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Sustainability *Now*

Newsletter of the Sustainability Initiative of the Association of Professional Engineers and Geoscientists of B.C.

If not now, when? If not us, who?

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Sustainable Materials

Editorial

Materials production and selection is an area where engineers and geoscientists can make great contributions to sustainability. Work has already been done to evaluate materials for sustainability, and to make sustainable materials available at competitive prices. Most of the popular construction materials can be chosen to maximize sustainability.

Structural engineers often specify materials for construction based on strength, cost, availability and aesthetic. A number of tools now exist to make adding sustainability to the list of considerations attractive. For example, the Canadian not-for-profit ATHENA Sustainable Materials Institute is a world-leading source of data, expertise and tools for designing buildings with the environment in mind. They have databases that compare the sustainability of everything from gypsum fibreboard to heavy trusses to nails.

Of course knowing which type of material is the most sustainable isn't enough, the material also has to be readily available and competitively priced. To help the design and building industry source building materials that have less of an impact on the environment, the Greater Vancouver Regional District (GVRD) developed the Directory of Resource-Efficient Building Products. It features over 250 products that contain either recycled or salvaged materials, utilize materials in a more efficient manner, are energy-efficient or conserve water. All products listed in the Directory are available in the Lower Mainland. The Directory is part of the GVRD's Buildsmart Program.

Buildsmart and ATHENA are just two of many tools that have been developed over the last several years to help engineers and geoscientists with the APEGBC Sustainability Guideline #1: Develop and maintain a level of understanding of the goals of, and issues related to sustainability. Check them out at www.athenasmi.ca and www.buildsmart.ca.

Anthea Jubb, EIT, Editor

In Conversation with Duane Palibroda, P.Eng

Fast + Epp Structural Engineers

Duane Palibroda, P.Eng., M.I.Struct.E. (UK) is a structural engineer with Fast + Epp, a Vancouver based structural engineering firm that has gained a reputation for sustainable building design.

***AJ:* Please tell me about your career path and your job with Fast + Epp.**

DP: I started out as a structural draftsman back in the early eighties in Saskatchewan, having completed an architectural engineering technology program. Since then I've had a parallel interest in both architecture and engineering. I returned to university in the late eighties to get my engineering degree and moved to England after graduation.

I moved back to Vancouver in the late nineties and have been with Fast + Epp ever since. I generally consider myself a detail-oriented person. This, combined with an interest in architecture and the experience working with existing buildings in the UK, seems to have channeled me towards sustainable building projects.

***AJ:* What role can structural engineers play in sustainable development?**

DP: The first thing we can do is to economize our design and use of materials. Less material means less waste. Looking at ways to incorporate recycled material into the structural design is another approach, which often adds to the aesthetic of the building. Also, rather than simply knocking down existing buildings to make way for new buildings, we could look at ways to save the building, if it fits into the clients program and budget.

AJ: Is re-using a building or using recycled material always cheaper?

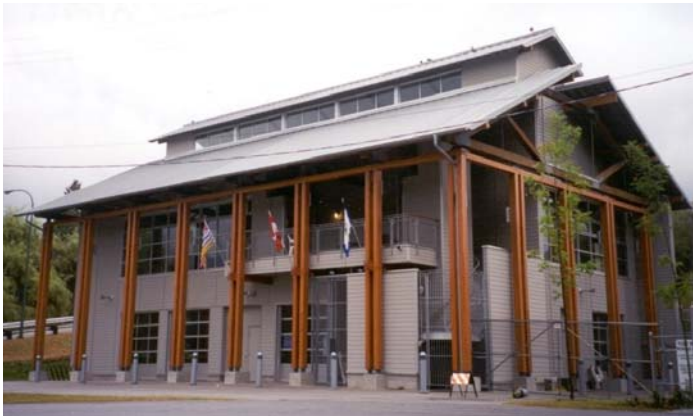
DP: The Centennial Arena Renovation in White Rock is an example where strong consideration was given to knocking the building down and replacing with a pre-fabricated building. A number of options were looked at and renovating the building was ultimately found to be the most cost effective, partly because we were also looking at a very tight timeframe. That particular project turned out quite successfully.

