Precast Construction of Green Buildings

Green Building LEED Certification: PRECAst

LEED Category1	Credit Reference	Credit Earning Factor	PRECA advantage	Potential Points
Innovation & Design	Credit 1.1 to 1.4	Innovation in design	Preca designs are compatible for meeting the innovation requirement	2
	Credit 1.1 to 1.4	Use of Supplementary Cementitious Materials (SCM)	Preca products, do not involve fly ash, but uses less cement and hence are better match for SCM	1
	Credit 1.2	LEED Accredited Professional	Optional, although LEED aspiring Structures appoints a professional	1
Sustainable Sites	Credit 5.1	Site Development: Protect or Restore Habitat	Preca Products, because of JIT, help avoiding the disturbance to the surrounding habitats	1
	Credit 7.1	Heat Island Effect: Non - Roof	For relevant structures	1
Materials & Resources	Credit 2.1	Construction Waste Management: Divert 50% from disposal	Preca Products automatically reduce construction waste	1
	Credit 2.2	Construction Waste Management: Divert 75% from disposal	Preca Products automatically reduce construction waste	1
	Credit 4.1	Recycled content, use 5% post - consumer or 10% other	Preca Products are amenable to use recycled content	1
	Credit 4.2	Recycled content, use 5% post - consumer or 20% other	Preca Products are amenable to use recycled content	1
	Credit 5.1	Regional Materials: 10% Extracted, Processed & Manufactured Regionally	Preca sources all the materials regionally after careful quality checks	1
	Credit 5.2	Regional Materials: 20% Extracted, Processed, & Manufactured Regionally	Preca sources all the materials regionally after careful quality checks	1
Indoor Environmental Quality	Credit 3.1	During Construction: Indoor Air Quality Management Plan	Preca products, subject to the design, facilitate indoor air quality	1
Energy & Atmosphere	Credit 6.1	Optimize Energy Performance	Preca products are naturally energy efficient	10
Total Potential points for Green Building LEED Certification				**23**
By adopting GMP, Conventional construction methodology also may scores upto10 points				

In summary

Precast technology is a proven environment friendly method of construction. It is recognized and recommended by several international environmental agencies as well as the Ministry of Environment and Forestry, GoI which calls for compliance with ECBC which are readily provide by precast elements

PRECAst Structures gain upto 23 Potential points of Green Building LEED Certification under the categories of

- Innovation and Design Process
- Sustainable Sites
- Materials and Resources
- Indoor Environmental Quality
- Energy and Atmosphere

which make it ideal choice for green buildings.

We will discuss these categories and how precast buildings may qualify for points in each of these categories.

Innovation and Design Process

Projects earn Innovation and Design credits when they demonstrate exemplary performance in a recognized area, or bring new approaches and technologies reduce embedded energy and advance sustainable design.

Building Design Considerations

Innovations can be achieved in any and all of the following categories with Precast Concrete

- Energy Efficiency
- Durability
- Space Flexibility
- Environmental Impact
- Supplementary Cementitious Materials

Energy Efficiency – Global Warming Potential

- The mass of a concrete structure makes it a significant thermal reservoir with the ability to store large amounts of energy. By storing and releasing the energy needed for heating or cooling, concrete delivers year round energy benefits.
- With energy simulation, it was found that the interior thermal mass inherent in precast concrete floors (compared to concrete toppings on metal deck) reduced annual heating energy use by 6 to 15% and reduced annual energy use by 2 to 3%.
- It has been proved, that the buildings with the lowest total primary energy (TPE) global warming potential (GWP), regardless of location and service life, were the buildings with precast concrete envelope.

Durability

- Buildings constructed from robust materials designed to withstand both occupant use and the elements for extended periods of time are often prime candidates for refurbishment and continued service. Buildings constructed from precast concrete meet both of these requirements.
- Additionally, in precast concrete, the low water-cement ratio combined with good compaction and curing in a controlled factory environment ensures a dense, highly durable concrete with low permeability.
- Concrete can withstand extreme loadings better than any other building material

Space Flexibility

- The ease with which the structure can be dismantled permanently or relocated as well as the scope for future expansion is considered a big advantage. This adds considerably towards building sustainable structure.
- The robust nature of precast concrete elements permits disassembly with little or no damage to precast wall elements, as long as some foresight for the same is extended in the beginning of the project.
- The panels on any side of the buildings can be removes, put into storage, new additional space can be constructed adjacent to the existing building, and the stored precast panels were then reinstalled into their new position.

