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CUBÂTI

CULTURE DU BÂTI
DE QUALITÉ :
RECHERCHE,
INNOVATION
ET ENTERPRISE
POUR LA DURABILITÉ

Technology transfer achievements
in the CUBÂTI project

edited by
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CUBÂTI

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The Italy-Tunisia Cross-Border Cooperation (CBC) Programme 2014-2020, adopted by the European Commission, aims to contribute to the overall ENI objective of progressing towards "an area of shared prosperity and good neighbourliness between EU Member States and their neighbours". The objective of the programme is therefore to promote fair, equitable and sustainable economic, social and territorial development in order to foster cross-border integration and enhance the territories and resources of the two participating countries.

Project No. C-5-2.1-16

CUBÂTI Culture du bâti de qualité : Recherche, Innovation et Enterprise pour la Durabilité

Programme Priority 2.1 - Promotion and Support of Research and Innovation in Key Sectors

Programme Thematic Objective OT2 - Support for education, research, technological development and innovation

Programme Outcome R2.1.b - Strengthening links between the business community and researchers working on innovation in key sectors

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Le Programme de Coopération Transfrontière (CT) Italie-Tunisie 2014-2020, adopté par la Commission Européenne, vise à contribuer à l'objectif global IEV de progrès vers « une zone de prospérité partagée et de bon voisinage entre les États membres de l'UE et leurs voisins ». Le but du Programme IEV de Coopération Transfrontalière Italie-Tunisie 2014-2020 est donc d'encourager un développement économique, social et territorial juste, équitable et durable, en vue de favoriser l'intégration transfrontalière et de valoriser les territoires et les atouts des deux Pays participants.

Projet N. C-5-2.1-16

CUBÂTI Culture du bâti de qualité : Recherche, Innovation et Enterprise pour la Durabilité

Objectif thématique du programme OT2 - Soutien à l'éducation, la recherche, le développement technologique et l'innovation

Priorité du Programme 2.1 - Promotion et appui à la recherche et à l'innovation dans les secteurs clés

Résultat du Programme R2.1.b - Liens renforcés entre le milieu des affaires et les chercheurs travaillant sur l'innovation dans les secteurs clés

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THE CUBÂTI PROJECT: CULTURE OF CONSTRUCTION AND COMMON

Maria Luisa GERMANÀ (Scientific Coordinator)

Culture du bâti de qualité: Recherche, Innovation et Entreprise pour la Durabilité is a strategic research and innovation project co-financed by the European Union within the framework of the ENI Cross-border Cooperation Programme Italy-Tunisia 2014-2020. Proposed in 2019 and concluded in 2013, for the first time in this Programme CUBÂTI turned the spotlight on the construction sector: an activity of considerable relevance for the cross-border economy, sustainability and quality of life for all.

The first lever on which CUBÂTI has acted is the concept of 'construction culture', from which the very title given to the Project derives. In 2018, the European Ministers of Culture signed the Davos Declaration, emphasising that building is always a cultural act and that high-quality building culture (baukultur) depends first and foremost on a holistic approach to the processes of production, maintenance and transformation of the built environment. In the light of this concept, CUBÂTI looked jointly at the architectural heritage and contemporary architecture, with the ambition of activating a virtuous circle between different productive activities (construction, agriculture and fish farming, cultural tourism) tending to strengthen the links between Sicilian and Tunisian researchers, professionals and entrepreneurs in the field of sustainable construction and sensitising the institutions towards an indispensable programmatic and strategic renewal, in the direction of the circular economy and holistic vision.

The second lever on which CUBÂTI acted is the added value of cross-border cooperation between Sicily and Tunisia, based on certain material and non-material elements of the common identity that are most closely related to construction activities.



> The eight criteria for a quality building culture (Davos System). From: <https://www.bak.admin.ch/bak/it/home/baukultur/qualitaet/davos-qualitaetssystem-baukultur.html>.



> Fields of application to which CUBÂTI refers. Graphic elaboration by the author, on image: <https://www.flickr.com/photos/marcocrupivisualartist/39367058165> (Creative Commons Licences).

In general, this common identity can be recognised both in the traditional and the contemporary, and it is not difficult to imagine that it will maintain its strength and recognisability in the future as well, against the backdrop of global scenarios. Sicily and Tunisia are located at the barycentre of an area that acts as a fault line between two macro-regions that are now more precariously balanced than ever: Europe and the MENA (Middle East and North Africa) area. A border that is the scene of fierce tensions, with two main critical flows: in the east-west direction, the huge economic interests driven by the Suez and Gibraltar routes, which connect the Indian and Atlantic oceans; in the south-north direction, the continuous waves of migration, driven by causes (climate change and conflicts) that cannot be easily resolved.

