

# A methodology for the development of a sustainability index for construction works in Spain

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## Summary

The present paper tries to describe in a systematic way the process followed to develop a methodology to obtain a Sustainable Index for Construction Works in Spain. Given the complexity of the task at hand, and having into account that this is the first attempt within the Spanish construction sector to create an integrating index, the description of the process becomes indispensable in order to replicate the index in a different context –e.g. another European country–.

On the other hand, the development of an index with a triple focus -economic, environmental and social-, transcending the interests of the different activities which coexist inside this sector, and joining efforts towards a common objective fills an existing gap in the Spanish construction sector, as it will be shown. The proposed index aims at establishing, on a permanent basis, a common reference for the assessment of sustainability within this sector, to the improvement of which all parties involved could and should contribute.

**Keywords:** sustainable construction, sustainability indicators, assessment methods, life cycle assessment

## 3. Introduction

During the past years, the convergence of the Spanish economy towards the EU has caused great environmental costs, territorial imbalance and social inequality that must be corrected for better sustainability of our development. In this sense, Spain, along with the rest of the countries integrated into the European Union, is deeply committed to the promotion of policies aiming at a greater balance among economic, social and environmental aspects.

Several years ago, the report 'Sustainability in Spain 2006' [1], published by the Observatory of Sustainability in Spain, dependent on the Ministry of Environment, concluded that despite all the efforts already undertaken in our country in this respect, the results were clearly insufficient, and consequently, a Spanish Strategy of Sustainable Development in accordance with the European Union Strategy for a Sustainable Development (EU-SSD) [2] was very much needed. Even more, the next report from the OSE, 'Sustainability in Spain 2007' [3], points out a moderate advance towards more sustainable practices, particularly regarding economic aspects, but still deficient regarding territorial, environmental and social aspects. Finally, in their last report published so far, 'Sustainability in Spain 2008' [4], some potential advances towards a better sustainability of our development have been detected, favouring a change in the production model.

Within this general framework, the building and construction sector, one of the most important of our economy, but also a great consumer of territory, energy and transport, must contribute to correct this situation by consolidating and increasing the initiatives towards sustainability.

In addition to this, and as a member of the European Union, Spain has adopted in the past years a number of measures to reach the aims assumed in the Kyoto protocol –ratified by the EU in 2002-, as well as having taken the necessary steps to incorporate to the national legislation the guidelines set by the Directive on the Energy Performance of Buildings (Directive 2002/91/EC) [5]. The Building Technical Code, approved in 17 March, 2006, is perhaps one the most relevant examples of this effort in relation to the building sector.

On the other hand, if we take a close look at the panorama of activities relative to sustainability in construction in Spain, we see an excessive atomism in terms of the initiatives taken, which results in an unnecessary multiplication -even reiteration- of the efforts instead of a convergence of them towards a common aim. To this we must add that, besides that they all respond to the interests of the specific activity in question, they fundamentally focus on the economic and environmental aspect of sustainability, practically leaving out its social aspect. However, at this time, as the European Union has recognised, the emphasis should be the development of reliable sustainability indicators, with special attention to social indicators.

In consequence, and in accordance with the aforementioned EU-SSD, the idea of a *Índice de Sostenibilidad de la Construcción para España* (ISCE) [Sustainability Index for Construction Works in Spain] [6] seems to make sense since it could be used by all decision-makers and stakeholders involved in the building process, who in turn are welcome to contribute to the improvement of this decision/assessment tool. Also, at a later stage, and following the Spanish index, it would be possible to initiate the same project in other countries of the EU, in order to get a series of national indexes that will allow a comparative base for the assessment of sustainability in the European construction sector and the implementation of measures towards its accomplishment.

