



## **Building on Lanzarote causes a lower impact than in other places, but the increase in building activity may cancel out these benefits**

**Approximately 83% by weight of the materials used in the construction of buildings comes from the island itself**

70-80% of the European population and 50% of the world population now lives in cities. Cities have become the main centres of production, distribution and consumption of human development, absorbing three quarters of the world's resources. The construction and maintenance of buildings alone accounts for 40% of the materials used, 33% of the energy consumed and 50% of all the emissions and wastes produced on Earth.

Construction on Lanzarote does not have an especially high impact because the building techniques employed use only a low percentage of imported materials, giving rise to an environmental impact that is between 40 to 50% lower on the island per constructed square metre than in other parts of Spain.

However, despite the low relative impact of the materials used in construction on the island, the overall impact of the sector will depend on the future volume of building. In this respect, current forecasts suggest that the envisaged increase in building activity may cancel out the aforementioned benefits. On the other hand, the fact that approximately 83% by weight of the materials used in the construction of buildings comes from the island itself, in the form of the components of mortar blocks and concretes, means that the extraction of aggregates and the future generation of construction waste, essentially composed of these aggregates, require an adequate strategy to reduce their local environmental impact.

### Summary of Report:

**“Analysis of environmental impacts associated with building materials used in construction on the island of Lanzarote and proposals from an environmental viewpoint”**

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## **Building and the environment**

There is growing concern about the impact of construction on the environment. All of today's urban systems give rise to a series of environmental externalities related with the consumption of resources and the generation of emissions, with negative effects at local and global level. Cities have developed following the line of the least possible effort and the maximum environmental dependence, in the belief that nature's capacity to furnish resources and to act as a sump for emissions is limitless.

In this respect, an analysis of the conventional flows of resources that occur in building processes allows construction to be related with its environmental impact, thus revealing its problems and relationships with the sustainability of urban development.

When analysing these flows we see that 70-80% of the European population and 50% of the world population now lives in cities. Cities have become the main centres of production, distribution and consumption of human development, absorbing three quarters of the world's resources, with the construction and maintenance of buildings alone accounting for 40% of the materials used, 33% of the energy consumed and 50% of all the emissions and wastes produced on Earth.

## **Materials in construction**

In this respect, it is vital to analyse the environmental impacts linked with the extraction and use of materials for building construction. This activity currently generates one of the most serious environmental impacts on a global scale, and above all at regional and local level.

Over the course of history the processes by which building materials have been obtained have changed substantially. Materials sourced from the surrounding natural environment have progressively given way to others that are obtained by more sophisticated procedures, as a consequence of the use of more powerful extraction means and the greater availability of relatively cheap energy and means of transport.

These materials, now obtained from the lithosphere, are extracted by drilling or excavating the surface of the earth and the organic systems that cover it. Besides altering the local environment, this new way of obtaining materials gives rise to by-products that can no longer be absorbed by the natural environment in the vicinity, leading to impacts on ecosystems relatively far away from the extraction site.

As the main vectors for the diffusion of wastes –water and air– disperse these by-products, not only do they affect distant organic systems but at the same time become saturated themselves. As a consequence, alterations occur in the biological function of water as a conveyer belt for materials in the biosphere and the composition of the atmosphere is modified at a planetary scale with the consequent changes in the climate.

## **Objective of the report**

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The objective of this report is to analyse the environmental impact of building materials used in construction on Lanzarote. It does not therefore include any analysis of other aspects related with construction, such as public works or road infrastructure networks. Within this scope, the report considers the following issues:

- To identify the current situation regarding building materials used in construction on the island.
- To evaluate each of the most important materials used in connection with their environmental effects at local and global level and their impact on health.
- And as a consequence of the above, to make a series of recommendations on the use of building materials on the island.

### **Building and the use of materials on Lanzarote**

Being an island limits the possibility of having a wide range of materials available and makes it necessary to orient construction systems towards maximising the use of local resources. This can be observed in the evolution of the different construction systems on Lanzarote, where various techniques are mixed in a relatively slow process of adjustment between old and new materials.