In Conversation with Duane Palibroda, P.Eng, Cont.

Our experience with using recycled material is that it is not necessarily the cheapest option. Consider that you first have to find the material in sufficient quantity, which means you either have to search through used lumber yards or you have to keep your ear to the ground for any heavy timber structures coming down, usually old mills or warehouses. Once the material is sourced, the client has to purchase the material early in the design stage and find a place to store the material. Recycled material also tends to need an amount of prep work before it can be used, de-nailing, sandblasting, that sort of thing. It all adds up. The one thing that you can't put a price tag on is the aesthetic and heritage aspect that recycled material brings to the building. That's been our experience with the buildings we've worked with.

AJ: **What role does the marketplace play in sustainability?**

DP: The market plays a huge role in both sustainable materials and practice. Look at the City of Vancouver. They've already taken the first step by requiring their new, larger civic buildings to be LEED Gold. (LEED, short for Leadership in Energy and Environmental Design is a popular sustainable building standard-*Ed*.) The venues for the 2010 Winter Olympics are also following the LEED guidelines. All of these efforts raise public awareness, and eventually sustainable design starts to become the benchmark. Ultimately, the more cost effective sustainable building practices are, the more common-place they will become.



AJ: **How does BC compare to other regions when it come to sustainable building practice?**

DP: LEED has really caught on in BC and I think that LEED has become the accepted template for sustainable design here. The first two LEED gold buildings in Canada were built in BC. How that compares to other regions of Canada, I can't say, but we seem to be heading in the right direction.

AJ: **What criteria do you use for comparing material?**

DP: Sustainability is one of the questions we ask, but it is not the only question. You first have to consider the size and type of building to be designed, the budget and the appropriate materials. Every material, to some degree, has a sustainable aspect to it. Wood, for example, is sustainable because it is a renewable resource. Engineered wood product like parallam and timberstrand are also considered sustainable because they essentially create a strong wood element out of waste material. Most steel uses up to 95% recycled material, so it can also be argued that steel is a sustainable material. Concrete, by itself is not a sustainable material. In fact, the production of cement contributes about 7% of the global CO_2 emissions. But, if you start to replace cement with flyash, suddenly concrete can be added to the list of sustainable materials. Bottom line is that you can argue that all of those materials, if used correctly, can contribute to the sustainability of a building. You really have to use your judgment.

AJ: **Are there any particular liabilities associated with sustainable materials?**

DP: From our perspective, the main issue is assessing the strength of the existing material. The codes do give some guidance, but generally you really have to take a good look at the material and use engineering judgment. In the case of heavy timber, it may require getting a professional grader involved, depending on the quality of the material and the anticipated stress levels.

AJ: **Are there other benefits of sustainable practices and materials aside from environmental gains?**

DP: There are economic gains associated with lifecycle costing, but that is usually more to do with the mechanical and electrical systems. Given that our buildings seem to have a 30 to 50 year lifespan, designing for deconstructability would lead to less energy to demolish the building when it has reached the end of its lifespan and may even lead to easier re-use of the salvaged material.

AJ: **Please tell me about one of your projects.**

DP: The Port Moody Paddle and Sail Centre is a good example. The City of Port Moody salvaged some heavy timber trusses from an old sawmill being demolished on an adjacent site and wanted to re-use them in their new Paddle and Sail Centre, mainly to retain a link to the heritage of the area. When we started working on the design, we found that that the trusses were actually about 8 feet longer than the original survey. Given the tight budget, the building could not afford to get any bigger, so the architect quite cleverly kept the exterior wall in its original position and created nice overhang to the second floor balcony and main floor walkway below.

AJ: **Are there any things that you think APEG could be doing to promote sustainability among its members?**

DP: The newsletter is a good start. I think that the design community in general is more than aware of sustainability, partially because of LEED but also because architects have become very knowledgeable on the issues. The challenge is to reach the public and raise awareness.

AJ: **Can you recommend some books or websites?**

DP: There is no one publication that stands out, but I do like the magazine *Greenspace* put out by Business in Vancouver. *Innovation* and *Sustainability Now* are both good. Even reading the LEED manual is helpful.