## **4. Methodological approach to the index**

Before presenting the methodology proposed, the following questions of interest raised during the process should be mentioned:

- The creation of a database, in principle as an attempt to manage in a systematic way the enormous amount of information gathered, turned out to be absolutely indispensable to handle the data needed in order to get a result for the index.
- The panoramic vision on the way the Spanish construction sector works, obtained as a result of the globalizing approach to the index, but obviously necessary to be able to develop a tool of these characteristics successfully.
- The possibility of carrying out similar research projects in relation to the deficiencies detected in certain sub-sectors within the Spanish construction sector, as it will be explained later on.

### **4.1 General aims**

In accord with that previously stated, and as a response to the current state of affairs, the aim of this research project is to develop an index of sustainability indicators for Spain that should:

- Be representative of and applicable to the complete sector
- Transcend the construction sector's different sub-sector's partial interests, along with those of the different agents implicated in the building process
- Be flexible enough to absorb possible future changes
- Be viable, not only from an economic perspective, but also in relation to the availability of data needed for securing a result

## 4.2 Operative principles

For this point we have focused on establishing the main characterising operational principles for the complete index development process, as well as for the index itself, and keeping in mind the general situation described, the following are essential:

- Focus on the balance between social, economic and environmental factors
- Take the complete life cycle as a reference, both in terms of materials and processes
- Consider the set of agents that intervene in the building process
- Conceptual robustness as a consequence of applying the general principles of sustainable construction

## 4.3 Phases and working plan

In order to achieve the previously defined aims, a comprehensive analysis of the different phases of construction is needed, always from the perspective of the life cycle, with the aim of being able to establish the most adequate indicators to evaluate the sector's sustainability, but also with the aim of suggesting changes or modifications that can improve its sustainability.

Parallely, and given that construction is integrated by not only a set of processes, but also a wide range of agents of all sorts with their own, sometimes contradictory interests, it is necessary to gather the information on each one of them in order to create a core set of indicators that properly represent the sector's complete reality.

In accordance with this general train of thought, we can define the following developmental phases. At present, phases 1, 2 and 3 have been completed. Phases 4 and 5 are still ongoing. Regarding phase 6, a proposal to start a pilot project together with a Spanish Regional Government, to refine and test the methodology, has already been submitted.

- **Phase 1:**  
*Collecting and selecting data.*

### Stage 1

*Collect documentation on the agents involved in construction (annual reports, publications, articles...).*

An approach to the creation of a construction sustainability index in Spain through indicators for agents intervening in the building process first requires that the agents be identified. For this, the starting point has been the agents included in the *Ley de Ordenación de la Edificación* (LOE) [Building Regulation Law] [7] to which others have been added to, not included in the LOE, even though of great importance to the process [Fig. 1].



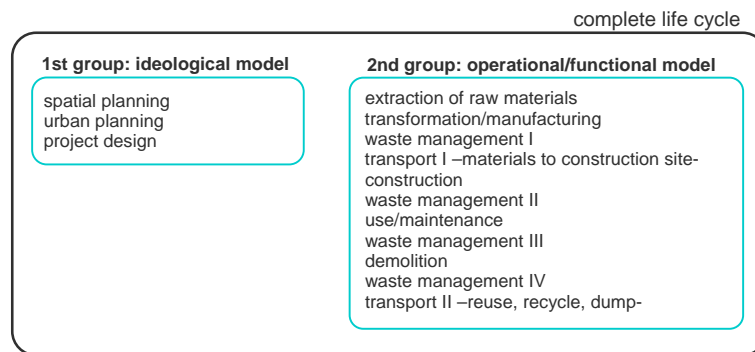
**Fig. 1** List of building agents considered by the research team for the index.

The final aim of this stage was to create a list of agents linked to the building process, defining the activity and legal framework in which it is developed, besides the responsibilities and obligations for this process. Also, a legal bibliography has been started from the information collected with periodic updates.

## Stage 2

*Definition and limits of the different phases and construction processes for future analysis.*

The ISCE project divides the phases included in the building process –considered from the complete life cycle perspective, both in terms of materials and processes- into two groups: the ideological model and the operational/functional model [Fig. 2].



