



THEME

ECO-COMPATIBLE MATERIALS



Project cofinanced by



European Regional
Development Fund



Lead Partner



Sustainable
Construction
in Rural and Fragile Areas
for Energy efficiency

THEME

ECO-COMPATIBLE MATERIALS

DECLINATIONS

- ✓ new constructions
- ✓ requalifications of recent buildings
- ☐ renovation and refit works of historical buildings
- ☐ works “ex novo” in historical contexts

Improvement of ecological compatibility, eco-compatibility (also called eco-design, design for environment, life-cycle design) is an essential target in recent public and industrial development policies. In the design of new materials, products and processes optimization of eco-compatibility is added to the common criteria of technical performance and economic viability. The basic motivation for the present concept is to provide a simple and effective tool, combining technical, economic and ecological aspects. In particular it is considered how a materials scientist and engineer can deal prospectively with the technical, economic and ecological aspects in development. The concept is a tool for life-cycle engineering. But it is mainly intended to be a tool which simplifies the analysis and clarifies the terms for improvement of eco-compatibility in scientific technical, economic-industrial as well as in socio-political contexts. Inherent complexity impedes the simultaneous, prospective and quantitative treatment of technical, economical and ecological aspects of a new material, product or process in a compatible framework. Traditionally, ecological assessments have started with considerations of damage caused by emissions and waste disposal.

The first reason that green building materials are better than conventional building material is the fact that these contain much lesser chemicals in comparison with conventional products and so are beneficial to the environment that is maintained within the home, and also beneficial to the people who work with the material. In addition, there is also lesser harm done to the environment, both through the form from which they are taken or manufactured. There are a number of different chemicals such as fluoro-polymers and plasticizers that are made use of in conventional building materials. The long-term effects of these products are known to be harmful and unfortunately, their detrimental effects only keep increasing with time.

There are two types of traditional material which can be used in new ways:

- a) Soil bricks (adobe), and
- c) Wood logs

The first one is the modern form of a very ancient material which can be produced locally.

The technology can easily be adapted to multi storey buildings.

The second relies on the importation of prefabricated houses based on north European and North American designs. Cyprus does not have the forests that would be needed to sustain large scale application. The technology is not easily adapted to multi storey buildings.

Another factor that decides the eco-friendly value of a building material is the efficiency that is provided towards the energy use of the structure and also the decreased maintenance costs. A product that is capable of providing more sustainability looks to a savings in terms of either money, or energy or both. This is not only over a limited period of time, but is rather a concept that is effectual for many years on end.

It is also necessary that the materials that are being used do not turn into ones with negative effects over a period. This is another criterion for eco-friendly building supplies. There is no saying that a product will be totally eco-friendly especially since a minimum of transportation is seen while the product is being used. However, if the product matches up to sustenance and efficiency levels that are a marker on the subject, there is no doubt that it is a green product.

CASE STUDIES

Showroom GEVO – Limassol: The exhibition centre of GEVO is an environmentally friendly building, since it combines perfectly the rational use and the implementation of several new technological systems utilizing renewable energy sources

Ayii Anargyri Natural Healing Spa Resort : The idea/concept was to design a spa resort with the following criteria: to respect the environment and the existing old trees, to keep the original monastery architecture on the exterior of the buildings using stone, wood, roof, tiles etc. and modern design on the interior, to use the natural sulfur water through modern machinery and technologies and to use renewable energies to cover part of the final energy consumption.

LEGAL AND REGULATORY ASPECTS

☐ EU directives reference:

DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2002 on the energy performance of buildings

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:001:0065:0065:EN:PDF>

☐ National laws and decrees reference:

- energy efficiency of buildings law N142(i) 2006

[http://www.mcit.gov.cy/mcit/mcit.nsf/All/DF8E187B6AF21A89C22575AD002C6160/\\$file/N142\(i\)2006%20peri%20Rythmisis%20Energiakis%20Apodosis%20Ktirion%20Nomos.pdf](http://www.mcit.gov.cy/mcit/mcit.nsf/All/DF8E187B6AF21A89C22575AD002C6160/$file/N142(i)2006%20peri%20Rythmisis%20Energiakis%20Apodosis%20Ktirion%20Nomos.pdf)

