

„LOW ENERGY BUILDINGS“ *...In Reality High Energy Buildings?*



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Summary

These days there's a fair amount of media focus on „low-energy buildings“. It all sounds good, but lets not get blinded by the words and the media; lets try to consider the concept of embodied energy and see exactly how the energy balance of these new buildings is...

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1 Introduction

The late American ecologist Howard T. Odum was one of the best known spokespersons of the concept of embodied energy „Emergy“ⁱ. Emergy accounting tries to provide a deeper understanding of the natural energy circles and a deeper level of challenge to current conceptions of sustainable living. Such accounting makes it possible to make a realistic whole cycle estimate of energy claims by looking at all related actions, keeping in mind that the term energy covers all actions. In this concept 'Energy' is not only viewed as a typical fuel, but also covers areas such as food, tools, infrastructure and technology: the driving forces behind all natural and human systems, and which all derives from primary energy sources collected from the natural environment. In brief „Emergy“ goes way beyond the typical selective (and deceptive) accounting process which constitutes a LCA (Life cycle analysis).ⁱⁱ

Both during my studies as human ecologist, my practice as permaculture teacher and as a natural builder, I'm repeatedly reminded of the need to limit the amount of embodied energy within any design: It's rare that we would not be able to save significant amounts of resources (energy) on any of our buildings if we all conscientiously kept the 'Emergy'

factor in mind; within a construction project it can be viewed on all levels from planning, purchasing, dimensioning, logistics, siting and choosing the appropriate materials.

2 Case Example

In order not to get too abstract, I've chosen a Czech example to demonstrate the issue: The new 'Low energy building' constructed for Slunakov o.s. near Olomouc, CZ, a project presented at this conference by Ondrej Hofmeisterⁱⁱⁱ: This is by no means meant as a specific critique to the center; The parameters are likely applicable to a large number of 'low energy building' and the Slunakov center is in some aspects very well thought through, especially when compared to most buildings of such size and versatility.

However, let's try to view the potential for saving embodied energy, had the following issues been prioritized:

2.1 Utilizing local expertise rather than distant architects, engineers, consultants etc. who has to drive far to see the site thus polluting more; such policies would also help to keep the finances for wages within the Olomouc region. The money allocated for the project originates from EU funds targeted at creating sustainable development, in this case by providing a facility for environmental education. Why not start such educational process with the initial planning of the process? I'm unaware if the construction firm were locally based: this would especially be an issue to contributing to the energy accounting in the project.

2.2 Attempt to minimize fundraising and bureaucracy whenever possible, as it's fundamentally unsustainable and helps drive the administration costs of a project through the ceiling; Often it also means having to accept certain undesired elements in order to fulfill the requirements of the grant. Whenever prestige projects are made it's noteworthy how the costs for the actual construction is grossly over-inflated due to the excessive administration. It's known that in the Slunakov project certain undesired compromises had to be accepted due to the requirements of the funding program.^{iv}

2.3 Small is Beautiful. We're all aware of the apparent need of politicians (and their servants; the architects) to erect monuments after themselves, however is it really always necessary? Often functions could be better served de-centralized in separate buildings, which may not need the same amount of concrete reinforcement as the tall prestigious power symbols. Try to have a look at www.botanicus.cz to see the tourist attraction created in the village of Ostra (near Prague); it's built of very natural degradable materials, yet have immense educative effect and attracts 1000s of tourists a year.^v



2.4 Siting. Perhaps the biggest controversy with the center is the location in a flood zone. According to the information from the architect company's website, the floor is designed above flood level, however question is how many people in Prague thought so about their homes in 2002? Or in Olomouc in 1997 and 2006? Fact is that we're only experiencing the start of the natural catastrophies to come, and siting such a construction in a flood plain seems irrational. Near Brno (CZ) a strawbale house is planned to be built upon stilts made from old concrete telephone poles. A very low-energy approach and quite educative..

2.5 Utilize local natural materials. This is the point where generally the biggest energy and health failures occurs, thus a special focus:

2.5.1 Wood: East European architects and engineers are

now starting to get over the concrete fascination of the past era and re-discover that wood is strong enough for most purposes. Unfortunately the Slunakov center had the wood milled, which then had to be laminated to gain strength again. It reminds me of the sisyphos myth: I wonder when we'll again see whole tree trunks integrated in architecture? Preferably from trees



harvested nearby, and with 10 new planted for each one cut... having various species of trees would add to the environmental effect of the centre.

