Buildwell 2010 – Innovative materials for a greener planet

January 27-30
Cavallo Point Lodge, Sausalito, San Francisco
Report by Carol Atkinson
www.homegrownhome.co.uk

Summary

Shelter is a basic human requirement. We need buildings! Our existing buildings have consumed vast quantities of the earth's resources and huge amounts of energy. They are rarely conducive to community or have any connection with nature.

Buildings in the future **must** be very different!

The carbon, fuel, water and biodiversity crises we are facing will shape our built environment. We must use more salvaged and renewable materials. We must produce renewable energy and use it more efficiently. We must take more care not to poison ourselves - or the creatures with which we share this planet. We must recognise the instinctive bond between human beings and other living systems.

We need change and we need it fast. How are we going to make it happen?

Regulation is moving slowly in the right direction but there is enormous pressure from the vested interests of big business and a lack of political will. Information technology makes it easier to research but can add to the confusion. Media can help or hinder. "Green fatigue" is setting in. "Green" has been used as a fashionable marketing tool and the general population is getting either bored or overwhelmed by it all. But this is not a fad – it is **crucial** to our future!

The International Living Building Institute is developing a framework to help every building in the future make the world a better place. Their latest document was published in November 2009 and can be downloaded from their website. http://ilbi.org/the-standard/version-2-0 . It tries to cover every aspect of the built environment and even if some of the desired outcomes are hard to achieve at the moment, the sooner we start thinking about them the better. I can't recommend reading it highly enough.

It has never been more important to co-operate, share information and help each other. The biggest, fastest change will be from the bottom up.

Lots of people, including governments, are saying the right things but it is only **actions** that will make a difference.

Presentations at Buildwell 2010

The speakers at the conference were all people trying to make a difference in the built environment. Academics, professionals, inventors, builders, regulators and entrepreneurs met to collaborate and cross-pollinate. It is very reassuring to know that there are so many good people out there working hard for the benefit of us all.

Subjects include materials, energy, habitat, toxicity, rules and business opportunity. There is a lot of valuable information and insight and something of interest to everyone.

Each speaker is listed in order of appearance. Contact or web details and background information is followed by a summary of their main points. The letter after their name can be used to search for papers or presentations in the accompanying file "Buildwell 2010 papers".

Bruce King (A)

Ecological Building Network www.ecobuildnetwork.org

A structural engineer for over 30 years, Bruce has conducted extensive, groundbreaking research into low impact building systems and helped write improved building codes to facilitate their use in the USA and other countries. He is the author of *Buildings of Earth and Straw, Making better concrete*, and *Design of Straw Bale Buildings.* He recently completed revisions to ASTM 2392/*Standard Guide for Design of Earthen Wall Building Systems.*

Bruce opened Buildwell 2010 with an overview of where we are now – 6.8 billion people living in the Earth's thin biosphere, only 5 miles deep (including our oceans and skies).

He explained how the built environment uses most of the Earth's resources. For example, most high-grade metals have already been extracted. They are already in the "human sphere".

Industrial cities and their skyscrapers will be uninhabitable without fossil fuels. We have to invent the eco city of the future.

Today's problems won't be solved with the mentality that created them.

We must apply the underlying principles of

- Short distance
- Simplicity
- Transparency
- Cyclic (use again or return to earth)

We must learn from nature. Spider's webs and seashells are examples of nature's efficient structures. We must design intelligently to make the most of the resources we have. We can learn from others and from the past. For example, great historic buildings that are loved have withstood the test of time. Cuba is another great example. It had to feed its population without fossil fuels in the early 1990's when the Soviet bloc collapsed and trade embargos with the US were tightened.

Sarah Billington (B)

Stanford University, California www.stanford.edu

Professor Billington's research focuses on sustainable, durable construction materials and their application to structures and construction. Two current areas of focus are damage-tolerant, high-performance fibre-reinforced cementitious composite materials, and bio-based fibre-reinforced polymeric composites that have a closed loop life cycle.

Sarah has been working on the use of bio-based composites in the automotive industry but is now turning her attention to the built environment. When over 40% of US landfill is construction material it would be useful to have a plant-based alternative to construction boards such as plywood or oriented strand board (OSB).

