СЕКЦІЯ 2.
УПРАВЛІННЯ РОЗВИТКОМ
СОЦІАЛЬНО-ЕКОНОМІЧНИХ СИСТЕМ

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SUSTAINABILITY OF STEEL BUILDINGS

Steel, is the basic material, both in the structures and for the finishes of office buildings. It shows its power to be adaptable to any shape in any manner, including large spanning without any obstacles, its capacity to be designed according to the climatic factors in a more natural manner, comparable to other construction materials, and its long duration in time. All these features of steel figure out its sustainable potential. Consumers are becoming increasingly concerned about the environment. They need to be able to make informed decisions about the impact of their activities.

1. Ecological design methodology

Ecological design is defined as the kind of design activity which transforms matter and energy using processes that are compatible with nature and modelled on natural systems. This is a process very similar to conventional design, but with some remarkable exceptions. The main difference are priorities established for green building design. From them the most important is that ecological design must be integrated not only with the environment but also with the ecosystems that are present (Bródka J., Broniewicz M., 2013).

Ecological design expresses sustainability in the sense of a long life span as well as the limitation of environmental damage. The central problem is determining the building materials in terms of how they affect the environment. For example a relatively complex device containing insulation, wiring, controls and other materials contributes to an exceptionally low energy profile for the building, but cannot be considered to be inherently green because its fundamental material cannot be readily recycled.

There are three priorities to select building materials for a project. The first is reducing the quantity of materials needed for construction. The second priority is to reuse material and products from existing buildings (deconstruction). The third priority is to use materials with recycled content and that are recyclable themselves.

Steel have high potential for recycling and most steel products used in building applications have significant recycled content. Steel has long been the building material of choice for commercial construction for reasons of strength, durability and stability. Although the LCA and embodied energy impacts associated with metals may appear to be higher than alternatives, the inherent recyclability of metals, their durability and low maintenance make them competitive for high-performance building applications. Even while two out of every three pounds of new steel are produced from old steel, it is still necessary to continue to use some quantities of virgin materials. This is true because many steel products remain in service as durable goods for decades at a time and demand for steel around the world continue to grow.

There are many benefits of using steel in office buildings comparison to other construction materials, which increase its demand in the construction industry. Most of the buyers are now opting for prefabricated steel buildings that are strong, durable and reduce the time frame of construction. Properly designed office buildings contain flexible and advanced working environments for business. Compared with traditional buildings (such as concrete or brick buildings), steel buildings has shorter construction period about 1/3 time. The dead load of steel building is lighter, so higher buildings can be built on the same foundations. At the same time, because the column, wall and floor plate are thinner than traditional counterparts, the usage space of steel building is bigger than traditional buildings. These above will make extra profits for owners. As steel building has good tensility, its earthquake resistance performance is better than traditional building.

2. Design for disassembly

Design for disassembly is a new concept for the design and building community which intends to maximize materials conservation from building end-of-life management, and create adaptable buildings to avoid building removals altogether (Sustainability of steel buildings, 2012). Given that many buildings are removed from sites due to redevelopment and their inability to remain useful within an alternative land use, DfD can also be an intelligent strategy to prevent obsolescence and mitigate economic factors (such as labor costs) that encourage destructive demolition and disposal of buildings. Design for disassembly consists mainly of:

Use high-quality reused materials that encourage the markets for the reclamation of materials.

Minimize the different types of materials which reduces the complexity and number of separation processes.

Avoid toxic and hazardous materials that increase potential human and environmental health impacts, and potential future handling costs and technical difficulties.

Avoid composite materials, and make inseparable products from the same material that are then easier to recycle.

Minimize the number of different types of components to increase the quantities of similar recoverable components.

Separate the structure from the cladding to allow for increased adaptability and separation of non-structural deconstruction from structural deconstruction.

Provide adequate tolerances to allow for disassembly in order to minimize the need for destructive methods that will impact adjacent components.

Minimize numbers of fasteners and connectors to increase speed of disassembly.

Design joints and connectors to withstand repeated assembly and disassembly to allow for adaptation and for the connectors to be reused.

