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PLANNING FOR DURABILITY IN BUILDING PROJECTS: STRATEGIES AND TECHNICAL RECOMMENDATIONS ACCORDING TO LEED® CANADA

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Abstract
This paper is a review article that is basically the *tropicalization* of strategies and recommendations for design and durability in planning building projects. This document is based on tropicalization life strategies that are based on the review and analysis of the LEED® Canadian version model, which includes several technical recommendations to improve the durability of buildings and their components. We conclude that the guidelines of tropicalization in countries such as Canada to countries such as Mexico will depend on its direct application in the design and construction processes with special attention to issues such as climate, building systems, quality of materials and workmanship of the construction.
Keywords: Durability, Tropicalization, LEED®, Buildings, Strategies.

1. INTRODUCTION

Today there is a well-known model called LEED® which is recognized all over the world for the application of sustainable architectural design and environmental building for the certification of buildings as well as saving natural, financial and human resources. The Canadian version of LEED® includes several different strategies of design to improve the *durability* of the installations and serve as technical recommendations for the designer as well as for the builder. These recommendations are extremely valuable not only to increase the durability of the building but to lengthen the *useful life of the building*. Though both concepts appear to be the same, they are not, because durability of buildings, according to Canadian norm CSA S478-95 (R2001), refers to the ability of a building or a component of a building to reach optimal usefulness in a determined environment or site without significant corrective maintenance, repairs or replacement of components and materials (CSA, 2001). On the other hand, useful life is defined as the period of time after installation or construction the building or its parts comply

or exceed the requirements of performance it was designed and built for (ISO, 2000). Though they are very different concepts, they are closely linked since both concepts affect the process of building design and construction. They both determine aspects like the cost of maintenance, corrective and preventative maintenance procedures, building safety, the environmental impact of construction (Masters and Brandt, 1989) and the comfort of the user during the entire lifecycle of the building.

It is important to point out that the LEED® strategies are based on North American construction systems and materials, and to make their application more efficient for other countries, it is recommended that they be adapted to the new context. For example, in the case of Mexico, these strategies will vary from the Canadian version in the following ways: the use and quality of the materials, construction methods and designs, type of maintenance to the building, climate, the building use and the way local norms are enforced. For this reason, this document describes these strategies and durability regulations specifically focused on the construction in Mexico and some Latin American countries, but using the LEED® Canada format as an acceptable and recommendable international model.

2. DURABILITY STRATEGY PLAN FOR CONSTRUCTION PROJECTS

Planning for *durability* in construction projects requires a *plan* which includes several different strategies to improve performance conditions and functionality of the components and construction materials in the building. This plan should include the following concepts, which are basically the areas which need to be controlled to improve the durability if the building (CaGBC, 2010): exterior water, interior water, air filtration, condensation, heat loss or gain, ultraviolet light, pesticides and other treatments, natural disasters and others. Several *durability strategies* for each area are shown in Table 1.

TABLE 1 - DURABILITY STRATEGIES FOR CONSTRUCTION

DURABILITY STRATEGIES FOR CONSTRUCTION
Exterior Water (keep the building dry and insulated from exterior water) **Foundation** • Alter the course of the water from walls and foundations using drainage systems in the subsoil with gravel and other shrinkage system when there is an excess. • Provide adequate drainage to avoid humidity in the lowest levels of concrete components. • Apply sealant to plumbing, pumps and other possible areas of water penetration like walls and floors. • Apply sealant to all the construction joints in the building. • Cover and seal all the pump connections and other equipment like hydropneumatics and systems which use and emit water and humidity. • Sustainable management of rainwater (guides it towards groundwater stores and water tanks avoiding the penetration of the building). • Waterproofing the parts of the foundation which are in contact directly with humidity. • Drain the water from roof systems appropriately. • Create the appropriate slope on floors and surfaces, especially on entrances and driveways. • Use drainage systems with sand and gravel where the water needs to be guided towards the outside and