The Mediterranean, since the antiquity connective between civilisations, dominates the multifaceted set of criticisms and opportunities that characterises the common identity of Sicily and Tunisia. On the shores facing the Strait of Sicily, in the area where the two continents are close, parallel cultures and cultures have developed, nurtured by millennia of fruitful exchanges (flows of raw materials, products, people, knowledge). The concept of quality building culture that inspired CUBÀTI is linked to the common identity between Sicily and Tunisia insofar as the project activities aimed at exploiting the opportunities offered by the common identity (with reference to local building materials and the architectural heritage), taking into account the orientation towards environmental sustainability, which is an indispensable condition for a high-quality built environment, where people can live well and reduce their ecological footprint.



> The Mediterranean area against the backdrop of the global scenario. Elaboration by the author based on image from:
https://pxhere.com/it/photo/1262215?utm_content=shareClip&utm_medium=referral&utm_source=pxhere (Licence Common)



> The Mediterranean Sea. Composition from satellite photos (credits NASA).
https://pxhere.com/it/photo/1262215?utm_content=shareClip&utm_medium=referral&utm_source=pxhere
https://pxhere.com/it/photo/1262215?utm_content=shareClip&utm_medium=referral&utm_source=pxhere

TECHNOLOGY TRANSFER IN THE CUBÂTI EXPERIENCE

Maria Luisa GERMANÀ

Technology transfer refers to a process whereby knowledge gained in science finds application, but also further development, in the operational reality. In the field of sustainable construction, more than sixty years of research have produced a wealth of knowledge that, however, has only recently and still only partially found application. The obstacles that continue to hinder technology transfer in this field are of a technical, economic and cultural nature, and CUBÂTI, aware of the limitations of the opportunity, has tried to take multiple paths.

The three main groups of project activities listed below are three intertwined and interacting strands, in which all project parties collaborated:

Technology transfer: joint experimentation of building materials linked to the common identity; demonstration of models, technologies and small buildings in Tunisia using materials linked to tradition and the circular economy (agro-food waste).

Capitalisation and Mainstreaming: technical documents to facilitate the transfer of knowledge and technologies on sustainable building materials in Sicily and Tunisia; exchange of best practices at workshops, seminars, fairs and through publications; development of cooperation projects on the culture of quality construction.

Mobility and development of common knowledge: support for cross-border mobility for the development of human capital; creation of a web platform for content sharing; CUBÂTI award for entrepreneurs and professionals.

IDÉE BASIQUE DE CUBÂTI

IDEA DI BASE DI CUBÂTI

« CULTURE DE BÂTI » DE QUALITÉ BAUKULTUR DI ALTA QUALITÀ

La coopération entre le monde des affaires et la recherche, tirant parti de la vision globale et stratégique de la « culture de bâti » de qualité, contribuant à l'innovation par le biais de deux éléments forts de l'identité transfrontalière :

- les ressources renouvelables pour des matériaux constructifs durables
- le patrimoine architectural.



La coopération tra impresa, professionisti e ricerca, applicando la visione globale e strategica della baukultur di qualità, contribuisce all'innovazione attraverso due forti elementi di identità transfrontaliera:

- le risorse rinnovabili per i materiali da costruzione sostenibili
- il patrimonio architettonico.

MATÉRIAUX DURABLES LIÉS À L'IDENTITÉ LOCALE / PATRIMOINE ARCHITECTURAL MATERIALI SOSTENIBILI LEGATI ALL'IDENTITÀ LOCALE / PATRIMONIO ARCHITETTONICO

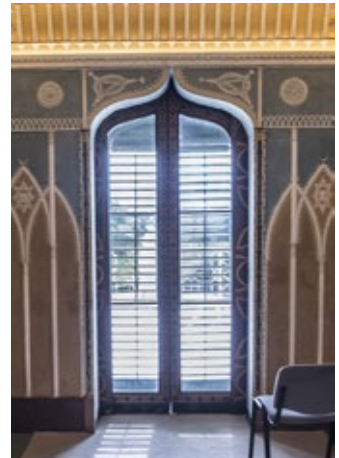


With the ambition to take into account culture, technology, production models and economic paradigms in a unified way, CUBATI has tried to contribute to the sustainable construction on the basis of two strong elements of the common identity between Sicily and Tunisia:

- the availability of local materials in the cross-border area, consistent with contemporary production realities: geo-materials with limited impact (gypsum and clay); bio-based materials (agro-food and fish farming waste); demolition waste (concerning the plague of unfinished buildings).
- a very rich architectural heritage (Sicily and Tunisia have respectively eight and nine sites on the UNESCO World Heritage List), which offers countless opportunities for ante litteram sustainability (in addition to the skilful use of local materials, such as passive heating and cooling solutions, i.e. not using energy systems).



