Building Materials Reuse and Recycle - A study based on Recycled Alternatives

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Abstract - While the world has come to rely on concrete as one of the main materials for building construction, concrete could harm the environment more than it is helping. To illustrate, 16% of all fossil fuel consumed every year is used to turn those raw materials into construction products. Regarding this, here are some several green alternatives for building material which can give a lower impact on the environment: Recycled Plastic , Ferrock, Mycelium , etc.

The building industry has not only become a major consumer of materials; it has also become a source of pollution. Environmental integrated production and reusing and recycling is of great importance for the competitive position in India . Indian States shall ensure that the technical, environmental and economic feasibility of alternative systems is considered before construction starts . The article focuses on Reuse Building Materials as a way for environment protection and sustainable development. Integrated environmental management integrates the requirements of sustainable development and LEED. There are many methods used to reduce waste and increase profits through salvage, reuse, and the recycling of construction waste. Sustainable development as a tool to continual improvement cycle and with processes innovation the need to save money in the processes via reduced resources and utility costs. This article demonstrates that alternatives to modern building materials are available through case studies locally and internationally and puts to light a product in market which brings awareness of sustainability in construction.

Key words: environment, management, reuse, salvage, sustainable development

I. INTRODUCTION

All systems recycle. The biosphere is a network of continually recycling materials and information in alternating cycles of convergence and divergence. As materials converge or become more concentrated they gain in quality, increasing their potentials to drive useful work in proportion to their concentrations relative to the environment. As their potentials are used, materials diverge, or become more dispersed in the landscape, only to be concentrated again at another time and place. Fitting the patterns of humanity to these material cycling pathways has become paramount in importance as our numbers and influence on the biosphere increases.

Directive 2002/91/EC on the energy performance of buildings (the EPBD) requires several different measures to achieve prudent and rational use of energy resources and to reduce the environmental impact of the energy use for buildings. This is to be accomplished by increased energy efficiency in both new and existing buildings. One tool for this will be the application by Member States of minimum requirements on the energy performance of new buildings and for large existing buildings that are subject to major renovation (EPBD Articles 4, 5 and 6). Other tools will be energy certification of buildings (Article 7) and inspection of boilers and air- conditioning systems (Articles 8 and 9).

A basic requirement for measures in Articles 4, 5, 6 and 7 is the existence of a general framework for a methodology of calculation of the total energy performance of buildings, as set out in Article 3 and the Annex to the Directive [1].

Directive 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16

December 2002 on the energy performance of buildings in article 5 says:

Member States shall take the necessary measures to ensure that new buildings meet the minimum energy performance requirements referred to in Article 4. For new buildings with a total useful floor area over 1 000 m2, Member States shall ensure that the technical, environmental and economic feasibility of alternative systems are considered and is taken into account before construction starts [2].

In order to stop the global warmth due to the CO_2 concentration, the energy use should be decreased. The investment of building construction industry in Japan is about 20% of GDP. This In order to save energy as well as resource, the recycle of the building materials should be

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urgent to be carried out.

II. Environmental Management and Strategies for Building Material Reuse and Recycle

Leaders of successful, high-growth companies understand that innovation is what drives growth, and innovation is achieved by awesome people with a shared relentless growth attitude and shared passion for problem solving and for turning ideas into realities. Companies that continuously innovate will create and re-invent new markets, products, services, and business models – which leads to more growth. Innovation is founded on your enterprise's ability to recognize market opportunities, your internal capabilities to respond innovatively, and your knowledge base. So, the best thing to do to guarantee growth is to build a sustainable innovation organization around the following components:

1. Vision and strategy for innovation
2. Culture supporting innovation
3. Processes, practices and systems supporting innovation
4. Top management team leading innovation
5. Cross-functional teams mapping innovation road
6. Empowered employees driving innovation.

Reuse and recycling of building material is a growing area of interest and concern in many parts of the USA. Current practices and trends in the building material waste management area are examined from a building life cycle standpoint or cradle to reincarnation concept.

