

Life Cycle Assessment

Are we sensitive to Environment

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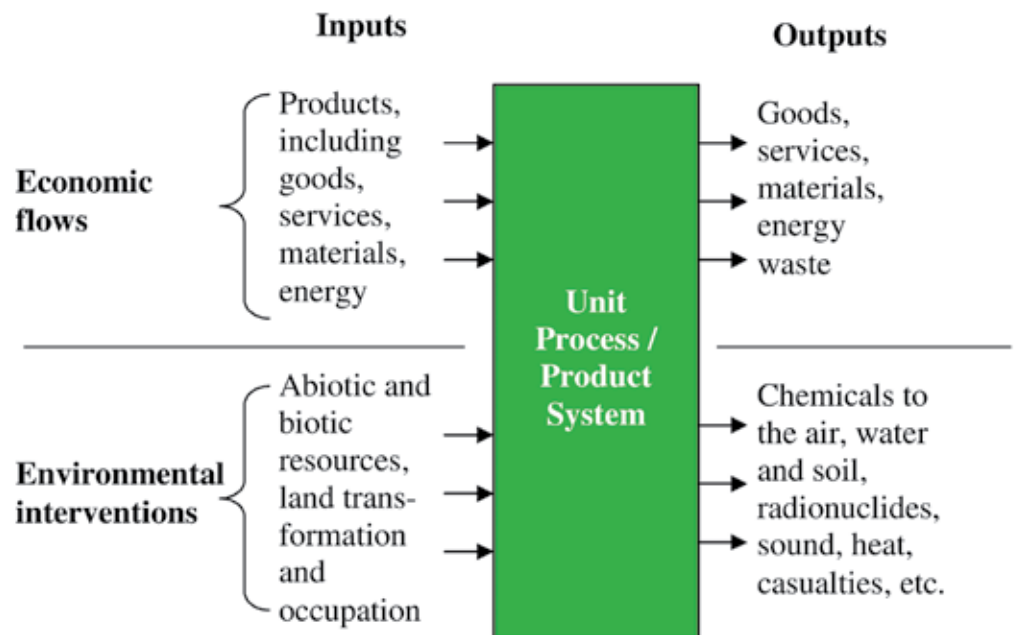
Life Cycle Assessment (LCA) Tools can help us make better choices amongst new products and building technologies. Elaboration of the Environmental impacts of different materials can be assessed for their Building Performances

Buildings have a profound effect on our environment. They consume precious material resources and energy, and produce other wastes that are potentially damaging our natural environment. A building's life cycle starts when raw materials are extracted from the earth, followed by manufacturing, transport and use, and ends with waste management including recycling and final disposal. The Life embraces a holistic approach to environmental and social issues. LCA can help the building industry make more informed decisions through a better understanding of the human health and environmental impacts of related products, processes, and activities.

Development of Life Cycle Assessment Tools for Sustainable Building Design can be done through cross comparative case studies of different building types with predominant materials. This will help in improvement of environmental performance of the buildings and construction sector by promoting life cycle assessment (LCA) as a tool to assess environmental impacts of building material and building system in India.

AIMS & OBJECTIVES

- Enlisting of building material with their constituent technologies required in finishing the raw material as a building product.



Inputs and outputs of a unit process

- Environmental burden of the materials individually and in combination.
- Understanding of building as three parts- Foundation, Building Envelope and Building services.
- Tool Matrix – categorising building LCA tools into six groups and ranking according to range of criteria like environmentally-driven life cycle justifications include energy efficiency, waste management, indoor environmental quality, and resource renewability.

Life Cycle Assessment (LCA) is a tool for the systematic evaluation of the environmental aspects of a product or a service system through all stages of its life cycle. LCA provides an adequate instrument for environmental decision support. Life cycle assessment has proven to be a valuable tool to document the environmental considerations that need to be a part of decision-making towards sustainability. A reliable LCA performance is crucial to achieve a

life-cycle economy. The International Organisation for Standardisation (ISO), a world-wide federation of national standards bodies, has standardized this framework within the ISO 14040 series on LCA.

“It takes into account all of the energy that is expended in mining, transporting, processing, finishing, installing, recovering, reprocessing, installing, and finally disposing of waste over the life of any piece of material. LCA factors in all energy expenditures and resource degradation and tries to bring them under a common metric so facility executives can assess one product against another product on a common basis,” says Owens.