**Fig. 2** List of building stages considered by the research team for the index.

It must be pointed out that, although the building stages are given in a sequential order, that is only for organization purposes since, in practice, many of these operations commonly overlap. Also, there are several stages with the same title but different number (e.g. waste management I, waste management II, etc.) for the sake of a better understanding, but in practical terms, they are treated as one.

The phases associated to the 1st group are considered of key importance, since the indicators selected in relation to them will be the result of the application of an ideological model or, if preferred, a proposal on how we want to live. Thus, Spatial Planning is a powerful tool capable of fostering the economic activity while improving productivity and energy efficiency at the same time. Different models of occupation produce different synergies on the territory, different patterns of mobility and accesibility, etc., which in turn has a strong potential influence on social well-being and user's satisfaction. The European Landscape Convention [8] recognizes it as *"an essential component of people's surroundings, an expression of the diversity of their shared cultural and natural heritage, and a foundation of their identity"*. So, the landscape, defined as *"an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors"*, is key to social and individual well-being. As a result, its management and organization imply a number of rights and responsibilities for all, and must be the object of a careful reflection.

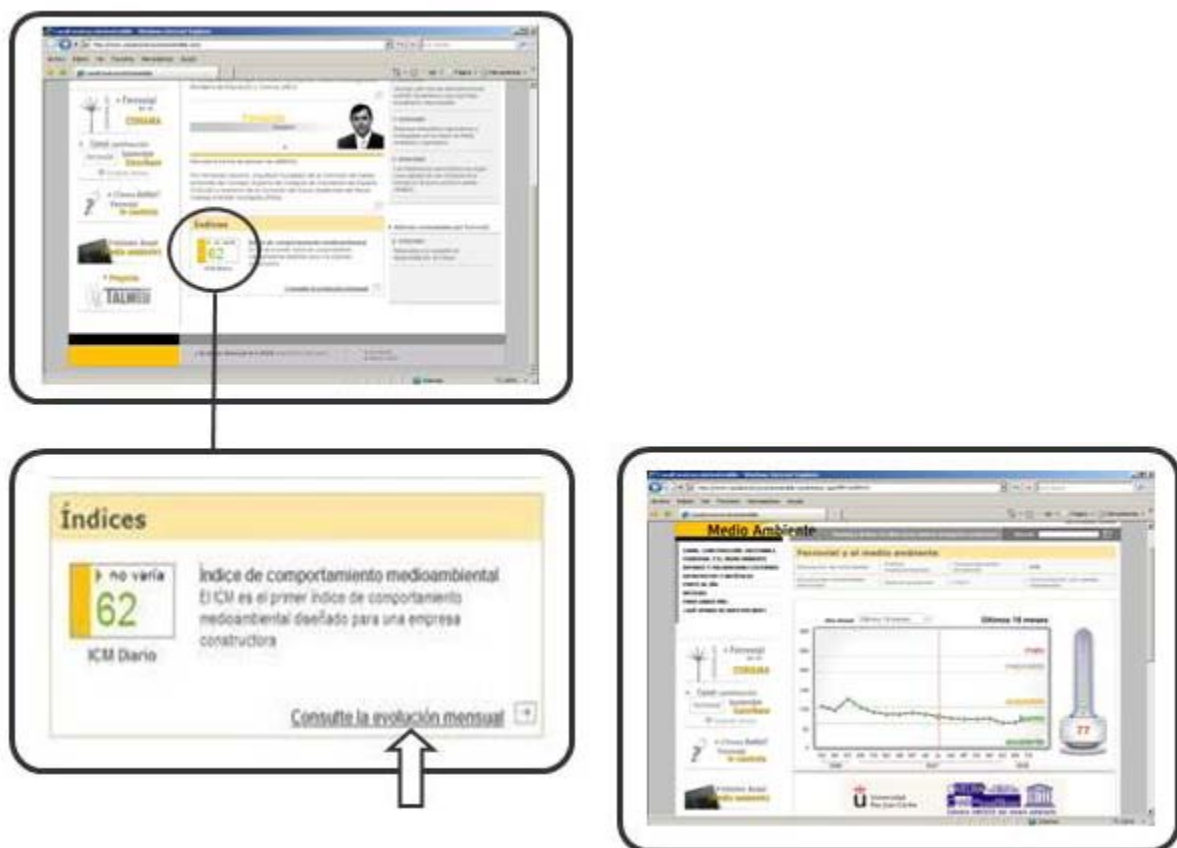
In a similar way, Urban Planning has a definite impact on sustainable building by means of setting previous unavoidable conditions –e.g. orientation, height, alignments-; not to mention other factors like density, green surface per inhabitant, noise levels, services available, accesibility or social integration, which bear an enormous importance to the city economy, the citizens' perception of the city and their level of satisfaction and identification with the cultural values of the community. Urban areas play a fundamental role in meeting the aims of the already mentioned EU-SSD. Four out of each five Europeans live in cities, and their quality of life depends directly on the state of their urban environment.