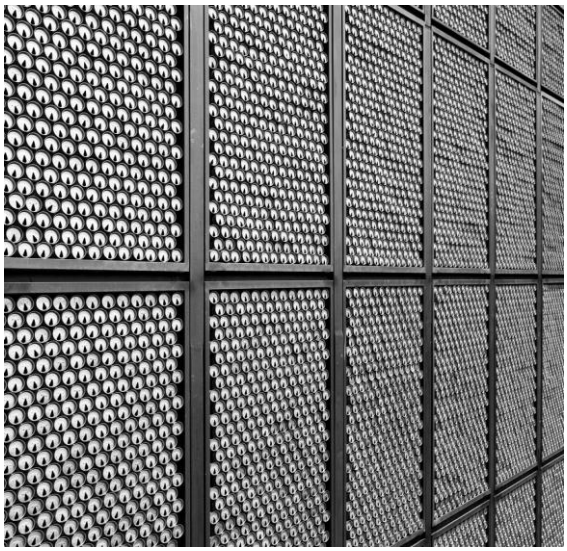

Figure 1: Archi Union Architects Inc. have developed a wall system that contains a grid of empty cans their mixed-use project, can cube. The can façade is even adjustable for daylighting by occupants. **Source : Archdaily**

In today's world "going green" has become a top priority in our society, and sustainable buildings and design are at the forefront of this green revolution. While many designers are focusing on passive and active energy systems, the reuse of recycled materials is beginning to stand out as an innovative, highly effective, and artistic expression of sustainable design. Reusing materials from existing on site and nearby site elements such as trees, structures, and paving is becoming a trend in the built environment, however more unorthodox materials such as **soda cans and tires as shown in Figure 1 and Figure 3** are being discovered as recyclable building materials. Materials and projects featured after the break.

It is important to recognize that the sustained growth in reuse efforts, as well as the sustained interest of the reuse industry, derives in large measure from the solid waste reduction hierarchy: Reduce, Reuse, then Recycle. It is best to reduce first, reuse as a second option, then to resort to recycling. Reuse is recognized as being distinct from recycling, both in doctrine, and in the handling of the materials this unique industry diverts from the waste stream. Recyclers have successfully kept materials out of the landfill by collecting, segregating, processing and manufacturing their collected goods into new products. Reusers, on the other hand, with little or no processing, keep materials out the waste stream by passing the goods they collect on to others. There are also forms of managing materials that are not quite reuse and not quite recycling.

- **Repair** is a method of taking an item, which may appear to have lived its useful life, and fixing it so that it can still be productive.
- **Remanufacturing** and **refurbishing** are ways of taking some used components and some new components to "rebuild" an item.

Reuse is a means to prevent solid waste from entering the landfill, improve our communities, and increase the material, educational and occupational wellbeing of our citizens by taking useful products discarded by those who no longer want them and providing them to those who do. In many cases, reuse supports local community and social programs while providing donating businesses with tax benefits and reduced disposal fees.

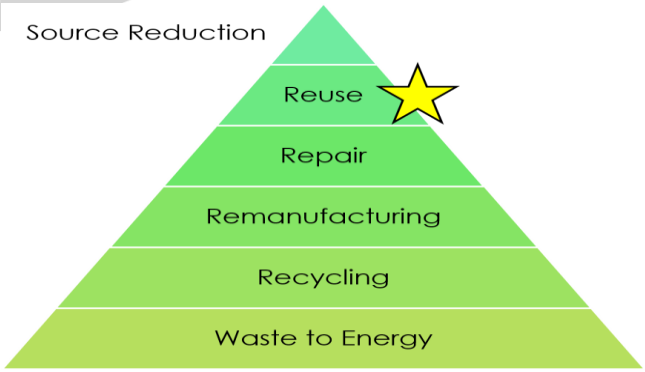

Figure 2: Reuse in waste reduction hierarchy.

Benefits of Reuse:

- Environmental Benefits

Many reuse programs have evolved from local solid waste reduction goals because reuse requires fewer resources, less

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energy, and less labor, compared to recycling, disposal, or the manufacture of new products from virgin materials. Reuse provides an excellent, environmentally-preferred alternative to other waste management methods, because it reduces air, water and land pollution, limits the need for new natural resources, such as timber, petroleum, fibers and other materials. The US Environmental Protection Agency has recently identified waste reduction as an important method of reducing greenhouse gas emissions, a contributing factor to global warming.

- Community Benefits

For many years, reuse has been used as a critical way of getting needed materials to the many disadvantaged populations that exist. Reuse continues to provide an excellent way in which to get people the food, clothing, building materials, business equipment, medical supplies and other items that they desperately need. There are other ways, however, that reuse benefits the community. Many reuse centers are engaged in job-training programs, programs for the handicapped or at-risk youth programs.

- Economic Benefits

When reusing materials, instead of creating new products from virgin materials, there is less burden on the economy. Reuse is an economical way for people of all socio-economic circles to acquire the items they need. From business furniture to household items, from cars to appliances, and it is less expensive to buy used than new.

III. GREEN BUILDING

Sustainable design and construction, or "green building," is a holistic approach that minimizes environmental impact, reduces maintenance, and creates a more desirable workspace for the building occupants.

