**MATERIAL CONSERVATION**

* Sustainability and efficiency of a building is largely dependent on the sustainability of building materials. Building industry is dependent on endless supply of high quality materials and energy resources.
* This can be justified by the fact that **buildings on a global scale consume about 40 % of the raw stone, gravel and sand, 25 % of wood, 40 % of energy and 16 % of the water each year.**
* These result in depletion of non-renewable materials and resources, production of waste byproducts, release of pollutants and deterioration of the air, water, soils and the habitat that surrounds it.
* The present time demands use of sustainably managed materials.
* These are the materials that are environmentally preferable and have a mitigated degree of adverse impact on environment and human ecosystem when compared with equivalent products for the same application.
* Use of sustainably managed materials is an environmental responsibility in contributing towards a sustainable habitat.
* Their basic characteristics that are required in the present scenario are, ability of natural resource conservation, low embodied energy, potential of recyclability and reuse and low emission levels of toxic substances or pollutant release in each stage of material life cycle.

**InsertImage: 4-Material/0.Intro.png**

**1. Handling of Non-Process Waste (Post Occupancy)**

**InsertImage: 4-Material/1.Post.png**

|  |  |
| --- | --- |
| **Type** | Mandatory Requirement |
| **Aim** | To ensure effective non-process waste management, post occupancy for recycling and safe disposal. |
| **Steps** | Have a facility to segregate atleast five of the following non process waste generated in the factory.   * Organic waste * Plastic * Paper, Paperboard * Glass * Metals * ‘e’ waste * Lamps * Batteries * Allocate a separate space for the collected wasted before transferring it to the recycling/ disposal stations. * Use different colored bins for the collection of different categories of wasted from the building |
| **Documents Required** | Submit detailed drawings of waste storage area and their location within the building. |
| **Approach** | **InsertImage: 4-Material/ProcessFlow/1.png**  (Source- [IGBC](https://igbc.in/igbc/), [GRIHA](http://www.grihaindia.org/)) |

**SOLID WASTE MANAGEMENT**

The average per capita generation of solid waste in India is 0.4 kg/day. The solid waste generated in India has higher organic content as compared to the developed countries as indicated by the biodegradable content of 52%. While the percentage of paper and plastics is about 6%, metal scrap, rubber, cloth, and other such products is higher, at 11%. An EU (European Union) citizen produces 500 kg/year (1.36 kg/day) of waste.

**Treatment techniques for waste processing**

1. Thermal processing
   1. Pelletization or briquetting
   2. Incineration
2. Biological processing
3. Landfilling

**Requirement for energy recovery from wastes using different treatment methods**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Important waste parameter** | **Desired Range** | **Waste treatment technique** | **LPG equivalent of biogas (kg)** | **Energy generation potential (kWh)** | **Power generation potential (kW)** |
| Moisture content | < 45% | Thermo-chemical  conversion  Incineration  Pyrolysis  Gasification | - | 1.16 x NCV x W | 0.012 x NCV x W |
| Organic/volatile matter | > 40% |
| Fixed carbon | < 15% |
| Total inert | < 35% |
| Calorific value NCV | > 1200 kcal/kg |
|  |  |  | 0.07 x W | 921 x W | 11.5 x W |
| Moisture content | > 50% | Biochemical conversion Anaerobic Digester/Biomethanation |
| Organic/volatile matter | > 40% |
| Carbon/nitrogen ratio | 25-30 |
| LPG: Liquefied petroleum gas  NCV: Net calorific value in dry basis in kcal/kg  W: Weight of solid waste in tonnes | | | | | |