Center Photo: Port Moody Paddle and Sail Centre.

EcoSmart™ Concrete Technology:

Making Concrete Changes in Construction

By Maggie Wojtarowicz, M.A.Sc., E.I.T., Project Engineer, and Bronwen Sprout, M.L.I.S., Knowledge Manager

Concrete, a universal construction material synonymous with strength and longevity, is relatively benign in nature. However, Portland cement, a key constituent of concrete, has a significant environmental impact: the production of every tonne of Portland cement produces a similar amount of carbon dioxide (CO_2), a greenhouse gas (GHG) that contributes to climate change.

"EcoSmart™ concrete" describes mixtures in which Portland cement is partially replaced with an optimum amount of supplementary cementing material (SCM), thereby reducing the "GHG signature" of the concrete while maintaining or improving cost, concrete performance, and constructability. EcoSmart concrete is not a proprietary technology or a rigid formula: as with ordinary Portland cement (OPC) concrete, the design of EcoSmart concrete mixes depends on the application (e.g., structural element, exposure condition, and required performance), taking into consideration regional differences in materials.

Replacement of Portland cement with up to 50% SCMs has been tested in laboratories for over 20 years, with common historical applications in dams and mass concrete structures. More recently, the use of EcoSmart concrete has been demonstrated throughout Canada in structures ranging from single-family homes to commercial and high-rise buildings to infrastructure projects. Reclaimed industrial by-products such as fly ash, slag, and silica fume (collectively referred to as SCMs) are regularly used in concrete construction across Canada at the 10-25% replacement levels, achieving moderate GHG emission reductions. The challenge – and the opportunity – exists in achieving greater GHG emission reductions by making increased levels of Portland cement replacement common practice. Spearheaded by the EcoSmart Foundation, recent revisions to the Canadian LEED® Rating System: Materials and Resources Credit 4 (expected to come into effect this Fall) will undoubtedly increase the incentive to partially replace Portland cement with SCMs.

SCMs in concrete not only reduce GHG emissions but also improve long-term strength and durability characteristics, and typically make concrete more economical. Designers choose EcoSmart concrete for its smooth, creamy texture, beige tint, and consistent appearance. Its ease in placing and increased workability makes EcoSmart concrete attractive to contractors and subtrades, and allows precast elements to achieve sharper and more distinct corners and edges.

The main shortcomings of EcoSmart concrete may include slower strength gain and longer setting time, especially at cold curing temperatures. Innovation in construction practices, such as adapting a water mister to finishing tools and adjusting the construction schedules (e.g., pouring late in the afternoon and finishing the next day), aids in increasing the acceptance of EcoSmart concrete as a common construction material.

When placed, finished and cured using proper construction practices, EcoSmart concrete has higher long-term strength, and is more durable and more resistant to deterioration (such as alkali-aggregate reactivity, sulphate attack, and chloride penetration) than OPC concrete. Considering these advantages, structural designers can innovate the design of structures to have stronger, thinner elements, and that require less maintenance/rehabilitation work. EcoSmart concrete together with good design and construction practices can significantly extend the life of a structure, translating into savings in future expenditures, resources and energy consumption, and GHG emissions. Check www.ecosmart.ca for more information.

Photo Centre: The Waterfall Building Live/Work Studios, Vancouver, British Columbia.

Comings and Goings

In September 2004 Anthea Jubb, EIT, completes her contract as the Sustainability Researcher at APEGBC, bringing to a close a three year project to develop the Sustainability in Professional Engineering and Geoscience Primer and provide a full time, in-house resource on sustainability for APEGBC.

Over the past three years sustainability has become a central part of APEGBC's operations, as well as gaining a higher profile in the professions. APEGBC is grateful for the hard work provided by Anthea Jubb, EIT, and for the financial support for the project provided by Western Economic Diversification Canada and the Industrial Research Assistance Program.

Primer on Sustainability

The APEGBC Primer on Sustainability in Industrial Process is complete and has been posted to www.sustainability.ca.

The primer examines some of the extensive body of work already published on the topic of sustainability in industrial processes and identifies those topics of most use to Professional Engineers and Geoscientists. It also provides case studies and links to more information.