PHB based composites need to be weather tolerant but still biodegrade in anaerobic landfill.
(Authors note: PHB is Polyhydroxybutyrate - produced from glucose or starch by microbial biosynthesis. The production of PHB will produce a biodegradeable plastic. http://en.wikipedia.org/wiki/Polyhydroxybutyrate)

David Johnson (C)

University of Oregon www.uoregon.edu
Centre for Green Material Chemistry

Dr Johnson's group has pioneered a new approach to the synthesis of extended solids that permits them to prepare families of new nano-structured and kinetically stable compounds. Read more at http://www.uoregon.edu/~grnchem/davejohnson.html

Looking at innovations that reduce waste from thin films to new nano chemistry being used to create new materials that are cheaper and easier to process.

Anil Netravali (D)

Cornell University www.human.cornell.edu
Department of Fibre Science

Dr Netravali's main research is to develop fully sustainable and biodegradable, environment-friendly green composites that can be used in place of petroleum based conventional composites. Green composites are made using plant-based fibres and resins that are carbon-neutral and can be easily disposed of or composted at the end of their life. In the past few years, his research group has made significant progress in developing plant-based green resins, e.g. soy protein and starch, with excellent mechanical and physical properties; in some cases, better than commonly used epoxies.

Dr Netravali talked briefly about his work with new green building materials for internal and external applications. The materials are plant-based and petroleum free. Composites could be made from particles, flakes, random fibres, long fibres, woven or braided fibres.

Plant composites can be much stronger than steel but 6 times lighter. This could help reduce material use in the built environment through smaller dimensions, reduced layers and number of components used.

Alex Wilson (E)

Building Green LLC www.buildinggreen.com
Environmental Building News

Alex is editor of Environmental Building News, a US monthly newsletter about a range of topics related to sustainable building. For more than 25 years Alex has written about energy-efficient and environmentally responsible design and construction.

Alex talked about the importance of durability, how small can be beautiful and how a great deal can be done on a budget, with salvaged materials for example. He described the need to communicate in a compelling way – we need to *reach* people to effect change. It is better to fight *for* a cause rather than against.

He then went on to list some of the harmful chemicals in the built environment that we know about;

- PVC
- Thallates
- Treated wood
- CCA
- Brominated fire retardants
- Polystyrene
- Halogenated compounds
- Silver and other metals

Then there are many new chemicals that may have negative impacts but about which we know little. The burden of proof should fall with the manufacturer.
Nano particles are so small that they could pass through cell walls. We have no idea what the impact of this could be.

Arlene Blum (F)

www.arleneblum.com
Green Science Policy Institute www.greensciencepolicy.org

Blum is a biophysical chemist. Her research contributed to the regulation of two cancer-causing flame retardants used in children's sleepwear in the 1970's, and prevented unnecessary flammability standards that would have led to the use of hundreds of millions of pounds of persistent toxic chemicals each year.

Arlene talked about the toxicity of flame retardants in buildings and what to do about them. In the US there is no regulation on the use of chemicals except for use in food and drugs. The chemicals of high concern are

- Solvents (formaldehyde, benzene, toluene etc)
- Metals (lead, mercury, cadmium etc)
- Organohalogens (carbon bonded to bromine, chlorine and fluorine)
- Endocrine disrupters (phthalates, BPA etc)

There are 21 chemicals banned globally by the Stockholm convention including organohalogen pesticides – but they are still used as flame retardants on many household goods and home insulation products. They don't stop fire, they just delay

it for a short while then they burn releasing nasty dioxins. Why not remove the main sources of fire instead? For example self-extinguishing cigarettes or candles with a metal base?

Many fire retardants are found in household dust. They cause many health problems and disrupt reproduction patterns.

Penta is a global contaminant found in bears, otters and whales. We are exposed through indoor air and through diet. The contaminant bleeds to the outdoor environment and will amplify in food chains.
(Authors note: Penta is pentachlorophenol - an extremely toxic wood preservative used to treat telegraph poles)

Theo Colburn (G)

President, The Endocrine Disruption Exchange
www.endocrinedisruption.org

A professor of Zoology at the University of Florida, Theo is an environmental health analyst, best known for her studies on the health effects of endocrine disrupting chemicals.
(Authors note: There is a good explanation of endocrine systems and Theo's work at http://en.wikipedia.org/wiki/Endocrine_disruptor)

Endocrine Disruption – are males at risk?

A hidden threat. There are no visible signs. Problems appear years later. Children born today have problems as a result of their grandmother's exposure. Theo described a global pandemic of endocrine disruptive diseases that could be a threat to the entire human race.

