiated in terms of users belonging to different socio-economic contexts, however always using local materials.

Figure 4. Construction details of a courtyard house, designed after the 1st workshop in Asni. Credits: F. Del Gatto, O. Lotti.

Figure 5. Workday on earth and lime construction techniques Credits: D. Giorgi.

The third workshop took place in September of 2016, and was focused on the rehabilitation of the habitat of the *douar* of Asni, on energy re-qualification and on the reorganisation of green areas surrounding the headquarters of the Tiwizi association. A topic of special interest requested by the local authorities was research into recovery techniques for existing dwellings. Particular attention was given to mending the urban fabric and to spatial organisation based upon hydric abduction and recovery and disposal of excess water. The recovery of some traditional dwellings is part of a project for a scattered hotel managed by the Tiwizi association.

The workshop offered the opportunity for organising a workday, open to the entire population, on earth and lime construction techniques, with the participation of the Department of Geology of the Cadi Ayyad University of Marrakech. The impact was positive for the local associations and inhabitants, since the interest of both local and foreign experts and universities, contributes to overcoming the negative perception the locals have of these materials and helps generate understanding of their worth and promote their use.

5 CONCLUSIONS

In Morocco, the diffusion of industrial construction materials has brought about a progressive abandonment of traditional techniques, considered as obsolete, and often unjustly seen as a symbol of social and cultural exclusion. The inevitable consequence of this phenomenon is a gradual loss of the know-how regarding building techniques, which today are entrusted to the memory of only a handful of elderly builders; at the same time, the absence of necessary maintenance interventions has resulted in the fact that a large number of buildings are in a situation of irreversible decay. All of this results in the progressive loss of a rich heritage of technical, environmental and socio-cultural knowledge.

The workshops we are carrying out in Asni are a part of a wider project which spans from architecture to landscape conservation and would include programmes for the environmental education for the local populations and support for local associations in terms of communication and in setting up a hospitality system on the model of the scattered hotel.

One of the main results obtained to this day is the fact that, beginning with the Tiwizi association, raw earth is no longer perceived as a poor and unsafe material, but rather as a founding element of the local cultural heritage.

Our ambitious project experience aims at understanding the logic and reasoning of an ancient building tradition and to participate in this process in continuity with it, while designing at the same time a

path for project experimentation and innovation that is both expressive and constructive, with the purpose of bettering the quality of new buildings in terms of architecture, welfare, safety and sustainability.

NOTE

In addition to the authors, the workshops were lead by: Oussama Moukmir, engineer, local expert in raw earth and sustainable materials, Maria Grazia Eccheli, Flaviano Lorusso and Adelina Picone, teachers of architectural composition, Graziano Ghinassi, teacher of On Farm Irrigation, Francesco Tioli, expert in 3D survey, Corinne Cauvin Verner, anthropologist, and the tutors: Eleonora Cecconi, Alessandro Cossu, Caterina Lisini, Iole Francario.

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