The primer can be downloaded from www.sustainability.ca or ordered by contacting Lise-Anne Vershinin, Project Manager Professional Practice—Sustainability, APEGBC, at 604-412-4868 or lvershinin@apeg.bc.ca

Building Outside the Lines

By Eerik Lilles, EIT. Eerik Lilles is a graduate of Lakehead University. He is currently working as an Engineer in Training for Dayton & Knight Ltd. In Smithers, BC.

Cob is a technique of building with unbaked earth that has a low environmental impact and is inexpensive. In cob construction clay and sandy soils are combined with fibrous materials such as straw. The resulting concoction is kneaded, rolled and mixed, usually under foot, until the desired consistency is achieved. This mix is then shaped into loaves or "cobs" -hence the name- and stacked and pressed into a building frame. Walls are intermittently shaved back to the desired finished shape and the process continues until the walls reach full size. Unlike adobe and other earth-building methods where bricks are formed and then sun dried, the earthen cobs are neither baked, nor set in cement or mortar. Instead, cob walls are built monolithically without any formwork.

In 2000, I was a technology student at Camosun College in Victoria and decided to do a project studying the work of a group of natural builders who were teaching and building locally in cob. In the beginning, the concept was foreign to me, but during the time I spent with the instructors and workshop participants I became indoctrinated into their world. The simple tests I preformed on this material showed its engineering properties to be respectable. This summer I decided to revisit the group at a Cobworks workshop on Saltspring Island.

It is a sunny afternoon in August when I approach the workshop. Patrick is an unlikely instructor and champion of a "back-to-basics" building concept: Huge and with a beard and bald head, he looks more like the strong man character from a childrens' book! He welcomes me to his Cobworks workshop with a toothy grin and crushing hug.

Cobworks puts on several workshops each year and this workshop is building the future home of Paul and Becky Niedziela. Participants are quietly at work in a picturesque hillside, kneading and pressing the cob mixture into the wall frame. After catching up with Patrick, I take the opportunity to join the group in some cobbing and I am reminded of the beauty and practicality of this building technique. Although labour intensive, few special tools or skills are required to build in cob other than common sense and a good work ethic. As in my previous experiences with these workshops, the background of participants is varied and this group includes a Vancouver based writer, a farmer from Alberta, and a government employee from Ontario. I quickly get into the rhythm of the builders and as the building progresses I sidle up to a number of participants to ask about what cob means to them. Many describe cob as filling a void in society by providing an alternative to expensive, resource gobbling, conventional building methods. They all find the skills they are learning empowering and talk about their dreams for affordable housing.

One only needs to buy a single sheet of plywood from the lumber store to realize why the cost of conventional housing is out of reach for many Canadians and why the use of alternative methods such a cob are being revived.But, as with other alternative building methods in Canada, building in cob is often an exercise in frustration. With no specific reference to cob in the National Building Code and few engineers interested in taking on the risk of the unknown in an increasingly litigious society, homeowners must frequently depend on the sympathies of local building inspectors or are forced to build covertly.

There is no doubt that building outside the lines tends to ruffle some peoples' feathers. But the Niedzielas can take heart that most people on the planet live in buildings made from unbaked earth and that western cob revivals have taken place periodically in European history due to dwindling resources or natural disasters – most recently during and after the world wars. Indeed, the Niedzielas are fortunate to be building in the jurisdiction of a sympathetic inspector and expect their home to be the first approved cob house on Saltspring.

As the day winds down I notice that the walls are a few feet higher. The cobbers are rushing off to the local swimming hole and Patrick delivers a crushing hug as I rush off to catch my ferry. On the ride back to the mainland with the sun setting I ponder the role in society that engineers play and wonder if our responsibilities include helping builders and teachers such as Patrick.

The picture (centre) shows a cob building under construction. Building envelope design is a principal concern in cob construction and the roof will have large overhangs and a water resistant coating will protect the finished walls. A course of stones can be seen at the base of the wall. These are bonded with cement to a foundation reinforced with steel. The stone course protects the wall against erosion from groundwater. Walls of modern cob buildings typically have rounded corners, arched openings, and are tapered towards the top, all techniques to aid in reducing load concentrations. The walls of this house will not be load bearing; instead, the house frame, made of vertical logs, will carry the roof system. Cordwood is incorporated into a portion of the cob wall.