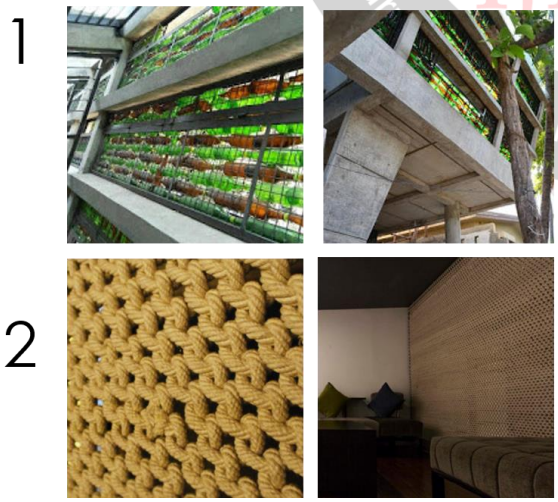

Figure 3 : **1 : MR. SYED RADHA RESIDENCE, ADAYAR AR. Murali Murugan 2 : CHENDOOR BAR , TRICHY AR. Santhosh Shanmugam**

Green building focuses on sitting issues, energy and water efficiency, recycled content building materials, minimizing local and global environmental effects caused by buildings, and indoor environmental quality. The goal is to transform the market of public funded construction, so that all projects will be designed and constructed reflecting green building principles [3].

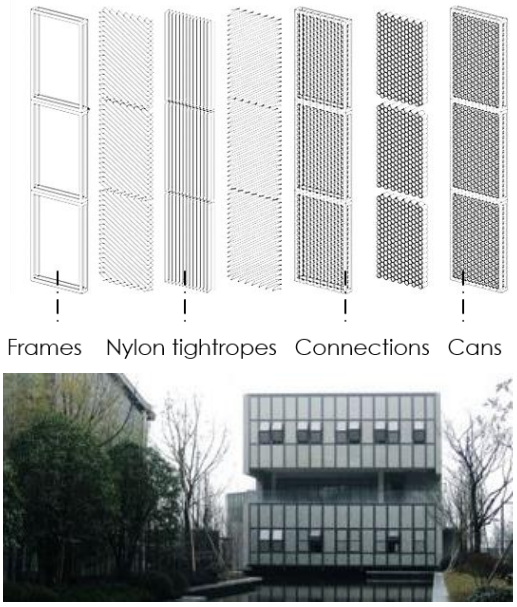

Figure 4 : Method of Façade in Can Cube

The EPBD is set to promote the improvement of energy performance of buildings with four requirements to be implemented by the Member States:

- General framework for a methodology of 1.
- Calculation of the integrated performance of buildings
- Setting of minimum energy standards in new and existing buildings
- Energy certification of buildings
- Inspection and assessment of heating and cooling installations.

Some of the Buildings were visited and reuse and sustainable practices were studied.

The goal in this project **Fig 3.1** was to adapt low cost construction techniques yet never compromising in making the best habitat for the client.

The interesting design feature in this house is the reuse of waste beer bottles on the inclined façade, making it visually appealing and at the same time being environment friendly at an affordable cost. It is a suitable alternative material for a partition and completely sustainable as it produces no harm during its making and being. Weaving a nautical docking rope created this handmade fabric yet translucent wall as shown in **Fig 3.2**

Buildings will have an impact on long-term energy consumption and new buildings should therefore meet minimum energy performance requirements tailored to the local climate. Best practice should in this respect be geared to the optimum use of factors relevant to enhancing energy

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performance. As the application of alternative energy supply systems is generally not explored to its full potential, the technical, environmental and economic feasibility of alternative energy supply systems should be considered; this can be carried out once, by the Member State, through a study which produces a list of energy conservation.

A Literature study was even studied where Can Cube's façade **Fig 4 and Fig 1** is a system of aluminium carbonated drink cans which are enclosed in an aluminium frame. The façade saves the energy wasted during recycling processes by reusing the cans in their current form, without the need for recycling or further processes.

Figure 5: Steve Hall @ Hedrich Blessing

IV. MINIMIZE CONSTRUCTION WASTE IMPACTS

The following considerations can minimize waste impacts on any size project. From the broad influences of design to the specific methods used on the job-site, all play a role in the prevention of waste.

A. Design to Prevent Waste.

Design with standard sizes for building materials. Specify materials and assemblies that can be easily disassembled at the end of their useful life.

Design precast concrete members for concrete (Tilt- up) construction.

Choose durable non-toxic interior finishes or materials.

Design spaces to be flexible for changing uses. Consider reusing materials (on-site) or installing salvaged materials from off-site sources.

B. Plan for Waste Prevention.

Target specific waste producing practices for waste prevention.

Include waste prevention measures in a Waste Management Plan.