In recent years there has been a huge rise in the level of endocrine disorders such as ADHD, autism, asthma, cancer, obesity, osteoporosis, cancer, Alzheimer's, Parkinson's, diabetes etc.

Sperm count has fallen 50% since the 1930's.

It used to be said that the dose made the poison but it is know known that the timing of the dose can be crucial. For example, when the foetus is exposed to these chemicals in the womb, the effects are much greater.

We are exposed through our skin, ingestion and inhalation. But males are affected more. In Japan, 3 times as many boys die before birth than girls.

National Institute for Environmental Health Sciences
Endocrine Disruption Prevention Act 2009

Pete Walker (H)

University of Bath www.bath.ac.uk

Professor of Innovative Construction Materials at the University of Bath (UK) and Director of Research for the Building Research Establishment (BRE) Centre for Innovative Construction Materials. His main research interests are in the use of low carbon and renewable construction materials; hemp-lime, straw bales, timber and earthen constructions. His interests in traditional building materials include studies in structural masonry, lime mortars, timber engineering and the conservation and repair of historic structures. Contributing author to *Hemp Lime Construction: a Guide to Building with Hemp Lime Composites,* and *Rammed Earth: Design and Construction Guidelines.*

The most recent research programs at the University of Bath have involved unfired clay, straw and hemp. Professor Walker mentioned *economic* challenges to mainstream uptake of these materials such as build cost, insurance and raising finance and *knowledge* challenges such as understanding the materials, design codes and the misconceptions in the market place. He had concerns over possible significant project failures and other demands for biomass such as burning or ethanol production. He also thought the construction industry would require delivery on demand rather than the seasonality currently associated with natural materials.

However, he stressed there were opportunities due to the need to reduce green house gas emissions, lower embodied carbon, better environmental performance, healthier buildings and new markets for agriculture.

There is a knowledge and skills gap with renewable building materials. A regulatory framework, cost reductions and better image were required.

Khosrow Ghavami (I)

Pontificia University Catolica do Rio de Janeiro www.abmtenc.civ.puc-rio.br

Professor of civil engineering and research fellow. Author and co author of of more than 200 technical papers. Founding member and chairman of the International Committee on Non-conventional Materials and Technologies (IC-NOCMAT) whose 12th annual conference will be held in Cairo, Egypt in September 2010.

Bamboo used instead of steel as a concrete reinforcement. There is much research into bamboo now certified. Grows in many developing countries.

Coconut fibres used instead of asbestos cement.

Originally from Persia (now Iran), Khosrow showed natural air conditioning in old Persian buildings and a pre industrial pigeon tower that was used to produce fertiliser in Persia!

Yan Xiao (J)

University of Southern California www.usc.edu

A professor of civil engineering, Dr Xiao's, research interests include reinforced or pre-stressed concrete, steel structures, composite or hybrid structures, earthquake-resistant design, and properties of structural materials.

Development of modern bamboo structures such as houses, foot and road bridges. Developed "glubam" and composites of bamboo, steel and timber. Mechanical testing of bamboo columns and beams, which are lightweight and with low embodied energy.

John Straube (K)

University of Waterloo, Ontario, Canada
www.buildingscience.com john@buildingscience.com

John is a building scientist and engineer who has pioneered the study of building enclosure, moisture physics and whole building performance. An expert in moisture related building problems.

To combat the issues of climate change, energy and resource security, pollution and health, green buildings should be low carbon, healthy and *rapidly* renewable.

The "industrial" response is

1. Marketing (re brand and call it green)
2. LEED compliance (pick out the odd "green" bits to win points)
3. Change marketing (find some real green benefits and emphasise those)
4. Change mix of products, using more of the greener ones
5. Change feed stocks and processes
6. The last stage of enlightenment – new products and approaches

Environmental damage is caused in many ways

- Resource extraction
- Processing
- Transportation
- Construction
- Operational
- Demolition

There are a plethora of solutions but many are limited in one way or another. How can we compare the effect of different impacts and move in the right direction? What will make the *biggest* difference?
We have to be vigilant against "green wash"!
Retrofit of existing buildings is going to be very important.

John suggested looking at the work of Professor D Harvey at the University of Toronto. In particular a study on the global warming potential of insulating materials.

Paul Hawken (L)

www.paulhawken.com

Environmentalist, entrepreneur and prolific author. Numerous titles include of *The Ecology of Commerce, Blessed Unrest* and *Natural Capitalism*.