**Components of a Landfill System**

|  |  |  |
| --- | --- | --- |
| Component | Material | Purpose |
| *Landfill cover* | * Low permeable materials such as clay and geosynthetic material * A minimum thickness of 18 inches for infiltration layer and the hydraulic conductivity <1 x 10-5 cm/second. An erosion layer of 6 inches’ thicknessto be provided above the infiltration layer * Vegetation with the desired slope and minimal maintenance | * To reduce the infiltration of water into the landfill, which in turn can reduce the leachate production * To prevent the seepage of washes, as plants can absorb water from the soil, and flow of water in the landfill |
| *Lining Material* | * Clay or membrane liners with a permeability of less than 7cm/second * The thickness of the membrane liners should be in the range of 0.03-0.08 inches | To prevent seepage and contamination of the groundwater |
| *Leachate collection* | * The collection pipes at the bottom of the liner should be at a slope of 1% * The slope of the liner should be a minimum of 2% | To facilitate the movement of the liquid into pipes |
| *Leachate treatment system* | * An effluent treatment plant based on aerobic or anaerobic digestion * For a low strength leachate with biological oxygen demand <100 mg/liter, use an aerobic system * For a high strength leachate, use anaerobic reactors with higher efficiency * Us the system based on the end-use application and the required treated water characteristics | To treat the leachate from the landfill |
| *Gas collection pipes* | * The components of the gas collection system consist of interconnecting pipes; collection points, vertical extraction wells; horizontal collectors/trenches; connection to existing vents, wells flow controls; and a combustion device | * To minimize the potential environmental impacts, and to recover and utilize the gas with high methane content for various applications * The permissible level of methane in soil atmosphere is 5% * To control the odor and harmful impact of the landfill gas |
| *Vertical extraction wells* | * For a waste depth of 10m, the diameter of boreholes varies as 60-90 cm and the spacing is 60-122m * One well is needed every 0.4 hectares * Not to be used in landfills with high leachate levels * The material used is PVC or HDPE with perforations 6m below ground surface * Air infiltration is prevented by a Bentonite seal and flow control valve; a pressure monitoring port is present in the wellhead. |  |
| *Horizontal collector system* | * Installed in trenches and covered with gravel and waste. The material can be of slotted PVC or HDPE with a size of 100mm * It can be installed at a spacing of 30-100 m * Used in landfills with elevated leachate levels |  |

**InsertImage: 4-Material/1/1.png**

**(Source-** [**Ministry of Environment, Forest and Climate Change**](http://envfor.nic.in/divisions/iass/Construction_Manual.pdf)**)**

**2. Handling of Non-Process Waste (During Construction)**

**InsertImage: 4-Material/1.Construction.png**

|  |  |
| --- | --- |
| **Type** | Mandatory Requirement |
| **Aim** | Minimize construction waste being sent to landfills. |
| **Steps** | **Waste Reduction**  Avoid atleast 50% of the waste generated during construction being sent to landfills and incinerators. Calculate percentage using either weight or volume. |
| **Documents Required** | Submit records tabulating the total waste material generated and the quantities which were  diverted from landfills. |
| **Approach** | **InsertImage: 4-Material/ProcessFlow/2.png**  (Source- [IGBC](https://igbc.in/igbc/), [GRIHA](http://www.grihaindia.org/)) |