Links:

A cob cottage recently opened in Stanley Park, Vancouver. Check out www.stanleyparkcob.ca to see pictures and find directions to it.

Information on the workshops mentioned above can be found at www.cobworks.com.

The LEED Standard for Sustainable Construction Materials

The LEED green building standard is quickly becoming the most popular standard in Western Canada. Last month the City of Vancouver adopted the LEED standard for all new larger civic buildings and the LEED standard will also be used for major new development in Vancouver's South East False Creek, and possibly for Olympic venues.

The LEED green building standard contains a number of recommendations regarding sustainable materials. The focus of the materials section of the standard is on used building materials and on high recycled content new materials. Substantial credit can be earned under the LEED system for using salvaged, refurbished or simply used materials. Lower Mainland suppliers of used building materials are listed at the Greater Vancouver Regional District's Buildsmart website at www.buildsmart.ca. Additional LEED credit can be obtained for using materials with post-consumer and post-industrial waste. The fly-ash concrete described on page 3 is an example of such a material. Another opportunity for credit under the LEED standard is locally manufactured and harvested materials. The LEED definition of local is within 800 kilometer, with the exception of rail transport, which is up to 3500 kilometers. The use of local materials reduces pollution associated with transportation and contributes to a viable local economy.

The LEED standard also gives credit for wood products carrying the Forest Stewardship Council (FSC) certification. The FSC standard is the most rigorous of the sustainable forestry standards, and is the most widely recognized internationally. FSC wood products are available in British Columbia through Eco-Lumber Co-op in Richmond (www.ecolumber.ca). Of the major forestry companies, Tembec is the local leader in FSC certification. The supply of FSC wood is expected to continue to increase as Tembec pursues certification for the rest of its timber licenses.

For more information on the LEED standard, check out the Canada Green Building Council website at www.cagbc.ca.

Upcoming Events

October 15 Massive Change: World Visionaries in Dialogue. This event looks at the future of global design. Location: Vancouver Art Gallery. Cost and Registration: See http://www.massivechange.com/.

October 20 "Walking the Talk" Transportation's Environmental Achievements. Location: Vancouver, BC. Cost and Registration: See www.westac.com.

October 21-23 "Reaching New Heights in Professional Excellence" APEGBC Annual Conference. Location: Whistler, BC. Cost and Registration: See www.apeg.bc.ca/prodev/ac04/ac04index.html.

October 28 Sustainable Design Seminar. Cement Association of Canada. Location: Vancouver, BC. Cost and Registration: See www.cement.ca.

November 2—6 Engineers Shape the Sustainable Future. World Engineers Convention. Location: Shanghai, China. Cost and Registration: See www.WEC2004.com

November 10-12 Greenbuild International Conference and Expo. Hosted by the US Green Building Council, this event is currently the leading green building conference in North America. Location: Portland, Oregon. Cost and Registration: See http://www.greenbuildexpo.org/

Construction Materials:
Performance, Innovations and Implications

The Third International Conference on Construction Materials: Performance, Innovations and Structural Implications will be held in Vancouver, BC, Canada, August 22-24, 2005 (www.civil.ubc.ca/conmat05).

Solicited: Original Papers on concrete, wood, steel, FRPs, and masonry related to: 1. Performance of Materials 2. New Design Concepts (New design methods, Integration of structural and durability design, Life cycle management, Sustainability, Life cycle economy, Codes and standards); 3. Specialized Materials 4. Operation, Maintenance and Repairs; and 5. Any other related topic

Special Sessions: ConMat'05 will feature a number of special sessions on hot topics such as High Volume Fly Ash Concrete, Life Cycle Costing, Recycling, etc.

Contact Ms. Terry Moser, Department of Civil Engineering, The University of British Columbia, 2010-2324 Main Mall, Vancouver, BC, Canada V6T 1Z4, Ph: 604-822-5984. Fx: 604-822-6901, conmat05@civil.ubc.ca.

Sustainability Now

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