> Left, diagram referring to technology transfer for the recycling of rubble in war crisis contexts. Right, diagram referring to the combination of agricultural residues and local materials for the production of building materials using different processes. From: Antonioli E., Ferrari M., Dalla crisi al futuro sostenibile. Processi di trasferimento tecnologico dall'Europa all'area MENA, in "TECHNE" no. 22/2021, pp. 55-62.



> Two elements of traditional architecture very common in Tunisia and Sicily that have now acquired the meaning of sustainability ante litteram: on the left the mashrabiya (Sidi Bou Said Tunis), on the right the persiana (Palazzina cinese, Palermo).

ADOBE (UNFIRED EARTH BRICKS) IN ANCIENT SICILY

Maria Luisa GERMANÀ

For millennia, raw earth building techniques have maintained a character of immediacy: the absence of firing allows the material to be prepared in situ, without operational or logical mediation, as is the case with animals that use clay soil to build their nests.

The basic material is earth, extracted just below the arable layer, mixed with different types of aggregates (bio-based, such as straw, sawdust or other vegetable fibres, or mineral, such as sand or bitumen) to increase the mechanical resistance and reduce shrinkage during drying.

In the case of bricks (adobe), which are used to build walls and vaults, the mixture is placed in moulds and set using moulding techniques after drying; in the case of compacted earth, the mixture takes on consistency as it dries after being laid (inside formwork, as in pisé walls, or inter-layered in grids as in torchis, or laid as a surface finish in cladding or flooring).

Thanks to research financed by the Ministry of Education, University and Research (MIUR) within the framework of Projects of Relevant National Interest and carried out from 2005 to 2007, we can now state that Sicily makes a substantial contribution to tracing the ancient roots of unbaked earth architecture in Italy, offering a privileged field of observation. In fact, in some Sicilian archaeological sites there are numerous artefacts dating from prehistoric to Hellenistic-Roman times that can be traced back to various building types: fortifications and burial grounds as well as residential, religious, productive and commercial buildings. In addition, the examples of archaeological earthen construction in Sicily provide numerous points of interest for the effects of conservation and protection measures that have been carried out in the past



> Above, swallows' nests

https://upload.wikimedia.org/wikipedia/commons/d/d0/Nidi_di_rondini_sottotetto.JPG (Licence Creative Commons).

Left, realisation of unfired brick

(from <https://www.romanoimpero.com/2020/03/il-mattone-crudo.html>). Right, unfired earthen plaster finish <https://www.guglielminocooperativa.it/intonaci-in-terracruda>.



> M. L. Germanà (2011), Earth in ancient Sicilian architecture _ La terra cruda nelle costruzioni della Sicilia antica, in S. Mecca, L. Briccoli Bati, M. C. Forlani, M. L. Germanà (eds.), Earth/Lands. Earthen Architecture in Southern Italy _ Terra/Terre. Architetture in terra dell'Italia del Sud, ETS Pisa, pp. 166-188].

sixty years. The adobe technique (unbaked bricks) is the one most represented in the Sicilian archaeological heritage that has come down to us: it spread around the Mediterranean from the 7th century B.C. onwards, both in sites of Punic and Greek influence.

In Gela, there is precious evidence of adobe constructions (a technique used especially when quarries from which to extract stone materials were far away), which have come down to us in exceptional dimensions, thanks to the sandy nature of the ground that covered them for centuries.

In Mothia, a site of Punic influence, there are traces of adobe walls dating from the 6th to 5th century B.C., in artisanal buildings and in fortifications.

The patrician houses of Heraclea Minoa, a Selinuntian colony on a hill near the coast of Agrigento, date from later times (2nd or 1st century BC). Most of the walls, both perimeter and exterior, are made of unfired earth (adobe and pisé) with some sections still plastered.

In Solunto, a Hellenistic-Roman site on the east coast of the province of Palermo, the earthen remains are limited to a few examples, which in many cases result from modifications of buildings originally built entirely of stone.

> Above Mozia (Trapani), frame wall with adobe parts in craft settlement (6th-5th century BC); photo by M. Schiera 2007. Centre, Heraclea Minoa (Agrigento). Residential building 2nd-1st century BC; photo M.L. Germanà 2014. Below, Solunto (Palermo), Peristyle house, block VII, 2007 (photo by M. Schiera) and 2013 (photo by F. D'Amaro).



> Gela (Caltanissetta). Above left, Archaic emporium at Bosco Littorio (6th c. BC). Bottom left and right, city walls at Capo Soprano 4th century BC. Photo by M. L. Germanà 2015.