At present, the materials that constitute the main body of buildings –mortar blocks and reinforced concrete– are produced largely using the island’s own resources, and accordingly a high percentage of the total weight of buildings –close to 80%– corresponds to materials sourced on Lanzarote. The lightweight aggregates that make up the mortar blocks and the aggregates for concrete and subbases are also obtained on the island, where, with the addition of cement and steel imported from the exterior, the mortar blocks, prefabricated reinforced concrete parts and site-cast concretes are manufactured. Cement and steel represent about 8% of the weight of construction on the island, which means that local materials and water account for percentages of close to 92% of the total weight of materials used.

More highly elaborated building components, such as carpentry, floor coverings, paints, etc. are also brought in from the outside, but their importance in the weight of construction is very low and, except in the case of lacquered aluminium, their environmental impact is not significant.

This model of construction and the materials that it uses are closely related with the systems and materials used in the past. Despite the possibility of developing a more lightweight architecture, in view of the island’s climatic conditions and the low transport cost of new construction systems, the technical model has continued to be strongly anchored on the use of local materials, maintaining a low relative environmental impact and a low level of exportation of effects.

In the past, local construction systems used masonry walls with stones collected in the area surrounding the construction site. The existence of soft rock has always been the guarantee of a stone wall construction system which, as far as the strength of the elements allowed, eventually extended to the formation of vaults, thus covering a wide field of applications in construction.

The rest of the construction elements that comprise the structure of the building, such as concrete floor slabs, were imported from the exterior. The use of wood in these elements, traditional in organic societies prior to the industrial revolution, allowed the

establishment of standard types and formats in construction which facilitated their importing in large standardised loads and their subsequent recycling.

This construction system, which can still be observed in places where old buildings continue to exist, serves as the material and functional model upon which construction on the island has evolved through successive modifications of type (greater heights in urban construction) and techniques (introduction of reinforced concrete –first in floor slabs and later in columns– and of mortar blocks replacing stone blocks).

### **Weighted analysis of the impact of materials on Lanzarote**

In order to evaluate the relative importance of the impact of building materials in construction on Lanzarote it was decided to compare the results obtained on the island with existing data for other places in mainland Spain, since references are not available for other islands in the Canaries archipelago.

As a result of these analyses it is noted, first of all, that the environmental impacts associated with building materials on Lanzarote are lower than those obtained in a similar study carried out in the construction sector in Catalonia (highly representative of the construction systems used in the rest of the country).

Thus, compared with a unit weight of 2,800 kg/m<sup>2</sup> in construction in Catalonia, this value falls to 2,353 kg/m<sup>2</sup> on the island, a reduction of 15%, which though not highly significant in itself is nevertheless very relevant in relation with two of the most important associated environmental impact indicators: equivalent CO<sub>2</sub> emissions and energy consumed in the manufacturing of materials.

CO<sub>2</sub> emissions associated with the manufacturing of materials per constructed square metre on the island amount to 523.14 kg, while in building in Catalonia this figure stands at 732 kg (40% more), with a repercussion of 222 grams of CO<sub>2</sub> emissions per kilogram of material used on Lanzarote compared with 271 grams in building in Catalonia (22% more net emissions).

The energy consumed per square metre in the manufacturing of materials is close to 6,000 MJ on Lanzarote, compared with 9,000 MJ in construction in Catalonia, a difference of 50%, which is translated into 2.55 MJ per kg of construction material on the island and 3.33 MJ per kg (30% more) in Catalonia.

Construction on the island does not therefore have an especially high impact. This is due to the typology of the buildings, which are less materials-intensive, and to the characteristics of the materials used, resulting in an environmental impact that is between 40 and 50% lower per square metre.

Secondly, the report warns that despite the low relative impact of the materials used in construction on the island, the overall impact of the sector will depend on the future volume of buildings constructed. In this respect it should be noted that the current indications are that the increase in building activity may cancel out the aforementioned benefits. The total amount of building is the main factor that determines the sector's overall environmental impact.

Thirdly, the fact that approximately 83% by weight of the materials used in the construction of buildings comes from the island itself, in the form of the components of mortar blocks and concretes, means that the extraction of aggregates and the future generation of construction waste, essentially composed of these aggregates, requires an adequate strategy to reduce their local environmental impact.