On a different note: Much too often you see construction wood in Czech Republic having a neon green color. Recently we're being taught by industry that wood which are not treated chemically will rot away. I'm happy that the simple farmer who build the 120 year old house I'm sitting in didn't know about this; the wood he placed right is still healthy: the wood which he placed straight on moist earth or exposed to rain had to be replaced. Reality has proven that the toxins applied to the wood are only effective for the first few years when the wood needs it the least. The biggest effect of the toxins is generally to create a profit for the companies producing it, while creating toxic spills, unhealthy living areas, toxic firewood and toxic dust for the carpenter. In case of need of a real good wood preservative it's well proven that the best one is oxo-blood: One application lasts for 300 years (if only the house will last that long!).^{vi} Natural linseed oil and wax are also excellent natural treatments for wood which are low in embodied energy...or howabout pitch; produced by trees and tested for several 1000 years?

2.5.2 Earth: The fundamental building material on the planet; perhaps the least expensive and most versatile material available, heat accumulative and with very beneficial indoor climate effect.^{vii} In the Horka center it is being used on some internal walls along with some plasters; Not bad, however much more could have been done: The 'Chapel of Re-unification' in the heart of Berlin has walls and floors of compressed earth and receives more than 100.000 visitors per year.^{viii}

2.5.3 Straw: To my knowledge the Slunakov center is heavily insulated with extruded polystyren (from Germany) and Rockwool. While it's hard to find a suitable natural substitute for subterrean areas subject to moisture, it's noticable that the tall Northern walls was not simply built of 'big bales' harvested from the surrounding fields: A far superior insulation material; inexpensive, healthy, low emergy and can hold the weight of the roof as well: Very educative, I may add. A sport hall in Austria was build with this material^{ix}, and 25 km from Slunakov the new PermaLot demonstration house managed to get the 1st building permit in Czech for a house built of strawbales with earthen plaster. Alternatively a wooden construction with natural insulation could have been utilized. I suspect that the only real reason why it was not used in Horka, is simply that the decision makers and funders insisted on the visual green image of the Northern earthen embankment...a clear green cover up.



2.5.4 Hemp and Flax insulation: The planning phase of the center took years. During one growth season the center could have grown a majority of it's own insulation,

indeed an insulation far superior to mineral wool in terms of health: A Danish research funded by the organisation of insulators (year 2000) proved that people working with Rockwool suffers from more than 100% over-mortality^x. In addition Rockwool is considered a possible human carcinogen and harmful to people^{xi} The use of such product should be banned from any site claiming to do ecological building, and in terms of energy this product ranks extremely high with around 11500 mega joules per ton (Strawbales has 115 mj/ton)^{xiii} Not to mention that it's made by a Danish company: Let's try to focus on local low energy materials...

2.5.5 Foundation materials: It's been said that there's two kinds of concrete: One which cracks fast and one which cracks slow. Fact is that concrete has a very high amount of embodied energy and it's very important to try limit it as much as possible. More so when it includes high amounts of steel re-inforcement. Considering the fact that Portland Cement is only about 120 years old^{xiii}, it's shocking that we believe it's the only way to make foundations. Have a look at the churches and castles around us: those where the stones were stacked well (on well drained stable soil) has no cracks in the foundations (Others were sited poorly or suffers from poor workmanship).



OK, so the building regulations typically ignore the issue of embodied energy and currently promote the use of concrete, but lets try to be clever about it. Every year millions of tons of concrete is looking for a new home: Germany alone generates 800 mio. ton building waste of mineral materials a year^{xiv}; This figure does not include the initial resource waste from production of cement, steel etc... Why not use it again? Technology exists to crush it up and only use a limited amount of new concrete as a glue between the old concrete. Unfortunately such issues were not included as far as I know in the Slunakov Environmental Center.

2.6. Conserve Water: I'm grateful that the Architects included a reedbed filtration system for cleaning all of the waste water arising from all of the events planned at the center, the integrated hostel, cafeteria etc. Unfortunately the esthetical issue of the green roof prohibits the collection of rainwater (which could be used for, washing, flushing and laundry), which means that the center also in this aspect functions as an energy drain, consuming more than it preserves. Those among you who may still believe that a green roof insulates: Please think about the fact that earth freezes up to one meter in our region: I doubt there's more than 30 cm earth on the roof of the center, as it would take excessive construction to hold the weight of the roof, especially adding weight of 2 meter of snow in the calculation.