Communicate your waste management plan at meetings, post it on-line, and promote the result.

C. **Use Construction Methods that Prevent Waste**. For wood construction, use advanced framing techniques trusses for roof or floor framing, finger- jointed studs and trim, and engineered wood products.

Consider using wood frame wall panels prefabricated off-site.

D. **Practice Job-Site Waste Prevention Methods**. Set up central cutting areas for wood and other materials. Reuse concrete forms or choose reusable metal or fiberglass forms. Clearly mark areas key to waste prevention, such as the material storage, central cutting, and recycling stations.

Another popular trend regarding recycled building.

As environmental designers, we continually replace natural landscapes with our own built environment, and today our built environment is embellishing the natural environment in a responsible (while still aesthetic) manner. We can use the leftovers also, try using them at façade, as shown in **Fig.5 T**he Steve Hall Ana Arbour District library by inForm Studio are reaping the harvest of their sites. The architects at inFORM researched the site for the Ann Arbor Library to find that ash trees from the surrounding forest were being destroyed by insects and could be salvaged into various surfaces within building & also the leftover materials. Require suppliers to take back or buy-back substandard, rejected, or unused items [3].

V. REUSE LIGHTWEIGHT CONCRETE

The process of reusing and recycling begin by product design and development. Some of these benefits may include: lower costs, stimulation of innovation, new business opportunities, and improved product quality. Strategies for recycling building materials:

- Set a goal
- Select a contractor with proven recycling experience
- Use a Construction Waste Management Specification
- Monitor the waste reduction program.

If you look at the recycling facts, you will see that since 1990, the United States has improved dramatically in their recycling activities. Recycling facts report that fifteen years ago, the U.S. recycled roughly fifteen percent of our waste materials, which today has doubled to thirty percent! The following recycling facts are both interesting and fun bits of information to increase your knowledge on the art of recycling.

Up until now, issues of modeling and improvement of heat protection and efficient use of energy in buildings have not been adequately addressed as it is required by sustainable development approach. Ecological concerns provided the need for intensive research of recycling of waste. Why is such kind of study important? Because of environmental protection:

- by minimizing waste,
- saving of fossil fuels due to recycling,
- to improving recycling process,
- optimized use of available resources,
- improved intellectual capital,

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- optimized, effective and efficient processes,
- enhanced organizational performance, credibility and sustainability
- reduced costs.

A variety of raw materials are used to produce concrete from lightweight aggregates. One of them is Poraver®. The raw material for Poraver® is glass or – to be more precise – recycled glass, which can be seen in **Figure 6** of which millions of tons are collected in the Federal Republic of Germany every year employing – to all intents and purpose – a perfect recycling system. Poraver® makes use of only the valuable raw material which for technical reasons cannot be utilized by the glass industry to manufacture new glass products, e.g. fine glass shards. Poraver® thus makes a decisive contribution to perfecting the glass recycling process, at the same time protecting natural resources.

The objective of this study was to investigate recycling of construction waste of concrete from lightweight aggregates (density from ca 600 kg/m^3). A commercially available concrete from lightweight aggregates Poraver® was selected for this investigation. Volume of the reactor, dimensions 150 x 150 x 150 mm, was charged with rest, construction waste material of concrete from lightweight aggregates Poraver® and rest of volume with new raw materials of concrete from lightweight aggregates Poraver® used as binding. We made the new step as a recycling crushed construction waste from concrete from lightweight aggregates Poraver® and fresh concrete from lightweight aggregates as a binding.

Figure 6: Alternative Material ,Poraver

VI. CONCLUSION

Construction Waste Management is a part of a growing movement toward a sustainable world. Sustainability or "green" management techniques are designed to protect the environment, save resources, and conserve energy. The use of construction waste management techniques which rely on salvage, recycle and reuse of materials have proven to have economic benefits for the construction industry . In our contribution we propose a model of recycling construction materials, made of lightweight concrete, with aggregates containing expanded glass. The scope of the model is to plan construction with minimum of waste and to improve energy efficiency in buildings. NSDS follows the general principle of the Renewed EU Sustainable Development Strategy and its key objectives. It covers its key challenges to a satisfactory degree as well and at the same time it integrates the Lisbon goals with the national setting. Slovenia is well aware of the fact that the principle of sustainable development necessitates to be perceived as a continuous process (and not as a one-time document) that has mechanisms set up for monitoring, reporting and adapting of the strategy if necessary. The theory on the basis of the practical experiences envisages sustainable development planning as a process of continuous improvement.

As the process of recycling materials continues to increase as a fashionable and sustainable statement in the architectural world, designers are proposing groundbreaking and futuristic methods that push the boundaries of how we think and build.

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