Environmental Impact

- Plant-controlled production with clean finish eliminates on-site mortar mixing, water runoff, cement dust, sand piles, lift truck operation, and scaffolding which in turn help sustainability
- Precast construction reduces transportation and disposal costs of wastes
- Curing of elements is done at the production facility which minimizes the wastage of water
- Process water can also be reclaimed, treated and reused. The amount of water that can be used with each batch will depend on the reclamation system and treatment type.

Supplementary Cementitious Materials (SCM)

- The judicious use of SCM's in concrete production is desirable both for environmental and energy conservation as well as for the technical benefits they can provide.
- Industrial by-products: Silica Fume, Fly Ash and Blast furnace Slag
- When properly used, the SCMs can enhance the following properties of concrete:
  - Generally improve the workability and finishing of fresh concrete
  - Reduce bleeding and segregation of fresh concrete
  - Lower the heat of hydration beneficial in mass pours
  - Generally improve the long term strength gain
  - Reduce permeability and absorption (especially silica fume)
  - Reduce alkali-aggregate reactivity

Sustainable sites

The Sustainable Sites (SS) category rewards decisions about the environment surrounding the building, with credits that emphasize the vital relationships among buildings, ecosystems, and ecosystem services. It focuses on restoring project site elements, integrating the site with local and and protecting the habitat.

Protect Habitat

- Excellent sound and fire protection and high thermal mass touch on every aspect of sustainable design as well as the important aspect of increased consideration for people's health and safety
- Concrete is the most effective building material when it comes to fire resistance. Buildings with higher fire tolerances also can be designed.
- Precast structures are built to last for many, many years.

Protect Habitat

- Use precast panel as interior surface saves material, no need for additional framing
- No construction debris
- Use parking garages to reduce building footprint and site disturbance
- More parking can be added in same space than conventional methods due to optimized design

Protect Habitat

- Scheduling for efficient, Just-in-time deliveries of precast that minimize vehicular idling time and traffic congestion
- Use of modular systems minimizes construction waste
- Dust, noise minimized due to minimal on-site activity

Protect Habitat

Clean Site

- No packaging required
- Fewer trades minimizes disruption
- Precast concrete construction reduces impact to site in both time and area

Managing the environment

- Compared to logging (wood) and mining (steel) aggregate and limestone extraction is the least disruptive to land
- In a few years after closing, quarries can be restored to agriculture, nature preserves, parks or other uses.

Reduce - Heat Island Effect

- Precast concrete parking structures that place at least 50% of the spaces under cover (for example, underground, under a building, or under a deck or roof) can reduce heat island effect.
- Any roof used to shade or cover parking must have a solar reflective index (SRI or albedo) of at least 29. In addition, high-albedo vertical precast concrete wall surfaces reduce the heat-island effect.

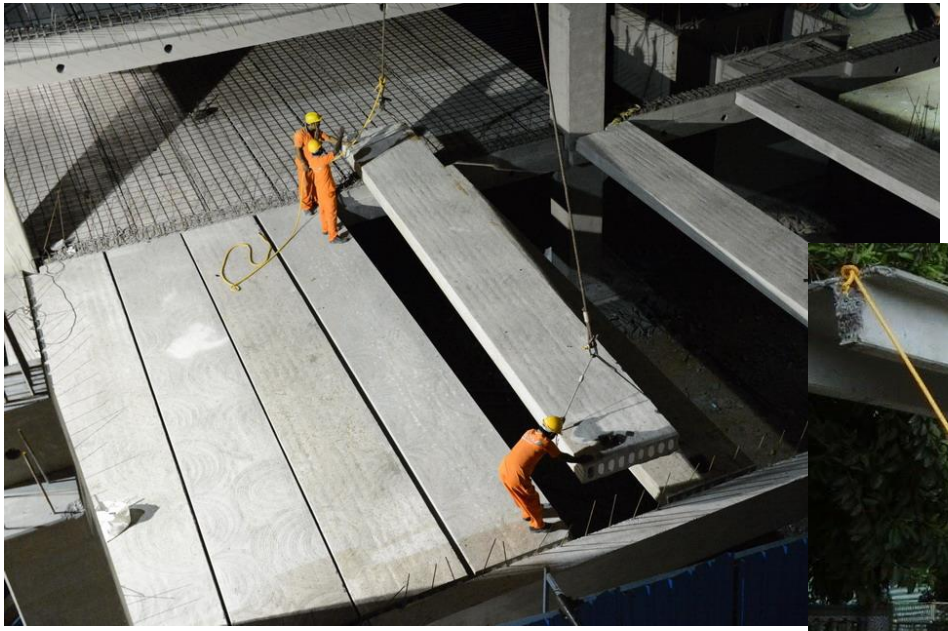
Materials and Resources

The following factors contribute towards conservation of Materials and Resources

- Optimized design
- Building reuse
- Construction waste management
- Resource Reuse
- Recycled material
- Local Materials

Optimized design

Structures are designed to optimize (lessen) the amount of concrete used. Prestressing allows designers to create longer spans, using less material and leading to enhanced flexibility of buildings in their use.