**Good practices in construction management**

|  |
| --- |
| 1. The explosive for blasting and excavation should be stored in a standard container. Hazardous materials must not be stored near surface waters and should be stored near plastic sheeting to prevent leaks and spills. The handling of explosives should be strictly according to the guidelines as prescribed by the Department of Explosives. |
| 1. Delivery of material on site must be done over a durable, impervious and level surface, so that first batch of material does not mix with the site surface. Availability of covered storage should be assured. Mobile and covered storage boxes with easy drawing and filling mechanism can be used, which can be used over a number of sites. |
| 1. Demolished brick masonry and concrete is a good material for filling. Steel from RCC must be carefully segregated and rest of the material should be crushed on site only. Crushed masonry and concrete is even good for manufacture of synthetic aggregate. |
| 1. The recyclable items like metal, plastic should be sent to recyclable industry, and rest of this scrap should be stored in a covered area. |
| 1. Dry processes of construction are effective for reduction of water requirements and even the waste generation. Use of Interlocking bricks, pre-cast roofing and wall panels etc. will be suitable for this purpose. |
| 1. Materials, which are durable and do not require frequent maintenance, should be used. Exposed brickwork in hot and dry climate with Class I bricks requires minimum maintenance. Instead of using stone masonry, stone cladding is a better way to minimize the maintenance. |
| 1. Wherever materials (aggregates, sand, etc.) are more likely to generate fine airborne particles during operations, nominal wetting by water could be practiced. Workers / labour should be given proper air masks and helmets. |
| 1. Skilled labour and good workmanship is must for judicial utilization of materials and minimizing the waste. |
| 1. Construction is more of management. Proper estimate of material is a very first measure to minimize the undue wastage. |
| 1. Contaminated runoff from storage should be captured in ditches or ponds with an oil trap at the outlet. Contaminated plastic sheeting should be packed and disposed off site. |
| 1. Communities nearby the blasting site should be consulted before deciding blasting timings / durations and they should be informed / evacuated as required with the knowledge of the district collector’ office . |
| 1. Bitumen emulsion should be used wherever feasible. Contractors should be encouraged to heat with kerosene, diesel or gas to gradually substitute fuel wood. Fuel wood usage for heating should be limited to unsound log i.e. dead and fallen trees. |
| 1. Bitumen should not be applied during strong winds to avoid danger of forest fire. Bitumen emulsion should not be used in rains. No bitumen must be allowed to flow into the side drain. The bitumen drums should be stored in a designated place and not be scattered along the roadside. |
| 1. Rubbish, debris and bitumen wastes remaining after blacktop works should be cleaned and disposed off in a safe place. |
| 1. Materials wasted on site should be reused at the same place. For example, use of excavated earth in landscaping, or use of waste pieces of floor tiles in floor of porch or outdoor spaces, or use of remaining pieces of glass from window panes into ventilators, skylights and boundary wall, or reuse of ply and other timber pieces into furniture etc. |

**RECYCLING DEMOLITION WASTE RECYCLING CONSTRUCTION WASTE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Material | Means |  | Materials | Means |
| Asphaltic Concrete Paving: | Break up and transport paving to asphalt recycling facility or recycle on-site into new paving.  **InsertImage: 4-Material/1.png** | | **Packaging:** | * Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location. * Polystyrene Packaging: Separate and bag materials. * Pallets: As much as possible, require deliveries using pallets to remove pallets from Project Site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood. * Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.   **InsertImage: 4-Material/15.png** |
| Concrete: | Remove reinforcement and other metals from concrete and sort with other metals.   * Pulverize concrete to maximum 4-inch (100-mm) size.   Crush concrete and screen to comply with requirements in Division 2 Section “Earthwork” for use as satisfactory soil for fill or subbase.  **InsertImage: 4-Material/2.png** | |
| Masonry: | Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.   * Pulverize masonry to maximum 1-1/2-inch (38-mm) size.   + Crush masonry and screen to comply with requirements in Division 2 Section “Earthwork” for use as general fill or subbase.   + Crush masonry and screen to comply with requirements in Division 2 Section “Exterior Plants” for use as mineral mulch.   **InsertImage: 4-Material/3.png** | |
| Wood Materials: | Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, and panel products for reuse and/or recycling. Separate wood material treated with heavy metal preservatives for reuse or landfill disposal.  **InsertImage: 4-Material/4.png** | | **Site-Clearing Wastes:** | * Chip brush, branches, and trees on-site * Comply with requirements in Division 2 Section “Exterior Plants” for use of chipped organic waste as organic mulch.   Source- [Environmental Protection Agency]((https:/www.epa.gov/sites/production/files/2014-03/documents/017419.pdf)) |
| Metals: | * Separate metals by type. * Structural Steel: Stack members according to size, type of member, and length. * Remove and dispose of bolts, nuts, washers, and other rough hardware.   **InsertImage: 4-Material/5.png** | | **Wood Materials:** | * Clean Cut-Offs of Lumber: Grind or chip into material appropriate for mulch or erosion control. * Lumber Treated with Heavy-Metal Preservatives: Do not grind, chip, or incinerate; must be reused or landfilled.   **InsertImage: 4-Material/16.png** |
| Asphalt Shingle Roofing: | Separate organic and glass-fiber asphalt shingles and felts for recycling into asphalt paving or by other recycling entities.  **InsertImage: 4-Material/6.png** | |
| Gypsum Board: | Stack large, clean pieces on wood pallets and store in a dry location for recycling off-site. Remove edge trim and sort with other metals. Remove and dispose of fasteners.  **InsertImage: 4-Material/7.png** | |
| Acoustical Ceiling Panels and Tile: | Stack large, clean pieces on wood pallets and store in a dry location. Separate suspension system, trim, and other metals from panels and tile and sort with other metals.  **InsertImage: 4-Material/8.png** | | **Gypsum Board:** | Stack large, clean pieces on wood pallets and store in a dry location for recycling and/or reuse on-site or off-site.   1. Moisture-damaged gypsum board with evidence of significant mold growth shall be disposed of in accordance with New York City’s “Guidelines on Assessment and Remediation of Fungi in Indoor Environments”: 2. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.   **InsertImage: 4-Material/17.png**  Source- [Environmental Protection Agency]((https:/www.epa.gov/sites/production/files/2014-03/documents/017419.pdf)) |
| Equipment: | Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.  **InsertImage: 4-Material/9.png** | |
| Plumbing Fixtures: | Separate by type and size.  **InsertImage: 4-Material/10.png** | |
| Piping: | Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.  **InsertImage: 4-Material/11.png** | | **Miscellaneous:** | * Anything called out to be ground and used on site should utilize an on-site grinder. * Grinder should be able to accommodate a variety of materials including masonry, asphalt shingles, wood, and drywall. |
| Lighting Fixtures: | Separate lamps by type and protect from breakage.  **InsertImage: 4-Material/12.png** | |
| Electrical Devices: | Separate switches, receptacles, switchgear, transformers, meters, panel boards, circuit breakers, and other devices by type.  **InsertImage: 4-Material/13.png** | |
| Conduit: | Reduce conduit to straight lengths and store by type and size.  **InsertImage: 4-Material/14.png** | |