Finally, taking into account that buildings support most human activities, and also that people spend an increasingly amount of time indoors –around 90% in Western countries-, the decisions made during Project Design phase heavily condition the later use of the building, not only in terms of psychological perception and general satisfaction, but also in terms of productivity, energy efficiency, easy maintenance and refurbishment, etc. In consequence, the development of sound indicators for these phases should be emphasized.

- **Phase 2**  
*Data processing.*

The data collected from the previous phase, which can be presented through annual activity reports, specialized sector publications, conferences, articles, news, etc., are then processed in order to extract a true representation of each activity to create the proposed index.

Thus, the indicators handled will be organized in three categories –economic, social and environmental-. The Spanish references used for the selection of indicators were: Agenda 21 – UN programme to promote sustainable development-, the Observatory for Sustainability in Spain (OSE), the Guide to Sustainable Building for Housing in the Basque Country [9], ITeC's Sustainability Practices [10], FCC's Good Environmental Practices [11], Ferrovial's Environmental Performance Index (ICM) [12] [Fig. 3], and CEN TC 350 [13], in order to include the most relevant initiatives developed both in the private and public sector.



**Fig. 3** Ferrovial's Environmental Performance Index as published on the web site.

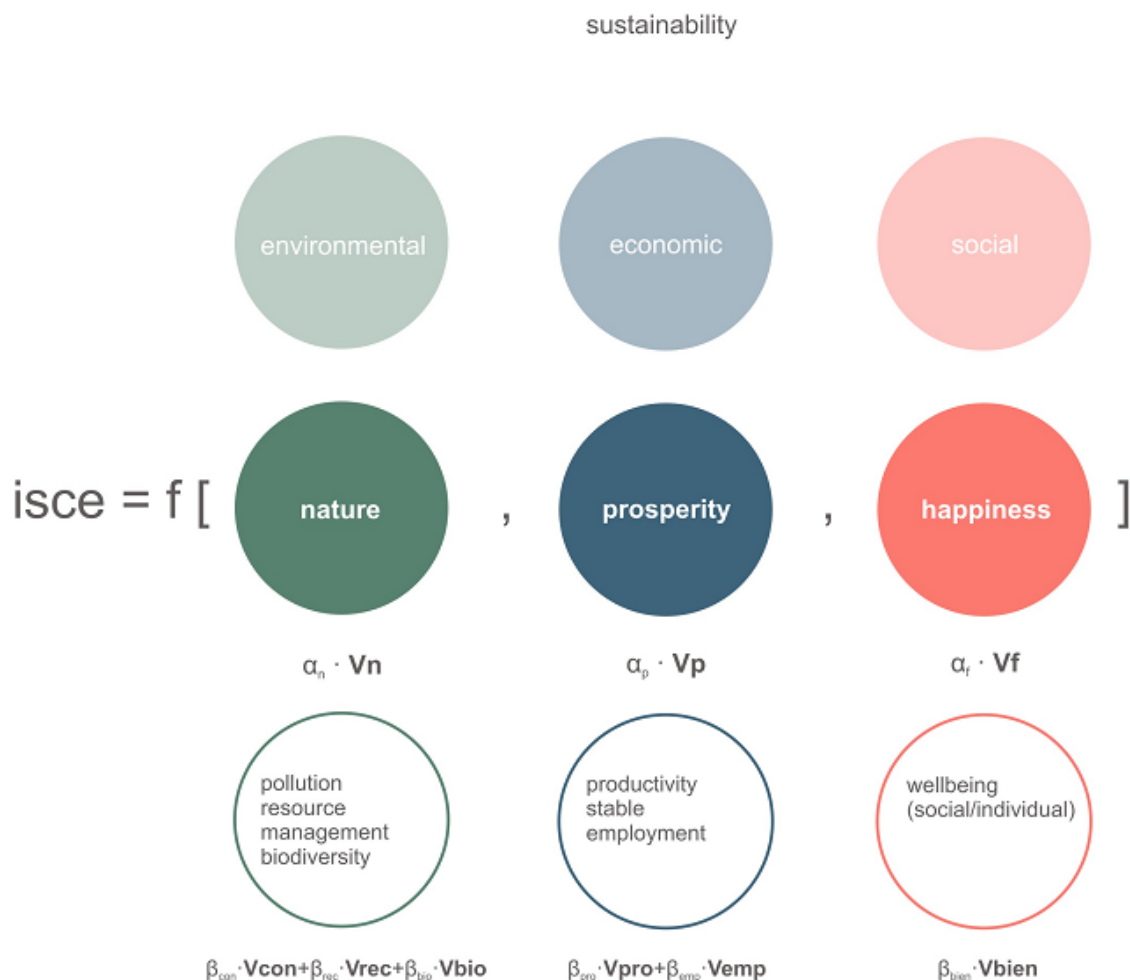
The currently available indicators relative to the construction sector in Spain will be associated, on the one hand, by their corresponding application phase, and on the other, by the agents implicated in it. The aim is to identify and organise the numerous indicators currently used in the

construction sector, and which have supposedly been chosen for being useful, representative and feasible. Then, they will be selected in accordance with this project's aims.