Frequently such facilities does not prioritize water conservation appliances used in the kitchens and bathrooms. I'd be pleasantly surprized to find the waterless urinals (often used in German highway bathrooms), a collection of modern compost toilets for inspiration, along with low-flow shower heads in the hostel accommodation, etc...

2.7. Conserve energy: This is the central claim of the building and undoubtly the involved experts know best. For a lay-person as me in these matters, I just wonder why, in such a super designed and engineer project, a large ventilation system has to be buzzing constantly, consuming energy while providing a constant background noise...couldn't the design team have looked more into passive ventilation and energy exchange?

Please refer to the the research (by Jakub Wihan) about natural ventilation of passive houses presented elsewhere in this publication.

Olomouc region now have a high prestige environmental center. It would be very interesting to calculate how many years the 'low energy' center has to exist in order to compensate for the energy resources which went into it. My guess is that the building will never be able to last long enough to reach a balance. And i believe this reflects the international trend of passive housing.

However to me the fundamental flaw is that such building will never be able to inspire any of the many users to make serious sustainable choices in regards to their own home building: It was obviously never part of the intentions, despite the fact that the Slunakov educators offer the schools of the region classes in 'ecological building'.

Try to imagine if a design had been chosen which were adaptable to the houses in the region; perhaps through retro-fitting one larger building and constructing several small out of various materials?

Allow me to emphasize that I am not an advocate for moving back to caves, nor to do all work by hand in order to save machinery.

Throughout Europe and elsewhere many good modern buildings are being made which both demonstrate low energy in the construction phase as well as in the operation of the building; have a look at Artefact, the International Centre for



Sustainable Development by Flensburg, the buildings by Arch Werner Schmidt for inspiration or talk directly with Doc. Minke here at the CESB.

References:

ⁱ Odum, Howard T. : *Environmental Accounting: Emery and environmental decision making* by John Wiley & Sons, Inc., New York, USA, 1996

ⁱⁱ International Energy Agency (IEA) 2001, The Life Cycle Analysis Approach, www.nea.fr/html/ndd/reports/2002/nea3676-externalities.pdf

ⁱⁱⁱ Hofmeister, Ondre, 2007 CESB07 Reader and www.projektil.cz/en/realizace/slunakov/

^{iv} Private talk to Slunakov's manager Michal Bartos, and Energy consultant who consulted Slunakov o.s.

^v Historic centre: www.botanicus.cz

^{vi} Søren Vadstrup. RAADVAD – Nordisk Center for preserving old crafts: http://www.kulturarv.dk/tjenester/publikationer/emneopdelt/bygninger/byggeblade/15_bygematerialer/02_materialer_II/index.jsp

^{vii} Minke, Gernot, Earth Construction Handbook, WIT Press/Computational Mechanics Publications

^{viii} Chapel of unification: <http://www.kapelle-versoehnung.de/bin/englisch/index.php>

^{ix} Strawbale house Allensteig: <http://www.baubiologie.at/europe/austria/austria.html>

^x Poulsen J, Dollerup H., Christensen , S and Wagner Nielsen, K. (2000): Teknisk isolering uden mineraluld, www.alternativisolering.dk/resumeer/teknisk_isolering.htm

^{xi} The International Agency for Research on Cancer (IARC) has classified ceramic fiber, fibrous glasswool and mineral wool (rockwool & slagwool) as possible human carcinogens (Group 2b) based on sufficient evidence of carcinogenicity in animals, but insufficient data in humans. The Commission of The European Communities (DG XI) has classified mineral wool among substances which should be regarded as if they are harmful to man. The American Conference of Governmental Industrial Hygienists (ACGIH) has categorized rock wool and slag wool as animal carcinogens (A3).

^{xii} Heidi Snell, Oekofil: HOUSES OF STRAW The rediscovery of Strawbale building <http://www.ecofilm.de/inhalte/films.htm> . Further Kilo joule facts: Including direct fuel use for mining and transporting raw materials, cement production consumes about 6.36 million kilojoules of energy for every tonne of cement produced.

http://twinshare.crctourism.com.au/cement_and_concrete.htm and CIRIA, 1995.

Environmental Impacts of Materials, Volume A/ Summary. CIRIA, London.

^{xiii} Portland cement was patented in England by bricklayer Joseph Aspdin in 1824

http://twinshare.crctourism.com.au/cement_and_concrete.htm

^{xiv} Heidi Snell, Oekofil: HOUSES OF STRAW The rediscovery of Strawbale building <http://www.ecofilm.de/inhalte/films.htm>

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