Building Reuse

- Precast concrete members are unique in that they can be dis-assembled. Precast concrete walls can be used for building expansion or fire walls.
- Crushed concrete can be used as aggregate or can be used as base material for roads, sidewalks or slabs.

Construction waste management

- Due to precast concrete products being plant cast and delivered as site-ready, this creates minimal to zero amounts of on-site waste material.
- The small amount of concrete waste generated in a plant has negligible toxicity.
- At the end of a building's useful life, 100 percent of concrete demolition waste can be recycled.

- After reinforcement has been removed, concrete can be crushed to produce aggregate used in pavement construction, as granular subbase, lean concrete subbase, and soil cement aggregate.

Construction waste management

- Exact Batching Technologies => little waste at plant
- Qualified and trained personnel minimize waste every day

Resource Reuse - Forms

- Steel forms are used to cast structural precast products. These forms have a long life span providing thousands of reuses
- Using steel instead of wooden forms conserves natural resources
- Specialty shaped forms are stored for future use.
- Re-use of forms reduces waste and debris at the job site.
- Construction sites are cleaner, neater and quieter.

Recycled Materials

- 85% of Precast Concrete is made up of the naturally occurring materials sand and stone. Compared to other materials extraction requires low amounts of energy and they go directly into the finished product.
- Recycled reinforcement can be used to further maximize re-use
- Recycling systems, installed effectively, capture virtually all process water, slurry, aggregates or cement and these are re-used in the production process.

Recycled Materials

- Industrial by-products such as fly ash, slag cement, and silica fume are used as partial replacements for cement, thereby reducing the amount of cement used in concrete.
- Reinforcement and connection hardware made from steel can be recycled

Local Materials

- The use of local cements, aggregates, etc. – keeps transportation of raw materials to a minimum.
- Precast Concrete components are most often transported and erected within 200 kms of the plant.

Indoor Air Quality

Indoor environmental quality (IEQ) refers to the **quality** of a building's environment in relation to the health and wellbeing of those who occupy space within it.