After having finished phases 1 and 2, a critique-informative meeting was organized with a small number of experts. The researchers explained the origin and development of the project to the group members, and presented the available results for discussion and critical review.

- Phase 3**  
*Conceptual proposal.*

The 2006 Review of the EU-SSD states that “Sustainable Development is a key objective for all European Community policies. It aims at the continuous improvement of the quality of life on earth of both current and future generations. It is about safeguarding the earth's capacity to support life and its diversity. It is based on the principles of democracy and the rule of law and respect for fundamental rights including freedom and equal opportunities for all. It brings about solidarity within and between generations. It seeks to promote a dynamic economy with a high level of employment and education, of health protection, of social and territorial cohesion and of environmental protection in a peaceful and secure world, respecting cultural diversity”. Therefore, considering sustainability as the necessary and harmonious integration of economic, environmental and social aspects, the index proposed is linked to the following concepts: **NATURE**, **PROSPERITY** y **HAPPINESS** [Fig. 4].



**Fig. 4** ISCE Project synthesis conceptual proposal.

- **Phase 4**  
*Selecting the indicators by processes, sectors and agents.*

The indicators finally selected, even if coming from different sources, are expected to be presumably coincidental so, after having analyzed them, the similar ones will be merged, the least representative discarded, others will be modified if necessary and also new ones could be included depending on the lacks observed. In any case, the final set of indicators must fulfill the requisites established by ISO 15392 Sustainability in building construction – General principles [14]:

1. Continual improvement
2. Equity
3. Global thinking and local action
4. Holistic approach
5. Responsibility
6. Involvement of interested parties
7. Long-term consideration
8. Precaution and risk
9. Transparency

Once the final list of indicators is set, a descriptive file for each one of them will be created to define the application framework of the indicator [Fig. 5].