[Read more about this]((https:/www.epa.gov/sites/production/files/2014-03/documents/017419.pdf))

**3. Materials with Recycled Content**

**InsertImage: 4-Material/3.Recycled.png**

|  |  |
| --- | --- |
| **Type** | Suggested Requirement |
| **Aim** | To encourage the use of products (materials other than plant machinery) which contain recycled materials to reduce environmental impacts associated with the use of virgin materials. |
| **Steps** | Use materials with recycled content such that the total recycled content constitutes atleast 10% of the total cost of the materials used in the project.  *Notes:*   * *Material Cost = Total Cost – (Labour Cost + Installation Cost)* * *If Labour and Installation cost is not known, the default material cost can be considered as 60% of the total cost of the component* * *Cost of equipment, systems, lighting fixtures, appliances, movable furniture need not be considered in the total material cost* |
| **Documents Required** | Provide details of all materials used in the project with the material cost.  Specify recycled content in the materials used. Submit letters from manufacturers specifying the recycled content. |
| **Approach** | **InsertImage: 4-Material/ProcessFlow/3.png**  (Source- [IGBC](https://igbc.in/igbc/), [GRIHA](http://www.grihaindia.org/)) |

The materials and technologies chosen for construction must, in addition to functional efficiency, fulfil some or more of the following criterion, for the cause of sustainability and a better quality environment:

* Non endanger bio-reserves and be non-polluting;
* Be self-sustaining and promote self-reliance.
* Recycle polluting waste into usable materials
* Utilize locally available materials
* Utilize local skills, manpower and management systems
* Benefit local economy by being income generating
* Utilize renewable energy sources
* Be accessible to the people
* Be low in monetary cost