Indoor Air Quality

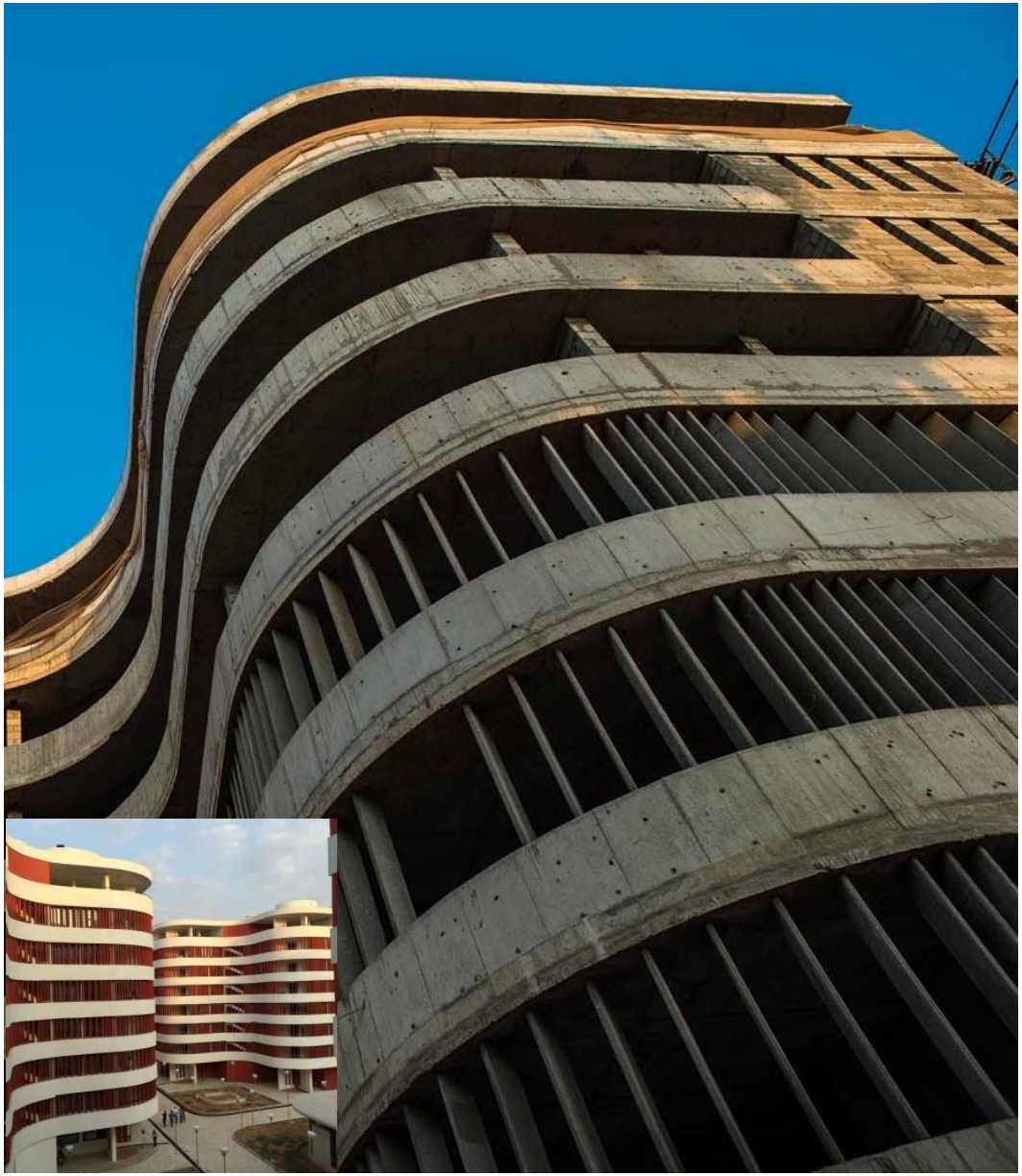
- Precast concrete is vermin proof –eliminating the need for chemical treatments or inhumane traps.
- Precast floors / walls also provide first class sound proofing with typical STC = 50 -55.
- Using precast walls reduces the out-gassing often attributed to other materials
- Textured interior walls can provide aesthetic alternatives to VOC-emitting paints or wall board

Energy and Atmosphere

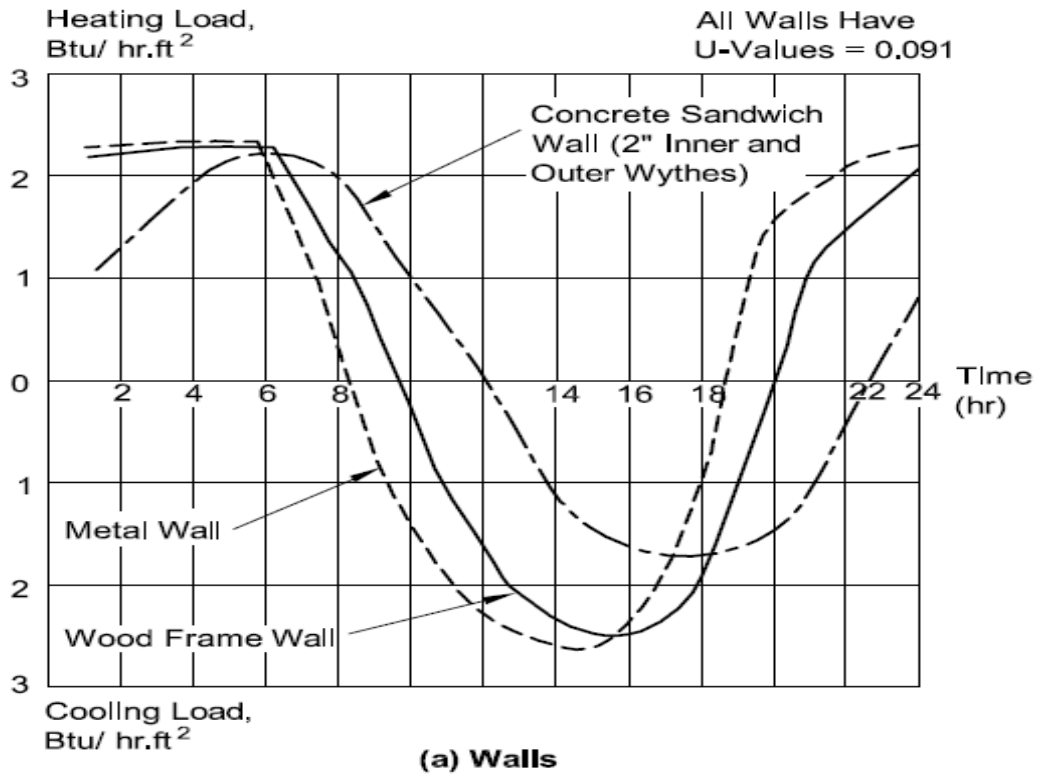
Energy efficiency in a green building starts with a focus on design that reduces overall energy needs, such as building orientation and glazing selection, and the choice of climate-appropriate building materials.