- energy efficiency of buildings law N30(i) 2009

[http://www.mcit.gov.cy/mcit/mcit.nsf/All/DF8E187B6AF21A89C22575AD002C6160/\\$file/KDP429_2006%20peri%20Rythmisis%20Odon%20kai%20Oikodomon%20\(Energeiaki%20Apodosi%20ton%20Ktirion\)%20Kanonismoi.pdf](http://www.mcit.gov.cy/mcit/mcit.nsf/All/DF8E187B6AF21A89C22575AD002C6160/$file/KDP429_2006%20peri%20Rythmisis%20Odon%20kai%20Oikodomon%20(Energeiaki%20Apodosi%20ton%20Ktirion)%20Kanonismoi.pdf)

- Calculation methodology on energy efficiency building ordinance of 2007 (ΚΔΠ 414/2009)

[http://www.mcit.gov.cy/mcit/mcit.nsf/All/DF8E187B6AF21A89C22575AD002C6160/\\$file/KDP414_2009%20peri%20Rythmisis%20Energeiakis%20Apodosis%20Ktirion\(Methodologia%20Ypologismou%20Energeiakis%20Apodosis%20Ktirion\)%20Diatagma.pdf](http://www.mcit.gov.cy/mcit/mcit.nsf/All/DF8E187B6AF21A89C22575AD002C6160/$file/KDP414_2009%20peri%20Rythmisis%20Energeiakis%20Apodosis%20Ktirion(Methodologia%20Ypologismou%20Energeiakis%20Apodosis%20Ktirion)%20Diatagma.pdf)

- Regulation 429/2006 on Roads and Buildings (Energy Performance of Buildings) ΚΔΠ 429/2006)

[http://www.mcit.gov.cy/mcit/mcit.nsf/All/DF8E187B6AF21A89C22575AD002C6160/\\$file/KDP429_2006%20peri%20Rythmisis%20Odon%20kai%20Oikodomon%20\(Energeiaki%20Apodosi%20ton%20Ktirion\)%20Kanonismoi.pdf](http://www.mcit.gov.cy/mcit/mcit.nsf/All/DF8E187B6AF21A89C22575AD002C6160/$file/KDP429_2006%20peri%20Rythmisis%20Odon%20kai%20Oikodomon%20(Energeiaki%20Apodosi%20ton%20Ktirion)%20Kanonismoi.pdf)

STRENGTHS/BENEFITS

❑ reduction of resources consumption: The use of mud bricks in their modern form, the adobe soil brick, has not really started in Cyprus. There was a research project some years ago which produced interesting results. The unfired bricks had only 2% the energy content of the fired bricks. Mass use of the adobe brick will make a considerable saving in the use of conventional fuels. Wooden log-houses have been imported and erected in very small numbers, particularly as holiday houses.

❑ reduction of environmental impacts: Phenomenal growth in the construction industry depends upon depletable resources. Production of building materials leads also to irreversible environmental impacts. Using eco-friendly materials is the best way to build an eco-friendly building.

❑ improving the quality of the indoor environment: Eco-friendly building materials enhance the interior air quality of a home by meeting one or more criteria. They can be low in toxins, including carcinogens and reproductive toxins, as proven by product testing. They may emit minimal levels of volatile organic compounds (VOCs). Some do not promote moisture or the growth of biological contaminants such as mold. A final criteria qualifying materials as eco-friendly is that they require cleaning with only natural, nontoxic cleaning products.

❑ other: Modern adobe bricks in the hands of a masterful architect can produce excellent designs and there are many examples to be seen around the world. In combination with timber the aesthetic effect is excellent. The adobe brick is 100% recyclable. The same can be said of wood houses.

❑ Health: Chemicals emitted from building materials can be a potential source of health problems if they are not properly addressed. For example, cabinets, counter tops, and furniture are often made from pressed wood products such as particleboard or medium-density fiberboard (MDF), which are typically manufactured with formaldehyde-based adhesives. This formaldehyde can release off gas into a building for years. Unfortunately for family's health, formaldehyde is a known human carcinogen according to the World Health Organization, it can also cause watery eyes, headaches, fatigue, and nausea. Paint and floor finishes can also contain formaldehyde and other chemicals that are not healthy to breathe, especially for small children. Eco products and materials reduce or eliminate these sources of indoor pollution. These include a wide range of products such as low-VOC paint, solvent-free adhesives, and water-based wood finishes that not only eliminate many of the suspected and known carcinogens, but often perform better than traditional products.



Houses built with eco-compatible materials

Wooden log houses are energy efficient as well as environmentally friendly. Natural log construction is on the "green" list, in part because it eliminates many of the toxic materials used in insulating traditional wood frame homes. Today's log homes are both contemporary and traditional, with a style to suit every taste.