ADOBE (UNFIRED EARTH BRICKS) IN MODERN SICILY

Maria Luisa GERMANÀ

Despite the fact that it is still used in many other places, and although it is increasingly appreciated for its environmental friendliness, in Italy raw earth is a building material that is foreign to the contemporary operating context. Impediments of a technical, regulatory and, above all, cultural nature prevent its spread.

In order to bring this material up to date, it would be useful to be able to trace its use back to the roots of the local building tradition, as is the case where it is present in vernacular and traditional architecture.

In Sicily, the archaeological constructions where unbaked earth has been found are not sufficient to support the hypothesis that this material is current because they are too remote. That is why the fortuitous discoveries of unbaked earth bricks in some buildings in the ancient part of Cefalù (Palermo) are of particular interest, even if they are of a very small scale: a superelevation and completion of walls in buildings in which the prevailing material is stone.

M. L. Germanà (2014), *Early modern period adobe in Sicily: recent finds*, in: C. Mileto, F. Vegas, L. Garcia Soriano, V. Cristini (cur.), *Earthen Architecture: Past, Present and Future* Proceedings of the International Conference on Vernacular Heritage. Sustainability and earthen Architecture, CRC Press Taylor & Francis Group, London, UK, pp. 163-168.

> Below left and right: construction site in Via Vanni in Cefalù (Palermo), photo by F. Vaccaro 2013. Unfired bricks used to close a room in an existing residential building: the same low-cost solution after about eighteen centuries.



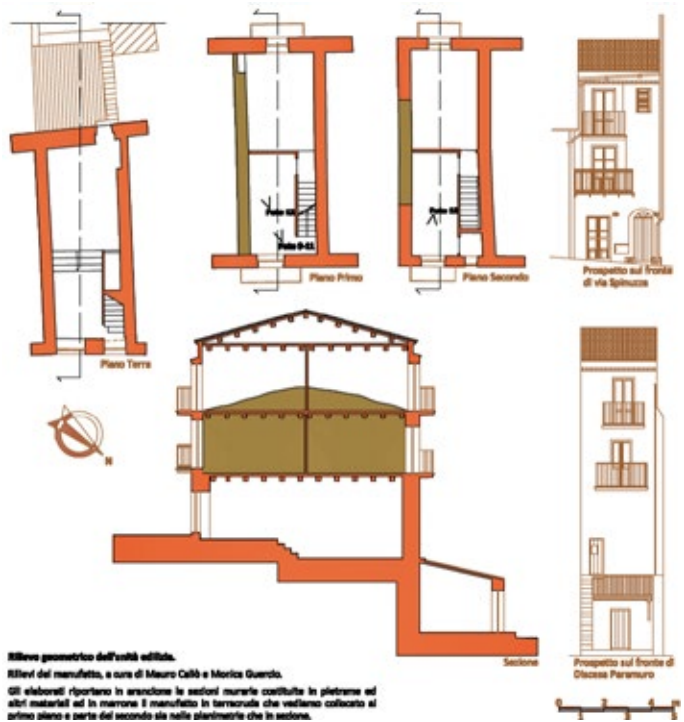
> Map of raw brick finds in Cefalù (Palermo) . From Master's thesis in Architecture "Repurposing raw earth in Cefalù for the improvement of the use of the UNESCO "Arab-Norman" site" by Federica Culotta (2019).



In 2010, during renovation work on a building in Via S. Spinuzza in Cefalù, architects Mauro Calìo and Monica Guercio found a mud brick wall. Two years later, while studying for his degree thesis, Fabio Vaccaro analysed the find in more detail and analysed a sample of unbaked brick from the wall. The brick turned out to consist of clay soil, sand and three types of inert material: of vegetable origin (straw, cane fragments and wood); of animal origin (bone splinters, shells); and of artificial origin (fragments of clay material).

In addition to these components, the sample surprisingly revealed the presence of the head of a small papier-mâché crucifix, which is still recognisable after about four centuries (the brick was dated around 1640 by the carbon-14 method).

> Findings in the raw material sample found in the building in Via S. Spinuzza in Cefalù. Below: the rest of the crucifix fragment (photo by Fabio Vaccaro 2012).



Rilievo geometrico dell'unità edilizia.
 Rilievi del manufatto, a cura di Mauro Calìo e Monica Guercio.
 Gli elaborati riportano in arancione le sezioni murarie costituite in pietrame ed altri materiali ed in marrone il manufatto in terracotta che vediamo collocato al primo piano e parte del secondo sia nelle planimetrie che in sezione.



> Above: drawings from the degree thesis in Architectural Science "Cefalù in adobe: raw earth testimonies" by Fabio Vaccaro (2012). Centre: building in the urban context and mud-brick wall found during the restoration work carried out in 2010. Bottom left: the niche from which the sample analysed in 2021 was extracted.