Energy Efficiency - Use of Vertical Fins

East and west facing windows are more effectively shaded by vertical projecting planes as seen in this research building. Vertical projections (fins) from either side of the window narrow the peripheral view from the window. In he Northern hemisphere the further south a building is located, the more important shading east- and west facing windows becomes, and the less important it is to shade south-facing windows. This is due to the high position of the summer sun in southern latitude with the resulting decrease in direct sunlight transmitted by the south-facing windows.



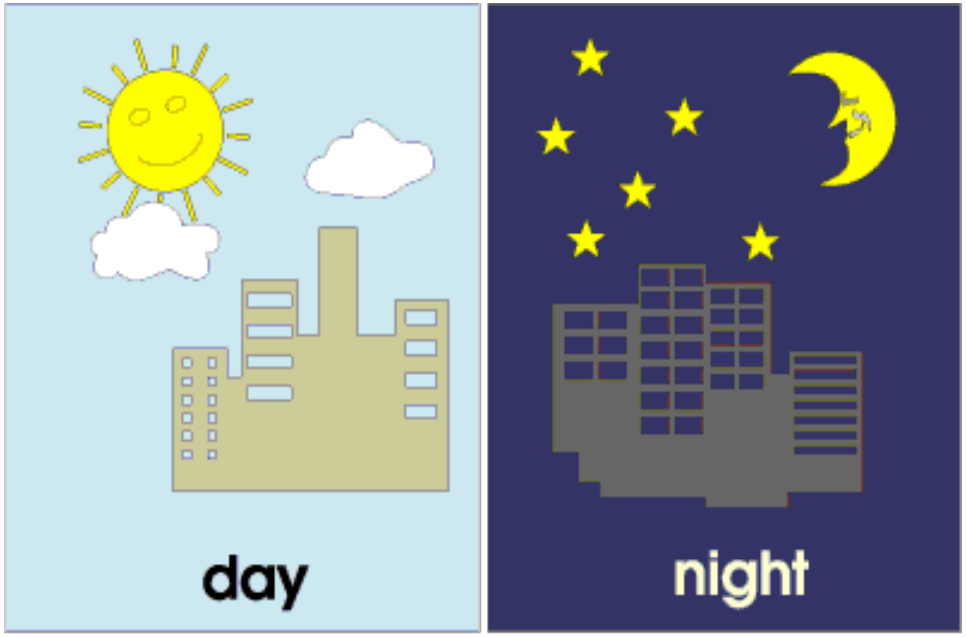
Energy Efficiency - Thermal Mass Effect of Concrete



Thermal Mass Effect

Thermal mass is particularly beneficial where there are wide fluctuations in temperatures. Precast concrete is a naturally insulating building material that helps keep buildings cooler in summer and warmer in winter. The thermal inertia, or mass, of a precast concrete assembly can have a positive effect on its actual performance. Sometimes this is called “performance R”.

Energy Efficiency - Thermal Mass Effect of Concrete



- Thick concrete walls can used as a thermal mass to delay the onset of peak heating or cooling loads
- Reduces indoor temperature fluctuations to improve occupant comfort
- By storing and releasing the energy needed for heating or cooling, concrete delivers year round energy benefits.
- May reduce peak demand/energy consumption and enable downsized HVAC systems

Economic Benefits

- Precast Concrete construction gives more rentable space because of lower floor-to-floor heights. Unlike other materials which necessitate a very thick floor, concrete requires only 8 inches where utilities can run.
- More expensive traditional materials can be replaced with cost-efficient architectural precast.
- Hygiene ledges where dust and dirt congregates are minimized in concrete structures, which is ideal for high precision industries such as food-processing or high technology plants.
- With precast concrete, materials are readily available; so project planners can count on just-in-time delivery from local suppliers.

Conclusion

In conclusion, we can say Precast Concrete is a truly green product contributing to various areas of sustainability including but not limited to the following green concepts:

- Energy Efficiency
- Conservation of material and resources
- Design Flexibility
- Environmental Impact
- Durability
- Reduce – Reuse – Recycle
- Quality of life