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towards the sides of the substructure of the building. • Use porous or inert fill materials and not materials from excavations. • Provide plumbing for water drainage from the groundwater stores to where it is required (avoiding water accumulation and humidity). • Use insulators and vapor retardants in rooms exposed to high humidity. • Waterproof the base of the foundation. **Walls** (the objective is to concentrate on door and window installation) • Provide adequate drainage for water to avoid accumulation on walls and Windows. • Main drainage systems should be below or almost below the level of walls and floors and be perfectly sealed. • Gutters for water from roofs should lead the water away from walls. • Plaster walls should be elevated to at least half an inch from the level of the concrete floor to avoid humidity. • When painting exterior walls, apply a primer or sealant to the stucco. • Apply layers of paint over the primer or sealant on exterior walls. • Seal all the windows and doors as well as each pane of glass on the windows. • Seal construction joints. • Use durable materials with humidity degradation controls on windows and doors. • Avoid the use of wood for exteriors. • Use the grooves at the edge of the roof to collect water and protect exterior walls. • Design the rainwater gutters of the building to be independent, insulate and seal them, keeping the water away from exterior walls. • Use special membranes, if necessary, between the wall and the exterior especially when it is a green wall. **Roofs and Mezzanines** • Apply adequate waterproofing on roofs and flat surfaces which are completely waterproof and can integrate perfectly with the structure. • Rainwater slopes should be completely sealed. • Avoid ponding on flat surfaces and roofs by achieving an adequate slope and using appropriate materials. • Use bituminous materials like waterproofing membranes as a sealant and on joints. • Complete sealing of construction joints between construction components of roofs, flat surfaces and mezzanines. • Seal domes and skylights on roofs. • In areas where ice forms, protect the area with extra waterproofing and an additional slope to drain water. • Acquire additional waterproofing reinforcement or polymer membrane for green roofs on flat surfaces or the building´s structure. • Seal all plumbing to avoid water and liquid leakage towards mezzanines and roofs.
Water Inside the Building • Install drainage systems along with plumbing which avoid the accumulation of humidity to the rest of the building. • Adequately seal the pumps and plumbing to avoid leakage to the rest of the building´s components. • Adequate installation and sealing of furniture and equipment which requires the use of water and waste of the same liquid. • Adequate use of durable materials in humid areas like bathrooms, showers, laundry rooms, kitchens, etc. • Avoid the use of carpets in humid areas. • Adequate design and installation of floors in areas of water release, paying special attention to slopes, drains and sealing systems.
Air Filtration (pay special attention to insulation and sealant in special equipment) • Air filters in special equipment should be airtight to avoid the lowering the potential of the systems. • Air sealant in ventilation ducts.
Condensation and Evaporation • The installation of the clothes dryers should be well ventilated and outside. • Insulate all cold and hot water plumbing and avoid installing plumbing on exterior walls. • Waterproof over the finishes of exterior walls (in hot and humid climates)
Loss of Heat • In areas of the building where there is no need for insulation, install protection from direct wind to avoid heat loss (walls, roofs, facades, mezzanines and foundations).
Ultraviolet Light • Install materials with properties which control degradation from sun and sudden changes in temperature.
Corrosion • Apply treatments to the structure such as finishes which prevents materials corrosion.

Plague Control • Apply treatments to avoid termites and rodents which can damage construction components, defining what types of systems and whether these need to be introduced during maintenance or construction.
Natural Disasters • Earthquakes (follow the local construction norms to calculate for earthquakes) • Strong winds (follow the local construction norms to calculate for winds) • Flooding (review urban development plans in the area to avoid construction on lands with a risk of flooding) • Risk of geological faults (review plans for urban development in the area to avoid construction on land with a risk of geological faults). In the case of large buildings, the conduct geological testing necessary for calculations. • Fire (build firewalls in areas of risk). Develop a firefighting and operations manual.
Other Requirements • Guarantee and ensure that the roof system has a useful life of between 25 and 30 years • Guarantee and ensure a minimum of 10 years of useful life for thermal insulation materials. • Ensure that air conditioning and heating systems, as well as electromechanical systems which have large enough accesses to allow for appropriate maintenance. • Guarantee and ensure a minimum of 5 years of useful life in waterproofing materials, applying system with the most durability and of natural, ecological origin. • Use rigid ducts and pipes where necessary to ensure more durability and better function. • Use the appropriate input (gases, combustibles, coolants, etc.) for the correct operation of the equipment.

Source: Adapted from the LEED® CANADA format, 2010

3. DISCUSSION

The LEED Canada analysis with relation to the durability of buildings has the objective of establishing the tropicalization of the instrument developed by Canadians to Mexican conditions. This process should take into account the prevailing conditions in terms of the climate, as well as construction processes, customs and norms in Mexico.

When it comes to the differences in climate, there are several relevant ones to consider. The extreme climate of Canadian winters produces large quantities of water, where Mexico has long periods of draught in the majority of the country. It is important to consider construction norms and practices (uses and customs) which can be applied, in different cases, as well as the use of similar materials. We must point out that some of the most noticeable differences occur in the development of norms and their strict application. In Mexico, construction norms are not strictly followed, nor are the human resources well trained. This is thought to be a solution to the level of poverty in the country. Some studies have shown that 70% of buildings in Mexico are constructed in an unofficial fashion or without following norms (De Hoyos & Carmona, 2003), which also means that criteria that could improve the quality and durability of the building has not been applied.