In the last decade, various organizations have developed computer-based modeling tools that attempt to qualify the potential environmental impacts and performance of various building materials. These models are generically known as Life Cycle Assessment (LCA) tools. LCAs have been developed to help user choose the most environ-

mentally friendly building materials and building designs. Thus far, these tools have been used primarily by architects, designers, product manufacturers, and builders and engineers in the commercial building industry. In the area of Life Cycle Assessment there are a number of excellent tools, however none are actually commercially available at the moment. There are a number of valuable tools and rating schemes, which are not full LCA tools, which apply to specific parts of the life cycle of buildings (EcoTect, Cheetah, CheeMix, Nathers, Greenhouse Rating Scheme, etc.). We recommend that existing tools and rating schemes should clearly define and make known the stages of their life cycle they apply to and the stages for which they do not apply. The development of new tools, rating schemes or design guides should make clear from the outset what aspect of the life cycle they will apply to.

Current data availability in the public arena for undertaking LCA is very poor. Outside the public arena there is a moderate level of data being held by research groups, companies, and government agencies, which is being applied in LCA. The Environmental Performance Data Sheet (EPDS) is a framework, loosely modelled off the Material Safety Data Sheet, to provide a consistent and understandable framework for companies wishing to supply environmental data, relating to their product. We recommend that the EPDS framework be trialed on different groups of material products, before being implemented as a pilot program on a number of green building projects.

THE PHASES OF LIFE CYCLE ASSESSMENT (ACCORDING TO ISO 14040)

Goal and scope definition - the product(s) or service(s) to be assessed are defined, a functional basis for comparison is chosen and the required level of detail is defined.

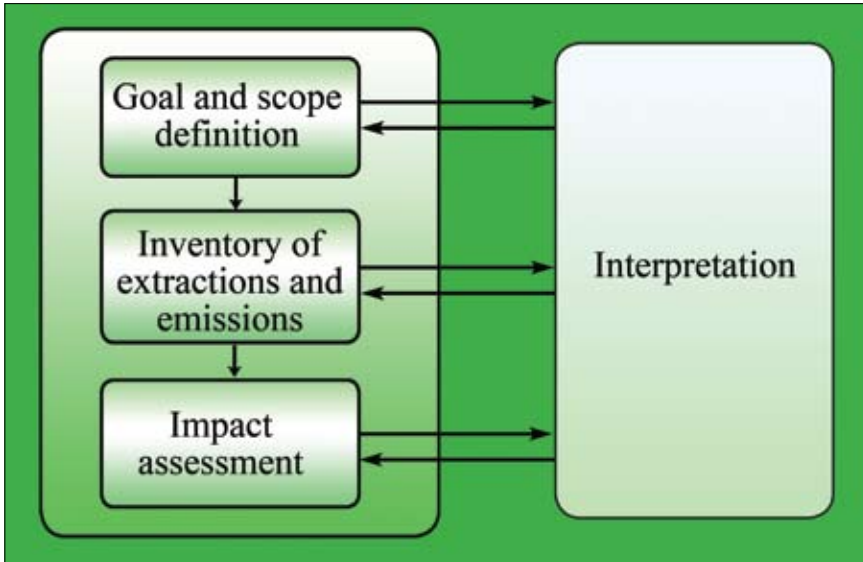
Inventory of extractions and emissions - the energy carriers and raw materials used, the emissions to atmosphere, water and soil, and different types of land use are quantified for each process, then combined in the process flow chart and related to the functional basis.

Impact assessment - the effects of the resource use and emissions generated are grouped and quantified into a limited number of impact categories which may then be weighted for importance.

Interpretation - the results are reported in the most informative way possible and the need and opportunities to reduce the impact of the product(s) or service(s) on the environment are systematically evaluated.

SCOPE OF LCA TOOLS

The LCA process is governed under ISO 14000, the series of international standards addressing environmental man-