INDICATOR	
Type of indicator	<i>Environmental/Economic/Social</i>
Phases of the building process	<i>To which it is associated</i>
Agents	<i>Involved in their application</i>
Definition/Justification	
Mathematical expression	<i>If there is one</i>
Unit of measurement	
Periodicity for calculation	
Data source	
Objectives	

**Fig. 5** *Example of a possible descriptive file.*

The descriptive file proposed is inspired by the files used by the Department of Environment, Spatial Planning and Housing of the Navarra Government, in collaboration with the local administrations included in the Red Navarra de Entidades Locales hacia la Sostenibilidad (Red NELS) [Navarra Local Network towards Sustainability] when applying the Local Agenda 21 [15].

- **Phase 5**  
*Establish the priorities and importance (weighting criteria) of each factor. Development of a mathematical model (application) to manage data.*

The aim of this phase, once the index's indicators are selected, is to establish whether it requires a mathematical model as a function of its characteristics, or a battery of indicators with the appropriate application level allocated. Having done this, the most suitable weighting criteria will be set and if necessary, the corresponding mathematical model.

At present, phases 1, 2 and 3 have been completed. Phases 4 and 5 are about to finish. Regarding phase 6, the intention now is to start a pilot project together with a Spanish Regional Government, to refine and test the methodology. Critical review by experts in phase 7 will be the necessary complement to phase 6.

- **Phase 6**

*Development of a Pilot Project to implement the index in a controlled area of a small-medium scale.*

This would be done in collaboration with the autonomous or local administration selected, taking into account that the index is intended mainly for all decision-makers that, like the administrations, have the capacity to implement policies oriented towards a better sustainability.

Within this context, a collaboration with the organizations that represent the sub-sectors involved in the construction process is proposed to develop reliable specific indicators for their activity, particularly in those phases of the life cycle for which there are not enough indicators that fulfill the conditions to be included in the index. Direct collaboration with the sub-sectors involved is considered necessary to guarantee that the indicators thus selected will be “feasible” for the companies in these sub-sectors.

- **Phase 7**

*Reviewing the Index. Corrections. Definitive Proposal.*

The aim of this phase is to review the index. Once a series of preliminary tests are performed, it will be submitted to external testing from experts, after which another critical review will be held.

- **Phase 8**

*Parallel initiation of the same project in other EU countries.*

The aim in this phase is to start the same project simultaneously in other European Countries (United Kingdom, France, Germany, Italy or Portugal), with the aim of obtaining a series of national indexes that make up a solid comparative base to evaluate the sustainability of construction in Europe and implement measures for achieving it.

## **5. Conclusions from the process**

### **5.1 Conclusions from Phases 1 and 2**

It should be said here that the following conclusions are general and associated to the phases described above. Other conclusions related to more specific issues, like the selection of indicators or the weighting linked to the mathematical model.

- Organising the building agents in tables according to their legal framework and by the responsibility their activity derives, along with a table linking phases and agents, or a list of associations, were initially posed as a necessary tool for the research. However, in practice they constitute a complete map of the sector, which is key to understanding its complete complex performance.
- So, phases 1 and 2, have laid the foundation to what could be a complete, comprehensive database of the sector, designed for clarity and capable of being periodically updated.
- On the other hand, as a provisional conclusion in relation to the indicators analysed, it has been observed that most of the indicators used by our reference sources are environmental, even when they might have social or economic implications. E.g. in the construction phase, exclusively social or economic indicators are very scarce.