**Environment Friendly Indian Building Material** technologies that utilize locally available raw materials, wastes and by-products from industry, agriculture and natural fibres are following:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SL. NO.** | **NAME** | **USE** | **RAW MATERIAL:** | **SALIENT FEATURES** | **PRODUCT** |
| **1.** | Flyash-Sand-Lime-Gypsum Bricks | For walls in housing and all types of building construction, boundary walls. | Flyash/Volcanic Ash (60%), Sand (20%), Lime (15%), Gypsum (5%) | * Environment friendly * Accurate dimensions and excellent surface finish * Excellent strength * Quick drying of bricks * Reduced water absorption and shrinkage * Reduction in mortar consumption * Utilization of industrial wastes (ashes/sludges) and volcanic ash. |  |
| **2.** | Compressed Earth / Fly Ash Sand Lime Gypsum Blocks (Interlocking Type) | For walling compressed earth / fly ash sand lime gypsum blocks. | A. Compressed Earth Blocks:  Soil with minimum 20% of clay  Cement 5-10% depending upon the strength  B. Fly Ash-Sand-Lime-Gypsum Blocks:  Fly Ash, Sand, Lime, Gypsum | * The interlocking blocks required minimum quantity of mortar, plaster in the masonry work. * Faster masonry * Improved performance of masonry because of less number of joints * Environment friendly, energy efficient technology with very low consumption of energy * The production plant can work on electrical or diesel * Machines utilised for manufacturing blocks are mobile and can be shifted from site to site, either near the raw material source or near the construction site * The product can be designed for use in earthquake/ cyclone prone region * Volume of 1 block is equivalent to 3 standard size bricks * Use of marble powder/stone dust is possible |  |
| **3.** | Compressed Earth Bricks/Blocks | Can be used in walling in a variety of ways to construct buildings that are aesthetic, efficient and easy to build. Particularly suitable for rural areas. | Soil with minimum 20% clay,  cement 5-10% depending upon the strength requirement | * Energy efficient, eco-friendly technology * Bricks produced are of accurate dimensions and excellent surface finish * Better thermal insulation * Cost effective technology * External and internal plastering not essential. | * Wet compressive strength: 20 - 30 kg/cm2 * Water absorption: < 15 % by weight * Erosion: <5% by weight * Surface characteristics: No pitting on the surface |
| **4.** | Clay Flyash Burnt Bricks | For walling in the same manner as conventional burnt clay bricks | Soil (with minimum of 20% clay), Flyash, Sand, Fuel coal | * Environment friendly and energy efficient technology * Un-burnt carbon present in flyash helps in reduction of fuel consumption * Reduction in drying shrinkage and efflorescence as compared to clay bricks * Reduction in weight * Better thermal insulation * Less reduced emissions from kilns * Percentage of 1st class bricks is very high * Consumption of coal is 50% less than conventional kiln * Kiln used is a covered kiln therefore can work throughout the year and is not weather dependent | * Compressive strength: 75 - 150 kg/cm2 * Water absorption: 12 - 18% * Unit weight: 2.5 - 3 kgs * Bulk density: 1700 - 1900 kg/cm2 * Colour: Red |
| **5.** | Marble Slurry Bricks | For walling as an alternative to conventional clay bricks. | Marble slurry (83%), Cement (7%), Sand (10%) | * Environment friendly and energy efficient technology * High volume utilization of waste * Saves construction cost & time * Much stronger than clay bricks * Good heat and sound insulation * Fire resistant technology * 28% less consumption of mortar * 32% less consumption of labour * Plastering can be avoided * High load bearing capacity | * Compressive strength: 93 kg/cm2 * Water absorption: 14% * Volume of brick: 1687.5 cm3 * Color: White/Grey |
| **6.** | Solid/Hollow Concrete Blocks | For walls in housing and building construction as substitute to bricks. | Cement, Sand, Aggregates | * Cost effective walling option * Environment friendly and energy efficient * Simple manufacturing process * Industrial wastes like Fly Ash, Blast Furnace Slag etc. can be utilised * Less consumption of mortar * Leaner mix for production of blocks * Faster masonry | * Compressive strength: 40 – 150 kg/cm2 * Water absorption: < 10% by weight |
| **7.** | Cellular Light Weight Concrete | In building construction as substitute to conventional bricks/blocks particularly in multi-storey buildings as it helps in substantial reduction of dead weight leading to reduction of cost of foundations | Cement, Fly Ash/Volcanic Ash, Fine Sand, Foaming Agent. | * Environment friendly * Make use of Fly Ash/Volcanic Ash as one of the major constituents. * Depending upon application the density can be designed. * Being light weight material, reduces dead load which results in saving of steel in structure & foundation * High thermal insulation - particularly suitable to air-conditioned buildings * Less consumption of mortar as compared to brick masonry * Energy efficient * The components can be manufactured at site * Substantial material saving | * Range of densities: 400 - 1800 m3 * Compressive strength: 10 - 250 kg/sq.cm. * Water absorption: 5% by weight * Thermal conductivity: 0.082 - 0.555 w/mk |
| **8.** | Ferro cement Wall Panels | For walling particularly suitable where speedy construction is required. | Cement, Coarse Sand, Aggregates, Polyproplyne fibre, Admixtures, Welded mesh | * Cost effective technology * Energy efficient * Dimensional regularity in shape & size * Reduction in construction & finish time * Components can be retrieved for construction on other sites. | * Compressive strength: 150 kg/cm2 * Water absorption: <5% |
| **9.** | Rat Trap Bond Brick Masonry | For walling as an alternative to conventional English/ Flemish bond | **(for 1 cu.mt. of masonry)**  Bricks: 400 nos.  Cement: 36 kgs.  Sand: 0.15 m3  Scaffolding: 2.00 m3 | * Reduction in consumption of bricks by 25% as compared to 230 mm thick solid brick wall * Reduction in mortar consumption * Reduction in load of walls in foundation as Rat Trap Bond load is 80% of solid walls * Good thermal insulation * Equal strength compared to other conventional bonds * Same stability as that of solid walls * No need of plaster in wall surface * Considered as Earthquake Resistant Technology * Labour intensive technology * Upto 3 storeyed buildings can be constructed with this bond |  |
| **10.** | Micro Concrete Roofing Tiles | Cladding for sloping roofs of different types of buildings, as a substitute to country tiles, asbestos and other corrugated sheets. | Cement, Fine Aggregates (5 mm & below), Sand. | * Highly cost effective * Production under controlled condition * More durable and strong in different climatic conditions * Can be colored to specification * No noise during rain * Decentralized production makes it more energy effective * Manageable tile size makes the structure relatively lighter. * Reduction in construction and finishing time | * Shape: Corrugated (Two shapes available) * Weight: 2.25 kg/tile * Loading capacity: 60 kg/sq.mt. * Water absorption: 10% |

