Reuse Building Materials

DAVORIN KRALJ[1], MIRKO MARKIČ[2]

ART-K, BusinessConsulting, Na gricu 47, 2000 Maribor, SLOVENIA[1],
Faculty of Management, University of Primorska, Cankarjeva ul. 5, 6104 Koper, SLOVENIA[1,2]

Abstract:

EU Member States shall ensure that the technical, environmental and economic feasibility of alternative systems is considered and is taken into account 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 LCA. 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.

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

1 Introduction

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 COUNCILof 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 such as:

- decentralised energy supply systems based on renewable energy,
- CHP,
- district or block heating or cooling, if available,
- heat pumps, under certain conditions,
-

is considered and is taken into account before construction starts [2].

2 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. Green building focuses on siting 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].
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 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 measures, for average local market conditions, meeting cost-effectiveness criteria. Before construction starts, specific studies may be requested if the measure, or measures, are deemed feasible [2].

3 Minimize 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 roll 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. See Waste Management Plan and Reporting Form.
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 (e.g. 24" on-center, and insulated headers), 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.
Practice material storage and handling procedures to prevent loss or damage.

E. Purchase to Prevent Waste.
Purchase salvaged, recycled, or recycled-content materials and equipment.
Check to ensure the correct amount of each material is delivered to site.
Maintain an up-to-date material ordering and delivery schedule to minimize the amount of time that materials are on-site and reduce the chance of damage.
Replace toxic materials with less toxic or non-toxic products to reduce hazardous packaging.
Choose products with minimal or no packaging.
Ask suppliers to deliver supplies using sturdy, returnable pallets and containers. Have suppliers pick up pallets and empty containers.
Require suppliers to take back or buy-back substandard, rejected, or unused items [3].

4 Reuse Lightweight Concrete

If you look at the recycling facts, you will see that ince 1990, the United States has improved ramatically 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 [4]. The process of 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 [5].
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 [6]

Up until now, issues of modelling 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,
- optimized, effective and efficient processes,
- enhanced organizational performance, credibility and sustainability
- reduced costs [7].

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, 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 utilised 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. Apart from its areas of use in the classic building materials and additional building materials industry, Poraver® is also gaining popularity in special applications [8].
The objective of this study was to investigate recycling of construction waste of concrete from lightweight aggregates (density fromca 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. Recycling follow next activity by normal room condition:

a) assembling rest construction waste from concrete from lightweight aggregates Poraver® ,
b) crumbling into small pieces (Figure 2),

after that we took crumbled construction waste of concrete from lightweight aggregates Poraver® (mechanical reprocessing), as a raw input material in the processing line to the reactor,

c) charging of reactor volume with "new" raw material,
d) binding reaction between new raw materials of fresh concrete from lightweight aggregates Poraver® and rest material of construction waste from concrete from lightweight aggregates Poraver® ,
e) binding process,
f) cooling,
g) quality control.

Prescription of raw materials of concrete from lightweight aggregates Poraver® was used from producer. Granular size [mm] of crumbled waste concrete from lightweight aggregates Poraver® presents figure 1. From the results it can be seen that recycled "new" recycled material, concrete from lightweight aggregates Poraver® has characteristics as presents table 1.

Figure 1: Granular size [mm] of crumbled from waste concrete from lightweight aggregates Poraver®

Test cube	-	Mass of LWC kg	Density kg/m^3	Compressive strength N/mm^2	Thermal conductivity W/mK
1	-	1,93	571,9	4,44	0,18
2	-	1,95	577,8	4,67	0,18
3	-	1,99	589,6	4,36	0,18
	Mass of waste LWC kg	Mass of recycled LWC kg	Density kg/m^3	Compressive strength N/mm^2	Thermal conductivity W/mK
4	0,2	2,15	637,0	4,31	0,19
5	0,2	2,14	634,1	4,22	0,19
6	0,2	2,18	645,9	4,04	0,19
7	0,4	2,12	628,2	3,33	0,21
8	0,4	2,12	628,2	3,64	0,21
9	0,4	2,13	631,1	3,82	0,21

Table 1: Characteristics of recycled material, concrete from lightweight aggregates Poraver®

Figure 2 and 3 present recycled material from concrete from lightweight aggregates Poraver®

Figure 2: Recycled "new" material from lightweight aggregates Poraver®

Figure 3: Recycled material from concrete from lightweight aggregates Poraver® scanning electron microscope

5 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 [9]. In our contribution we propose a model of recycling construction materials, made of lightweight concrete, with aggregates containing expanded glass. The scope of the aforementioned model is to plan construction with minimum of waste and to improve energy efficiency in buildings.

References:

[1] CEN/BT WG 173 EPBD N 15 rev, Explanation of the general relationship between various CEN standards and the Energy Performance of Buildings Directive (EPBD) ("Umbrella document") Version 3a, 25 October 2004

[2] Directive 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCILof 16 December 2002 on the energy performance of Buildings

[3] http://www.ga.wa.gov/EAS/CWM/guideline.html / 10.12.2007

[4] http://www.www-recyclinganswers.com/recycling.html/14.12.06

[5] ISO 14062:2002(E) Environmental management-Integrating environmental aspects to product design and development

[6].http//www.resourceventure.org/rv/publications/building/CWM-NonConstProfs.pdf,10.03.2007

[7]Ogrin U, Kralj D.: *Economic Efficiency and Environmental Management System, WSEAS ED 06, Issue 10, Vol 2, Oct 2006*

[8] http://www.poraver.de/EN/frame_en.html/ (10.03.2007).

[9] Kralj D.,: *Environmental Waste Management in Constructions,*Lecture Notes on Energy and Environment, WSEAS 07,Archanchon, France, Oct.2007.

[10] ISO 1401:2004(E) *Environmental management system – Requirements guidance for use*