### **Risks of an increase in the environmental impact of construction on Lanzarote**

Though simple and versatile, the island construction system has its weak points with regard to the future. While the quality conditions of buildings in the construction boom experienced on the island have been functionally based on the existing building heritage with its tried and tested techniques, the future may be approached in other terms, questioning the existing model of construction.

Certainly, the low climatic demands on the island –compared with mainland conditions– allow simple solutions with a low insulating capacity and low thermal inertia to be maintained. However, humidity problems due to condensation or the exposure of outside walls to humid winds cast a doubt on the construction model, confronting the functionality of the system with increased demands regarding building quality.

Improving the response to these demands will involve increasing the insulating capacity of walls or incorporating wall cavities –or both at the same time–, which may lead to the appearance of new materials and the adaptation of the construction system to other models with a higher environmental impact, probably more dependent on outside materials.

At the same time, the demand for comfort –which is now a cultural demand that goes beyond the realm of physiological wellbeing– not only requires the availability of reasonable temperature ranges but absolute control at all times of the climatic conditions of the inhabited spaces. This demand, permitted and fostered by the availability of low cost energy and technical air control systems, will imply a considerable modification in the energy functioning of buildings and, consequently, an adaptation of the construction system which may considerably affect the materials used.

Besides the increase in environmental impact resulting from the generalisation of air conditioning systems, consideration must also be made of changes in the construction system to improve its thermal insulation capacity, air tightness, and in short to make it more efficient with regard to its new function.

On the other hand, construction systems that are more efficient than those currently in use could be defined, combining traditional and current systems, vernacular and modern building types, and socialising building usage patterns based on the knowledge of their environmental repercussion.

In short, the aim is to avoid an exponential rise in energy resource consumption as a consequence of the worse behaviour of building containments and of increased demands regarding building comfort standards. It is noted that the generalisation of air conditioning systems may lead to an exponential increase in CO<sub>2</sub> emissions and failure to comply with the objectives set out in the Canaries Energy Plan (PECAN).

### **Main challenges for the future and recommended action**

By describing the construction system and evaluating its environmental impacts, the logic of its formation and the new demands for quality and comfort –all of which are matters analysed in the report– it is possible to establish a reference framework with

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regard to the main impacts that must be considered, the threats that must be faced, and the corresponding recommendations to improve the current systems.

The proposed initiatives are based on actions which strictly involve the actors in the sector, it being considered that regulating the amount of construction on the island forms part of a central debate which concerns all of the island's society.

These initiatives are:

- To perform an exhaustive environmental impact assessment of the life cycle of aggregates on the island –from extraction to management as wastes– with the aim of considering the actions that, while maintaining the dependence on local materials, allows the impact that they cause to be reduced.
- To reduce the dependence on external materials, by means of strategies to minimise their use (including recycling) or to seek local or external alternatives with a lower environmental impact, which to a large extent means redesigning the construction system in order for this to be possible, consciously reinforcing the existing tendency to work with local materials. The priority objectives are cement, steel and aluminium, since these represent the greatest impact in the sector.
- To design strategies for defence against changes that threaten the functionality of the current construction system. Besides avoiding the introduction of factors which imply a high environmental impact in themselves –such as the generalisation of air conditioning– adequate technical responses must be available to address demands that can trigger the entry of materials or systems with a high environmental impact.
- To prepare a waste management strategy which, in the future, when the construction boom eases off, will address the management of the accumulated materials generated by current building activity. Achieving a reduction in wastes to a large extent means preventing their generation, introducing a culture of refurbishment in preference to replacement or new construction, and though this may currently seem unnecessary, in the mid and long term it must be adequately established.

In summary, the proposed initiatives seek to achieve a two-pronged strategy: to defend a construction system that presents a low relative environmental impact profile against the pressure of other systems with greater impacts, and to reduce to a minimum the impact caused by the materials used. The approach combines an improvement in the understanding and use by the sector of the materials employed and the development of technical solutions which keep construction systems functionally viable while maintaining their environmental benefits.

The instruments that will be used to apply the proposed recommendations require the performance of specific studies. The conclusions of these studies will allow the drafting of the regulations, agreements, grant-aid policies, etc. that are necessary to achieve the environmental impact reduction objectives which are considered viable.