These technologies have been frequently taken from published literature of Building Materials & Technology Promotion Council (BMTPC), Central Building Research Institute (CBRI) and other Research Institutes engaged in R&D in the area of development of environment friendly, energy efficient and cost effective materials and technologies. These technologies have been successfully utilized for environmental protection, employment generation and housing construction in rural and urban settlements in India and several other countries.

[**Read more about this**](https://www.unido.org/sites/default/files/2009-04/Environment_friendly_Indian_building_material_technologies_for_cost_effective_housing_0.pdf)

**4. Local Materials**

**InsertImage: 4-Material/4.Local.png**

|  |  |
| --- | --- |
| **Type** | Mandatory Requirement |
| **Aim** | Encourage the use of factory building materials available locally thereby minimizing the associated environmental impacts.. |
| **Steps** | Ensure that atleast 50% of the total factory building materials by cost used in the factory building are manufactured within a radius of 500 Km. |
| **Documents Required** | Provide calculations demonstrating that, the project uses the required percentage of local materials in terms of cost.  Provide letters from the manufacturers / vendors indicating the distance between place of manufacture and the project site. |
| **Approach** | **InsertImage: 4-Material/ProcessFlow/4.png**  (Source- [IGBC](https://igbc.in/igbc/), [GRIHA](http://www.grihaindia.org/)) |

Environmental and financial building costs have been in an upward spiral for decades, with no end in sight. One way to fight this trend is to use green construction materials and methods whenever possible. They offer many advantages over traditional approaches.