## **5.2 Conclusions from Phases 3, 4 and 5:**

- In general terms, the reference –intended from the beginning- of the entire methodology to the current legislation, directives of relevance, strategic policies, etc. in order to get a total insertion of our index in the geographic reality it tries to represent, has proven to be a positive factor for its comprehension and acceptance by the agents involved in the building process.
- Even after having organised critical sessions with experts throughout the development of this project, it seems necessary to establish a more direct collaboration with the different agents and sub-sectors that make up the construction sector in Spain. The aim is to update the information obtained from each one of them, their implication in the process, and a joint effort to adapt and improve the proposed index according to the needs and function of these sub-sectors.
- Moreover, there is an obvious need to constitute a permanent platform to manage the database created during the development and periodic updating of the index. This platform would constitute an open dialogue within the sector, with the same integrating character that marks the index. This way, the platform can also articulate the relationships with those EU countries that have started or will start the creation of indexes similar to our own.

## 6. References

- [1] OSE, Observatorio de la Sostenibilidad en España. "Sostenibilidad en España 2006: breve síntesis". Ministry of Environment, Madrid 2007
- [2] EUROPEAN COMMISSION. EU-SSD, European Union Strategy for a Sustainable Development. 2009 Review. Brussels, 24.7.2009
- [3] OSE, Observatorio de la Sostenibilidad en España. "Sostenibilidad en España 2007". Ministry of Environment, Madrid 2008
- [4] OSE, Observatorio de la Sostenibilidad en España. "Sostenibilidad en España 2008". Ministry of Environment, Madrid 2009
- [5] EUROPEAN PARLIAMENT and COUNCIL. Directive on the Energy Performance of Buildings (Directive 2002/91/EC). Brussels, 16.12.2002
- [6] GARCÍA NAVARRO, J.; ANTUÑA ROZADO, C. "ISCE Project. Development of a methodology for a Sustainable Index for Construction Works in Spain". Final Report, 9.3.2009
- [7] LEY 38/1999, de 5 de noviembre, de Ordenación de la Edificación [Building Regulation Law]
- [8] COUNCIL OF EUROPE. "The European Landscape Convention". Council of Europe Treaty Series no. 176. Adopted on 20 October 2000 in Florence, Italy; came to force on 1 March 2004
- [9] EVE, Ente Vasco de la Energía; IHOBE S.A., Sociedad Pública de Gestión Ambiental; ORUBIDE, Centro de Gestión de Suelo; VISESA, Vivienda y Suelo de Euskadi, S.A.; Departamento de Vivienda y Asuntos Sociales del Gobierno Vasco, con la colaboración de Labein. "Guía de edificación sostenible para la vivienda en la Comunidad Autónoma del País Vasco". Published by the Basque Government, Bilbao 2005
- [10] ITeC, Institut de Tecnologia de la Construcció de Catalunya, en colaboración con el Col·legi d'Arquitectes de Catalunya y el Col·legi d'Aparelladors i Arquitectes Tècnics de Barcelona. "Prácticas de Sostenibilidad en la Edificación". Published by the Generalitat de Catalunya, Departament de Política Territorial i Obres Públiques, Direcció General d'Arquitectura i Paisatge, Barcelona 2005
- [11] FCC CONSTRUCCIÓN. "Memoria de Sostenibilidad 2007/2008". Actualización 2008. Published by FCC Construcción, 2008
- [12] PERIBÁÑEZ, E.; RUIZ DE GALARRETA, J.; ALFAYA, V.; CRIADO, R. "Diseño y aplicación de un Índice de Comportamiento Medioambiental (ICM) para el sector de la construcción". Accepted paper at the Congreso Nacional del Medio Ambiente (CONAMA) 6, Madrid 25-29 November 2002
- [13] CEN/TC 350. "Sustainability of construction works – Sustainability assessment of buildings – Part 3: Framework for the assessment of social performance". Under approval, 2012-01
- [14] ISO, International Standard Organization. TC 59 Building construction. ISO 15392:2008, "Sustainability in building construction – General principles".
- [15] Red NELS, Red Navarra de Entidades Locales hacia la Sostenibilidad. "Indicadores de sostenibilidad local de Navarra". Published by Red NELS and Gobierno de Navarra, Pamplona 2006