Paul described how all our energy originates from the sun but differentiates energy three ways:
Long – coal, gas and oil formed millions of years ago

Slow – from water and soil
Fast – from the sun and wind

We are using up the long energy available to us and must move towards generating fast energy, and using much less of it. This is where the designers among us will be important – we need to design new ways to live. A complete new system is needed. The built environment disconnects us from nature but we are nature!

Dan Reicher (M)

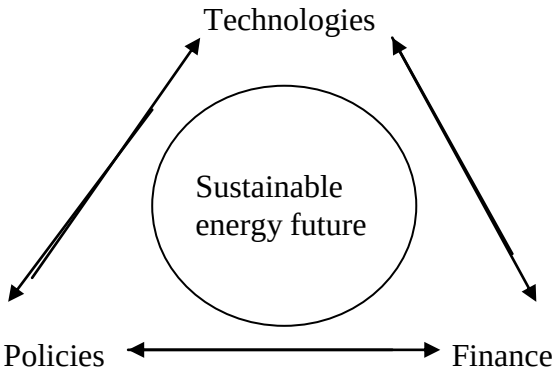
Google Inc., Director of Climate Change and Energy Initiatives
www.google.org

Over 25 years experience in energy and environmental technology, policy, finance and law. Adviser to President Obama on energy and climate issues.

Before talking about our sustainable energy future, Dan started with a few of his favourite quotes
"The future is not what it used to be" Paul Valery
"The best way to predict the future is to invent it" Alan Kay, Computer Scientist

People aren't interested in energy as such, merely the *service* it provides.

The grid is so old, Edison would recognise it! Tomorrows "Smart Grid" will be much different. Including renewable sources, more efficient distribution, smart homes and perhaps plug in vehicles.



We need to pick the low hanging fruit first, the cheap efficiency opportunities first such as insulation, fuel efficient vehicles and lighting for example. Laws passed to reduce the energy used by refrigerators mean that none in the US now use more than 450W per annum.

"If you can't measure it, you can't improve it" Lord Kelvin. If we knew more about how we use energy – by appliance or time of day for example we could improve efficiency. Knowledge could be less power!

Google Power Meter – download free software at www.google.org - the philanthropic division of Google. Click on the link on the link on the left hand side of the home page. A clip device will be needed at the fuse box.

Could save 5-15% with simple behaviour changes and 20-40% with better equipment.
Energy technology meets information technology.
Making smart devices secure will be important.

An Industry Perspective……
New "green" products coming to market in the US;

Karen Slimak (N)
Timber Treatment Technologies www.timbersilwood.com
Karen described the extraordinary lengths established competitors went to in order to prevent/delay her glass-wood product coming to market.

Julie Rapoport (O)
Calstar Products www.calstarproducts.com
jrapoport@calstarcement.com
Calstar's bricks are made from fly ash, a waste product from coal fired power plants. The bricks have lower embodied energy than conventional bricks but as the raw material is highly toxic some consumers are wary.

Patrick Govang (P)
e2e Materials www.e2ematerials.com
Bio composite solutions for the wood panel market – less embodied energy, biodegradable, no formaldehyde or fire retardant, lighter and stronger than conventional boards.

A Practitioner's Perspective……..
Those with green building experience in the US;

Anthony Bernheim (Q)
www.AECOM.com
Traditionally architects would consider design, functionality, investment, fire resistance, lighting and acoustics. Now being asked to consider renewable materials, renewable energy, re usability, re cyclability, life cycle analysis, toxicity and indoor air quality, cleaning and maintenance.

Designers are not scientists. They need reliable certification; preferably multi attribute certificates that;
- Present the *whole* picture
- Are transparent
- Understand risk and life cycle
- Are globally harmonised

Larry Strain (R)
Siegel & Strain Architects
www.siegelstrain.com

Material selection in a carbon challenged world

Larry's guidelines for sustainable materials and methods are incorporated in the GreenSpec Directory, published by Building Green Inc. Criteria change according to place in building.

(Authors note: In the UK we have a similar resource, the excellent and highly recommended www.GreenSpec.co.uk)

Embodied carbon is important. Carbon saved now is worth more than carbon saved later. Lower embodied carbon materials include aggregate rubble trenches, earthen floors, non-engineered wood, wooden windows, and cellulose insulation. Using reclaimed wood means that trees are still growing!