|  |  |
| --- | --- |
| **Cost Savings** | When viewed as a whole, green construction materials offer significant financial benefits when compared to traditional components. This is true for the following reasons:   * Green materials are often recycled or reclaimed from other projects, avoiding initial production fees. * They make it easier to conform to building codes, which are becoming increasingly stringent across the nation. This reduces or eliminates costly delays in obtaining permits and passing inspections. * Many green materials are becoming less expensive every day, due to increased production and improved fabrication methods. The exact opposite is true of more traditional products.   Major cities are offering bonuses and other incentives to spur the development of building projects that incorporate green materials and methods into their makeup. |
| **Enhanced Health, Productivity, and Well-Being** | The hazards of using traditional materials in construction are well-documented. Not the least of these is the presence of volatile organic compounds (VOCs), which have a proven association with increased cancer risks and other health problems.  Green products are free of such contaminants. For example, wheat straw can be formed into sheets that perform the same function as plywood, without the use of formaldehyde. Vinyl-free floor coverings don’t contain that substance’s many toxins.  Being guided by such facts in selecting construction materials offers many benefits. It enhances the overall environment in the completed structure, leading (in the case of commercial buildings) to more productive employees, and (in the case of residential dwellings) to healthier, more physically active occupants.  Also, green construction materials go hand in hand with environmentally friendly building designs and methods, which incorporate natural light sources, open spaces, and brighter surroundings. All of these elements are associated with enhanced health and greater happiness. They have considerable payoffs for employers, builders, health care providers, and society at large. |

**InsertImage: 4-Material/4/1.png**

**How to achieve these benefits?**

|  |  |
| --- | --- |
| **Site Choice Criteria** | Choosing an appropriate location for the project involves numerous considerations. Some of the factors that could disqualify a particular choice include:   * The nearby presence of endangered species. * The site’s cultural or historical significance. * The need to deforest large areas, significantly alter the landscape, or disrupt the local ecosystem in any major way, such as altering the course of waterways or draining wetlands.   Determining that the land shouldn’t serve another purpose, such as agricultural production or providing recreational opportunities, is also an essential part of this stage of the project. While these considerations might limit the choice of sites, they will help ensure that the final structure is an asset to the surrounding environment, not a detriment to it. |
| **Site Design** | Traditional architecture has done far too little to consider the effect of local resources such as sunlight and wind on the shape the completed structure should take. For example, air conditioning bills are affected by the predominant breezes in the area. Areas free of existing trees can incorporate natural sunlight into structures better than can locations in valleys or those with significant overhead vegetation cover.  A long, narrow structure is well-suited to making the most of prospects for solar power generation. Locating fixed structures, like stairwells, in the building’s interior zones can leave room for work areas to receive a greater share of natural light. |
| **Planting and Landscaping** | Eco-friendly structures incorporate vegetation choices into their overall design. For example, traditional lawns require maintenance by gas-driven lawn mowing equipment and the use of pesticides. They provide little in return other than conformance to cultural norms. Alternative plants such as Dutch clover, on the other hand, have a pleasing appearance, require little or no upkeep, and provide food for wildlife.  As much as possible, the choice of plants, shrubs, and trees must be determined by what is native to the local environment. For example, arid regions are home to drought-resistant plant species that flourish on minimal water, greatly reducing or even eliminating the need for such intrusive methods as installing sprinkler systems. A green landscaping plan will take such factors into consideration. |
| **Technology** | Modern building automation developments offer significant benefits for minimizing waste and should be incorporated into the structure as much as possible. Motion detectors can switch off lights in unoccupied rooms. Individualized climate control systems can limit heating and cooling to areas of the building where people are present. HVAC systems that use green refrigerants avoid the damage to the ozone layer caused by CFCs. In addition, wind turbines and solar panels should furnish as much of the building’s power needs as possible. |

**(Source-** [**Burnham**](https://www.burnhamnationwide.com/final-review-blog/2013/01/benefits-of-using-green-construction-materials-and-methods)**)**

[**Read more about this**](https://blog.thomasnet.com/top-6-benefits-of-local-sourcing)

**5. Material Reuse**

**InsertImage: 4-Material/4.Local.png**

|  |  |
| --- | --- |
| **Type** | Mandatory Requirement |
| **Aim** | Encourage the use of salvaged building materials and products to reduce the demand for virgin materials thereby minimizing the impacts associated with extraction and processing of virgin materials. |
| **Steps** | Ensure atleast 5% of the total cost of the building materials is salvaged, refurbished and reused. |
| **Documents Required** | Provide calculations demonstrating that the project uses the required percentage of salvaged materials in terms of cost.  Provide sources of such salvaged materials. |
| **Approach** | **InsertImage: 4-Material/ProcessFlow/5.png**  (Source- [IGBC](https://igbc.in/igbc/), [GRIHA](http://www.grihaindia.org/)) |