The recommendations presented by LEED® Canada are considered and taken into account in Mexican construction practices, in part, by the Normas Oficiales Mexicanas (NOM), official Mexican norms, as

well as in the construction practices of many construction[1] companies and project managers. They are applied as a result of the technical specifications.

With these technical specifications, it is then necessary to carry out studies on the building site and adequate planning for the durability of the building. When it comes to water management, rainwater and municipal water supplies, we must concentrate on the adequate use and conservation of the resources through use and re-use. Once the resource has been used, it should be treated in septic tanks and grease traps as well as other advances in technology for adequate water management (CAMARA DE DIPUTADOS DEL HONORABLE CONGRESO DEL ESTADO DE MEXICO, STATE OF MEXICO CONGRESS, LV, 2005).

What has been defined in this paper as *good construction practices* are design and construction procedures, applying appropriate and adequate technologies, systems observed in nature, appropriated and appropriation systems[2], and concepts developed in the 80s which allow us to identify ways of building in a sustainable fashion.

Construction processes in this country must concentrate on the fact that there is a lot of excess water from groundwater and canalization, and create drainage and run-off systems capable of handling high levels. When we refer to used water drainage, we have NOM-001-CAN-1995, which governs the tightness of drainage and sewage systems, avoiding humidity and infiltrations, helping to prolong the durability of the systems. Humidity, a product of capillary action, can be reduced with systems of ground stability by using mixtures of cementitious compounds like NLH 3.5 lime or quicklime, an ecological product which permits the stabilizing and waterproofing of the ground. We also have sealing materials and systems for construction joints which are known as expansion joints which allow for movement in the case of pressure or bad weather.

Finally, when it comes to building maintenance, we have not advanced much in this country, which is obvious in the fact that maintenance manuals are not created as part of the project nor in a systematic fashion. This significantly affects the durability, useful life and the cost of preserving the building.

[1] The practice of construction is the result of the knowledge of construction practices of the past, new technical knowledge and techniques, norms applicable to the development of new materials, technologies currently being researched and the application of diverse areas of modern knowledge.
[2] Appropriated means that the practice is taken from nature and appropriable refers to what different groups or communities can do with the practices.

4. CONCLUSIONS

The most important variations between Canada and Mexico go through a *tropicalization* process described in this paper. The paper begins to establish a *Durability Strategies Plan for Building Projects.* The *tropicalization* suggested has the objective of establishing a common language in terms of the Plan, with technical specification and applicable norms. Another aspect to consider related to the very different and extreme climates of these two latitudes and with that the priorities for each construction system which can guarantee durability.

It is evident that the definitions proposed in this article define, clarify and establish the way in which it is pertinent to establish a strategy plan for durability. Mexico has advanced in favor of norms, nevertheless, more effort in needed in terms of building maintenance, starting at project development or detailed engineering. Each project needs to have adequate manuals for the use and operation of the building in time and cost. One overlooked and extremely important aspect is the quality of the human resources involved in the building process. Workers should be certified. This includes those working on-site as well as off-site. This will guarantee the execution of quality control processes. We should also include the certification of control laboratories, allowing for better compliance with norms, which do exist and with that the guarantee of quality during the entire construction process.

REFERENCES

CaGBC [Canada Green Building Council] (2010), *LEED™ CANADA, Guide of Reference, Version: 3.0,* Ed. CaGBC, Canada.

Cámara de Diputados del Honorable Congreso del Estado de México, "LV". (2005), *El Código para la Biodiversidad del Estado de México*. México. Obtenido de Comisión de Protección Ambiental, retrieved from <http://www.edomex.gob.mx/legistelfon/doc/pdf/cod/vig/codvig009.pdf>.

CSA [Canadian Standards Association] (2001), S478-95 (R2001), *Guideline on Durability in Buildings*, pp. 9-17, CSA, Canada.

De Hoyos, J. E. and Cormona, R. (2003), *Construcción (Vivienda)*, retrieved April 01, 2012 from Cluster de Vivienda <http://www.contactopyme.gob.mx/estudios/docs/construccion_edomex.PDF>.

ISO International Standards Organization (2000), *Buildings and Constructed Assets-Service Life Planning*, part 1: General Principles, ISO 15686-1, pp. 18-49, ISO, Switzerland.

Masters, L. W. and Brandt, E. (1989), Systematic Methodology for Service Life Prediction of Building Materials and Components, *Materials and Structures/ Matériaux et Construction*, 22, 385-392.

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