LIFE CYCLE DESIGN

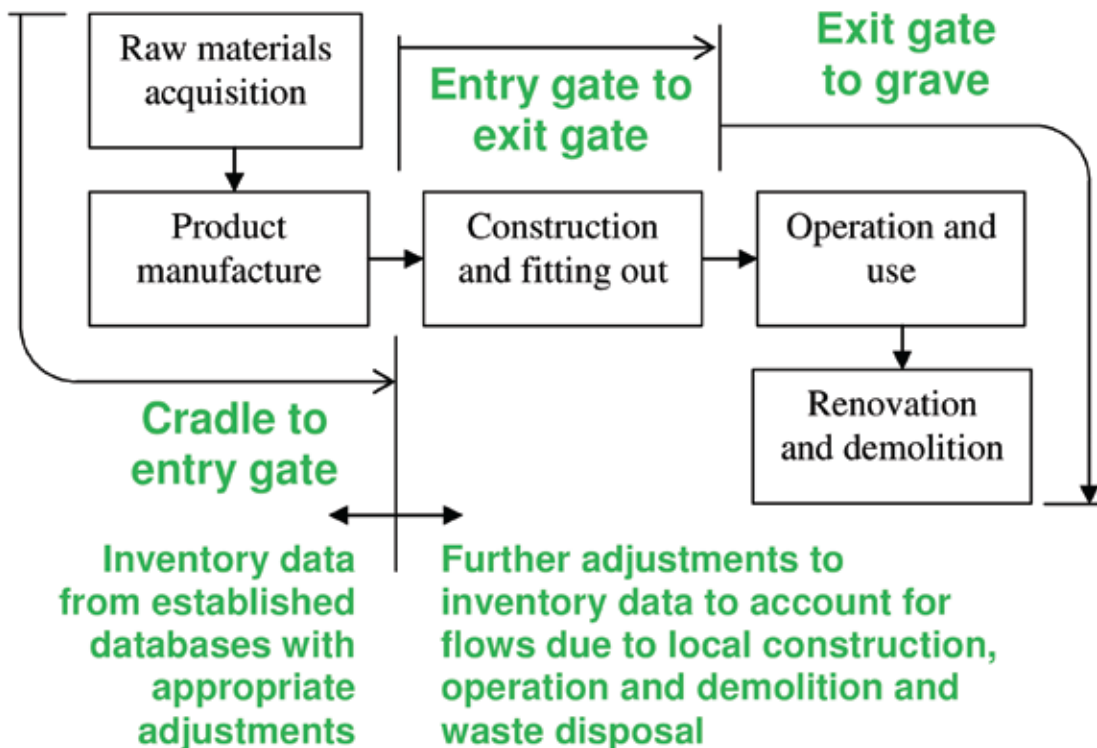
A cradle to grave analysis of building products, from the gathering of raw materials to their ultimate disposal, provides a better understanding of the long term cost of materials. These costs are paid not only by the client, but also by the owner, the occupants, and the environment. The principles of life cycle design provides important guidelines for the selection of building materials and technology. Each step of process from gathering raw material , manufacturing, distribution and installation, to ultimate reuse or disposal, is examined for its environmental impact.

agement. The process requires four general steps: goal and scope definition, inventory analysis, impact analysis, and interpretation and conclusions.

The investment in higher performance building solutions and technologies is limited by first cost decision-making. The development of a life

cycle tool comparing the cost-benefits of building technologies is central to the commercialisation of higher performance building solutions. Examples of the environmentally-driven life cycle justifications include energy efficiency, waste management, indoor environmental quality, and renewability.

Three Phases of Building Material : A materials life cycle can be organized into three phases : Pre building; Building; and Post building. These three life cycle phases relate to the flow of materials through the life of the building. These stages parallel the life cycle phases of the building itself.