**InsertImage: 4-Material/5/1.png**

|  |  |
| --- | --- |
| **Checklist** | |
| **Concrete** | * Types of concrete and rubble accepted. * Size of concrete pieces. * Amount of preprocessing. * Acceptable levels of bricks and tiles. * Acceptable amount of contamination from materials such as glass, metal, soil. |
| **Metal** | * Types of metal accepted. * Contamination tolerances from materials such as plastics and leftover product in containers. |
| **Plasterboard** | * Whether demolition board is acceptable. * Minimum and maximum sizes of chip or powder particles. * Contamination tolerances from materials such as screws, nails, paint and glues. * Moisture tolerances. * Minimum and maximum quantities. |
| **Timber** | * Types of timber acceptable (for example, treated, native, untreated). * Minimum and maximum sizes of board and lengths of timber. * Minimum and maximum quantities. * Contamination tolerances from materials such as nails, paint, concrete. * Any preprocessing requirements such as sorting or grading. * How timber is to be received (for example, loose, stacked in containers or on pallets). |

[**Read more about this**](http://www.level.org.nz/material-use/minimising-waste/reuse-and-recycling/)

**6. Certified Wood / Rapidly Renewable Building Materials and Furniture**

**InsertImage: 4-Material/6.FSC.png**

|  |  |
| --- | --- |
| **Type** | Mandatory Requirement |
| **Aim** | To minimize the usage of virgin wood thereby encouraging responsible forest management. |
| **Steps** | Ensure atleast 50% (by cost) of all wood based products used in the building will be FSC (Forest Stewardship Council) or the local Forest Department certified wood or rapidly renewable based products. |
| **Documents Required** | Provide details showing the total cost of wood based products procured for the building.  Provide details on the FSC / Forest Department certified wood or rapidly renewable products  used. Also show the percentage calculations of the certified wood / rapidly renewable  materials used to the total cost of new wood used for doors, windows, furniture etc. |
| **Approach** | **InsertImage: 4-Material/ProcessFlow/6.png**  (Source- [IGBC](https://igbc.in/igbc/), [GRIHA](http://www.grihaindia.org/)) |

**FSC and SFI are the two green certifications**

FSC (**Forest Stewardship Council)** runs a global forest certification system with two key components:

* [Forest Management](http://www.fsc-uk.org/en-uk/business-area/fsc-certificate-types/forest-management-fm-certification)
* [Chain of Custody](http://www.fsc-uk.org/en-uk/business-area/fsc-certificate-types/chain-of-custody-coc-certification)

**Responsible forest management** Includes:

* Protecting fragile ecosystems
* Respecting native cultures and economies
* Preventing illegal logging
* Restricting clear-cutting (removing all trees in a tract) and pesticide use
* Monitoring the “chain of custody,” or ensuring that the wood in the product you’re looking at really came from the forest that was certified.

This system allows consumers to identify, purchase and use wood, paper and other forest products produced from [well-managed forests](http://www.fsc-uk.org/en-uk/business-area/fsc-certificate-types/forest-management-fm-certification) and/or [recycled materials](http://www.fsc-uk.org/preview.recycled-label-factsheet.a-146.pdf). The Sustainable Forestry Initiative (SFI) certification is helpful, too, though less rigorous. FSC's [“tick tree” logo](http://www.fsc-uk.org/en-uk/business-area/use-the-logo) is used to indicate that products are certified under the FSC system. here are three types of FSC label: 100%, FSC Mix or FSC Recycled. Because it’s harder to achieve, it’s harder to find in the store.

**Click here to know about the suppliers**

**InsertImage: 4-Material/6/1.png**

**InsertImage: 4-Material/6/2.png**

**(Source-** [**FSC International**](https://ic.fsc.org/en/for-business/business-benefits)**)**