Allow for parallel disassembly to decrease the time on-site in the disassembly process

3. Energy efficient office buildings

The most expressive example of energy efficient office building is the new head office building for Manitoba Hydro in Winnipeg, Canada – Figure 1. Manitoba Hydro Place uses goethermal energy storage which produces all the energy required to cool the building and 60 per cent of the energy needed to heat it.

Figure 1. Manitoba Hydro in Winnipeg

Source: (www.isbe.org)

The design uses a "living building" concept that interprets and reacts to its physical environment rather than the traditional method of achieving energy savings by isolation from the elements through highly insulated and sealed construction. The shape and massing of the building was generated by solar orientation. Two towers converge at the north and divide to the south to capture maximum sunlight. The envelope is divided into separate single and double glazed walls, with a partially conditioned buffer zone in between. The temperature between the two walls is heated slightly, to ensure minimum temperatures during winter months, maintaining the performance of a triple-glazed façade. These buffer zones are configured in the winter for thermal insulation and fresh air heating (in the case of the south atrium), however their configuration changes with the seasons, through actively controlled, solar shading, exterior venting and humidification systems.. A solar chimney, a tall thin slab at the main entrance on the north end of the building, draws fresh air through the building from the south atria. The south atria also feature a water curtain that enriches the space while efficiently adjusting humidity.

The example of the steel building which represents the ultimate in green building philosophies and combines the old construction with the new idea is Kraanspoor office in Amsterdam – Figure 2.

Located on the river IJ in Amsterdam, Crane Track began life in 1952 as a concrete crane platform along a harbor.. It was saved from demolition and used as the foundations of a contemporary, a three-storey, 12,500m² glass office building. The building's transparent image would not have been possible without the slim steel construction. By using a skeleton made of light

Figure 2. Kraanspoor office in Amsterdam

Source: (www.nikiomahe.com)

steel containing hollow floors, the existing concrete construction was fully utilized, and as a result maximized square meters of office space. A double-skin façade with movable louvers and solar-controlled glazing regulate the building's indoor climate, whilst openings in the floor and a low-energy mechanical extraction system provide ventilation. In summer, Crane Track is cooled by water from the river below whilst, in colder months, the relatively warm water from the river is used to preheat the central heating system.

3. Conclusion

Design for disassembly or deconstruction is the design of buildings to facilitate future change and the eventual dismantlement (in part or whole) for recovery of systems, components and materials. This design process includes developing the assemblies, components, materials, construction techniques, and information and management systems to accomplish this goal (Design for disassembly, 2013). It incorporates the life-cycle of buildings, including end-of-life, into the decisions made before a building is built thereby increasing its value and effectiveness in the face of future use and costs. Some of the benefits include:

Reducing resource-use and waste starting early in the building design process and as integral to the entire building life.

Meeting market demand for flexible and convertible buildings, particularly speculative building types with high changes in internal spatial usage.

Meeting owner-occupant building adaptation needs to accommodate future change, from adaptation to large-scale additions and subtractions.

Maintaining value for resale to future building Owners who may wish to make adaptations or removals. This value is in the reduced adaptation and removal costs incurred by a future Owner.

Allowing for ease of maintenance and repair of components and assemblies and enabling product leasing and take-back systems.

Reducing toxicity in materials selection through a concern for reuse and recycling capability subsequently reducing potential worker and occupant exposure to environmental and health impacts from materials.

Reducing potential future liability and waste disposal costs and burden to the community where the building is located.

Insuring the future economic viability of managing materials from the use, adaptation and removal of buildings within the context of rising labor, equipment and fuel costs.

Enabling future adaptation and building removal that reduces the site environmental impacts of destructive demolition, such as dust, noise and mechanical equipment emissions.

Preserving the embodied energy that is invested in building materials and facilitating the substitution of recovered materials for virgin resources.

Making the deconstruction industry more cost effective by potentially reducing time and labor requirements which are currently the major impediments to the disassembly and recovery of buildings and materials, respectively.

Enabling tax benefits to commercial building owners by the segregation of building components.

References

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