Benefits:

1. Ecological construction with natural wood without the use of harmful substances to human health.
2. Energy conserving construction, with a direct effect on fuel economy and excellent field of electromechanical applications and innovations, such as floor heating with solar collectors, photovoltaic energy, geothermal etc.
3. Anti-seismic construction because of the manner of construction and the use of the materials.
4. Greater fire resistance compared to conventional structures where, if the fire is not extinguished quickly, the large expansion of the iron in reinforced concrete leads to the collapse of the concrete and the immediate demolition of the construction. In the same time of burning a conventional construction, the logs of wood in a wooden house would have lost (burned) 1-2 centimeters on the outside. After sanding and repainting, a log house can be reoccupied, without requiring demolition.
5. Fast delivery time. This is something that is imposed by the properties of the material because the logs are received with high moisture and should be placed in position immediately to avoid any distortion problems.
6. Durability. Wooden constructions with arctic trunks have the greatest durability with over 500 years duration. Examples are the hundreds of Russian churches of the 14th century that are kept in excellent condition while those made of stone last 200-250 years and those of conventional construction have only 100 years lifetime.
7. Dismantling and reuse of logs at another site is possible whenever required. In a conventional structure the house has to be demolished, e.g. when one would change the use of land. With wood, if it cannot be utilized for anything else, it can be used as firewood providing free fuel for many years.
8. Very little maintenance. After an initial treatment with ecological varnish primer internally and externally during construction no other maintenance is required for life. The exterior can be freshened each decade, while internal maintenance costs are minimal due to the physical properties of wood. The walls will not ever absorb moisture, thus saving the cost of paint and painting services, compared to a conventional dwelling.
9. Wooden construction has perfect acoustics. It is known that the wood develops special acoustic properties as it is "aging".



Wooden log houses

WEAKNESSES/DISADVANTAGES

❑ difficulty of building integration Adobe bricks can be integrated into existing buildings but their full potential is best realized in new construction. The problem of plastering over a mud or soil base wall is no longer an issue.

❑ cultural: The mud brick has to be rediscovered (re-invented). Considerable promotional effort must be expended to change the current mind-set. The technical and ecological advantages must be vigorously projected and there is no one to do this as there are no manufacturers. For the wood-log house the cultural barrier does not seem to be so high.

❑ normative: To qualify any material as eco-friendly it is necessary to conduct a life cycle analysis of each material. Each study has to be on a product to product basis. This would not be a problem for the adobe brick or the wood log house. However there are new building codes to be followed and the architects and engineers must understand how to satisfy the code with a material little known to them. In fact it is surprisingly easy!

❑ other : There will be quite some resistance to entry into the market because there are a lot of vested interests in the fired brick variety, there is lack of technical information on the properties of the adobe brick and there is no one at the moment producing it so that it can be seen and tried.

❑ technical difficulties of installation / assembly: There are no technical difficulties of installation for either material.

❑ difficulties in the context of local production: There are no companies producing eco-compatible materials in Cyprus so all these materials are imported from other countries and the prices are higher than the non-eco materials. There is import of prefabricated timber houses but to a very low volume. Adobe bricks need very little investment to make but nobody has invested yet into their mass production.

❑ other: The potential of locally produced eco-materials has not been realized by the appropriate authorities. They do not perhaps realize the potential for modern day innovation by looking into the past !

SUGGESTIONS TO OVERCOME THE WEAKNESSES

There is need for a powerful and influential champion in order to get any results worthy of mention. Before users can switch to eco-friendly materials there has to be a change in the mind-set of key individuals of the appropriate bodies. Applied research must be encouraged so that momentum is gradually built up regarding the technical knowledge and specifications of such materials which must be viewed in a new context. There has to be governmental expenditure in demonstration buildings. There seem to be interested individuals to follow on provided the path is opened by the authorities.



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Lead Partner

- Province of Savona (ITALY)



Project Partner

- READ S.A.-South Aegean Region (GREECE)
- Local Energy Agency Pomurje (SLOVENIA)
- Agência Regional de Energia do Centro e Baixo - Alentejo (PORTUGAL)
- Official Chamber of Commerce, Industry and Navigation of Seville (SPAIN)
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- Development Company of Kefalonia & Ithaki S.A. - Ionia Nisia (GREECE)
- Rhône Chamber of Crafts (FRANCE)
- Cyprus Chamber Of Commerce and Industry - Kibris (CYPRUS)
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