Stages of Building Life Cycle

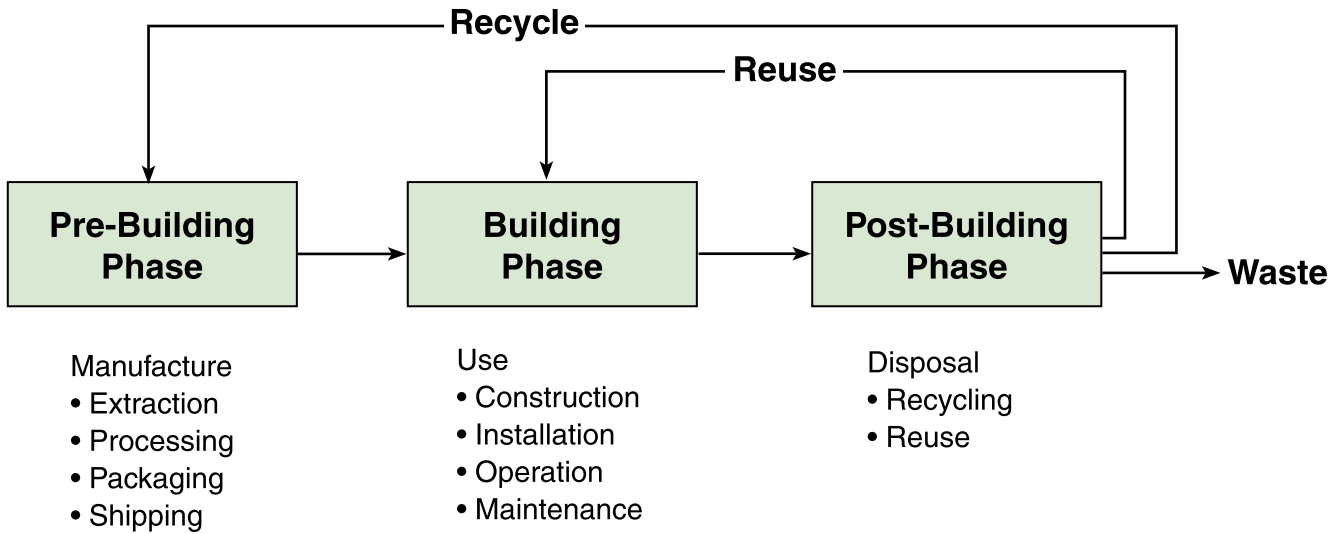


Figure - Three Phases of Building Material Life Cycle

Table – Showing Green features of a Building Material

S. No.	Pre Building Phase :	Building Phase	Post Building Phase
i)	Waste Reduction	Energy Efficiency	Reusability
ii)	Pollution Prevention	Water Conservation	Recyclability
iii)	Recyclable capacity	Waste Recycling	Bio- degradability
iv)	Embodied energy	Longer Life	
v)	Use of Non-toxic materials		

The evaluation of building materials's environmental impact at each stage allows for cost benefit analysis over the life time of the building, rather than simply accounting for the initial construction cost.

PRE – BUILDING / BUILDING PHASE

- Reduction in Construction Waste is possible by using standard size products which omit possibility

of trimming, cutting during installation.

- Energy efficiency of building material can be measured through R-value, shading coefficient, luminous efficiency and fuel efficiency.
- Materials with Longer life are less likely to be replaced during their life time. It depends on durability of products which effects the life cycle costs. Expensive materials like tiles

and slate though initially expensive considered cost effective due to their durability. Low maintenance cost is another important factor in analyzing life cycle cost of products.

- Water Conservation : Rainwater collected from roof and paved areas can be reused for all purpose other than drinking till it is purified to safer limits.
- The long term energy cost of operating a building are heavily

dependent on materials and technology used.

- Material toxicity is of increasing concern with growing number of building products containing petroleum distillates. These chemicals known as volatile organic compounds (VOCs) can continue to be emitted into the air long after the material containing them are installed. The severity of these process called out gassing, is dependent on the chemicals involved, rate emission, concentration in the air and length of exposure. Higher air exchange rates and expensive air scrubbers are required to reduce ill effects of these toxins.

BUILDING PHASE – DISPOSAL

- Recyclability is the material capacity to be used as a resource for new products. Glass and steel are most easily recyclable building materials after being segregated on a demolition site.
- Reusability comes in as an integral part of durability. Some materials outlast the age of building itself and can be reused at a new site.
- Bio-degradability is the ability of material to get naturally decomposed when discarded without making a hazardous combination with other substances. Organic materials quickly return to earth rapidly while steel takes longer time.

LCA TO MEASURE ENVIRONMENTAL IMPACTS

In the last decade, various organizations have developed computer-based modeling tools that attempts to qualify the potential environmental impacts and performance of various building materials. These models

are generically known as Life Cycle Assessment (LCA) tools. LCAs have been developed to help user choose the most environmentally friendly building materials and building designs. Thus far, these tools have been used primarily by architects, designers, product manufacturers, and builders and engineers in the commercial building industry. LCA analyzes the total environmental impact of all materials and energy flows, either as input or output, over the life of a product from raw material to end-of-life disposal or rebirth as a new product. (This is not to be confused with life cycle costing, or LCC, which considers only monetary cost.)

The long term energy cost of operating a building are heavily dependent on materials and technology used. Building is considered as a product and divided into components and elements for Assessment. Environmental consideration cover wider issues like raw material extraction, harvesting, manufacturing process, construction techniques and disposal of demolition waste. Architects can encourage the production of a wider variety of sustainable materials, insist on data sheets. Fire safety is another issues as materials like foam emits toxic gases when exposed to high heat.

CONCLUSION

Life cycle approach stipulates to understand the ecological, social and economic impacts across the life time of a product, process, material technology or the services. Considering it for life span of the buildings, as in architecture includes site selection, design and construction to operation and demolition, this is done through a systematic framework for tracking technologies, materials and assemblies with a matrix of environmental

impacts including, sourcing, manufacturing, use and maintenance, re-use, recycling and disposal.

If we all remember Christopher Alexander's saying – "when you build a thing you can not merely build that thing in isolation, but must also repair the world about it, within it, and the thing which you make takes its place in the web of nature", we all will at least like to strive to know the impacts of our work on the very environment we live in.

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