There has to be lots of carbon reduction in the next 10-20 years

- Tackle high volume materials first to make the biggest difference
- Use salvaged and recycled materials
- Limit energy intensive materials
- Using local really does make a difference

Kirsten Ritchie (S)

www.gensler.com

Going Green in an urban/digital age

Kirsten's green priorities;

1. less space/less stuff (use more intensively)
2. less waste when build in factory, assemble on site
3. continually innovate to reduce carbon

Operations footprint – this analysis can inform decisions. Low energy doesn't always correlate to low carbon. There is an excellent diagram in Kirsten's presentation to illustrate this.

Phil Williams (T)

Webcor builders www.webcor.com

14th largest building company in the US. Member Climate Change Action Registry.
Look at carbon in own business and how can help others reduce their impact.
All Webcor subcontractors have to report carbon data. Webcor not yet concerned what the number is, they are simply collecting data at the moment.
LEED good starting point but improvement necessary. Comprehensive approach is critical.

From the Regulatory Perspective……..

Alison Kinn Bennett (U)

Environmental Protection Agency (EPA)
Pollution Prevention Division
US EPA Green Building Workgroup www.epa.gov/greenbuilding

It's not as simple as a low carbon economy. Must look at the situation holistically. For example the US weatherisation policy is pushing out lots of toxic insulation product into the built environment.

Need to shift to a full life cycle analysis and risk assessment. Need a coherent message, increased transparency and less confidentiality. Focus must be on adapting, re using, deconstruction and retro fit.

www.greenbuildingproductscoalition.org

Norman Bourassa (V)

Californian Energy Commission
www.energy.ca.gov

Public Energy Interest Research (PIER)
Seeks to reduce energy use and peak demand in residential and commercial buildings – the easiest and most affordable way being to increase energy efficiency – building envelope, lighting, appliances, building integration, community integration, renewables.

The rising "plug load" has wiped out recent savings made by energy efficient lighting.

Insisting humans modify their behaviour is not going to work.

Aggressive retro fit of existing homes is needed. Need objective, reliable information about how to spend your money.

Martin Hammer (W)

Architect, Berkley, California
mfhammer@pacbell.net

In the US there have been straw bale building codes in some states since 1996. Testing is critical in developing these codes. Currently all codes have a limited lens – (fire, structure, light, ventilation etc). Chapter 5 of the first draft of the 2012 International Green Construction Code simply talks about greening concrete, glass, gypsum, masonry and steel! It defines indigenous materials as within a 500-mile radius!! But at least it is a start.

There is a lot of objection from the big players in the construction industry who use dirty tactics to protect their vested interests.

Jan Stensland (X)

Indoor Environmental Quality and Product Contaminant Exposure Work Group

Confusopoly – confusing labels and terms. In this global economy there should be and international effort to harmonise. Toxic facts label should appear in all buildings,

There is so much green wash going on. This website (http://sinsofgreenwashing.org/) highlights many of the tricks.

Jeff Frost (Y)
Akagreen www.akagreen.com
Arizona Green Chamber of Commerce

Book recommendation – *Cheap – the high cost of the discount culture* by Ellen Ruppel Shell.

"green" terms are getting out of control in the media. Every company wants to be green and we are heading towards "green fatigue"

Tom Lent (Z)
Healthy Building Network
www.healthybuilding.net

www.pharosproject.net - a new tool for categorising chemical hazards.

Chris Erickson (ZZ)
CEO Climate Earth www.climateearth.com

Software to measure and track carbon foot printing. Looks and acts like a financial system, merging life cycle analysis with data management technology to produce reports, analytics and impact assessments.

Other useful contacts from **Buildwell 2010**

Centre For Maximum Potential Building Systems
Austin, Texas www.cmpbs.org
Co Directors: Pliny Fisk and Gail Vittori gvittori@cmpbs.org
Non profit policy, education & research. Design & master planning.

Ecosa Institute, Arizona
Innovative programs in sustainable design
www.ecosainstitute.org , www.econet.org

International Living Building Institute www.ilbi.org
Living Future – Conference 5-7 May 2010, Seattle, WA

Rebuild Associates, Nebraska
Alternative materials methods of construction
Joyce Coppinger jc10508@windstream.net

Oryzatech Inc, California
Large straw bricks known as STAK BLOCK™
www.oryzatech.com

Serious Materials, California
www.seriousmaterials.com
High performance windows (u value 0.12W/m2K) and EcoRock dry wall system

Adobe Building systems LLC
Vancouver, Canada www.adobebuilding.com
Lisa Morey Schroder, owner