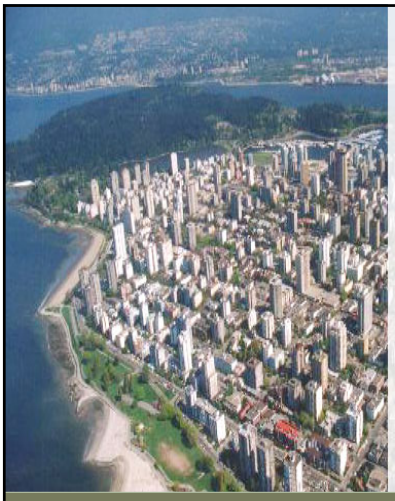

Concrete in a Sustainable World

" The World will not evolve past its current state of crisis by using the same thinking that created the situation."

~ Albert Einstein

DIANA KLEIN P.ENG, LEED AP
NOVEMBER 2006

ECO-INTEGRATION
Building Designs to Enhance Life

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CONCRETE, SCM's and BEYOND

- Specifying Cement Reduced Concrete
- Using Cement reduced concrete in Schedule Driven Construction
- Energy Use and Concrete

ISLAND MEDICAL BUILDING, UVIC, BC

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SPECIFYING CEMENT REDUCED CONCRETE

Dockside Green, Victoria

Guidelines for % Cement Reduction

Element	Range in Vancouver
Highest in footings (minimal impact on schedule, minimal finishing required, lowers heat of hydration in core & crane raft footings)	40% - 50%
Mid-Range in vertical elements (usually limited by formwork stripping and winter conditions)	35% - 45%
Lower in horizontal elements (finishing, curing, and formwork stripping time can impact costs)	10% - 40%
Low in C-1 exposure class (HVFA concrete exposed to freeze-thaw and deicing has scaling concerns)	15% Maximum

Greatest concrete component is usually slabs (40-60%)

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CASE STUDY

TECHNOLOGY ENTERPRISES FACILITY III UBC - 2002

UBC TEF III CERTIFIED LEED SILVER

Overcoming the early strength gain issues:

- Options to achieve a higher early strengths with fly ash concrete
  - Lower the water/cement ratio and add plasticizer
  - Add an accelerator
  - Reduce the air content
- Alternate options researched
  - Formwork adaptation
  - Insitu tests
  - Hybrid systems
  - Permanent formwork

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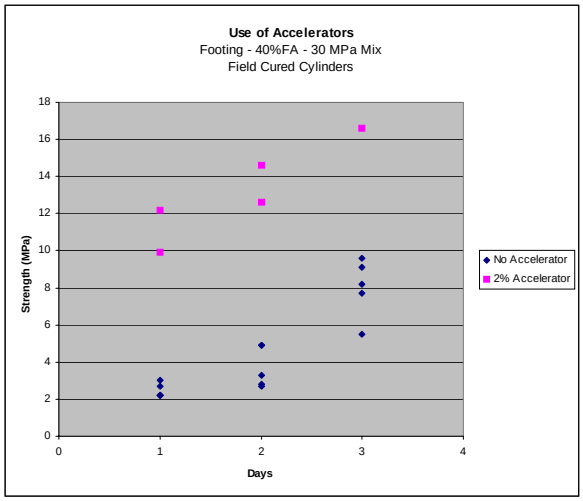
CASE STUDY

BISON COURTYARD
BANFF, ALBERTA 2004

Use of accelerators:

- Doubled strength gain in first three days



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STRUCTURAL SYSTEMS

HIGH-RISE RESIDENTIAL
STUDY, VANCOUVER, B.C.

FLAT PLATE CONCRETE
Conventional Fly Forms modified
Proprietary Form Systems
(Peri Sky Deck or similar)

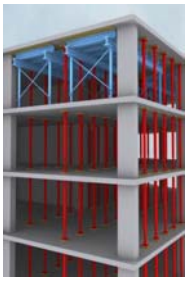
Disadvantages

- Additional cost of for system or propping

Advantages

- Forms can be stripped at a lower early strength
- 4-day cycle can be achieved with HVFA concrete

PROPRIETARY FORM SYSTEM



CONVENTIONAL FLY FORMS MODIFIED

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ABBOTSFORD HOSPITAL,
ABBOTSFORD, BC

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C&W HEALTH CENTRE OF BC

BUBBLEDECK

A two-way concrete hybrid 'hollow' flat plate system

In Factory

- +/- 75mm precast concrete base
- Cast in bottom rebar and light top mat clamping hollow plastic balls

On site

- Panels arrive and are craned into position
- Interlacing rebar to 'connect' the panels is placed
- Top mat rebar placed
- Pour and finish concrete creating a monolithic slab

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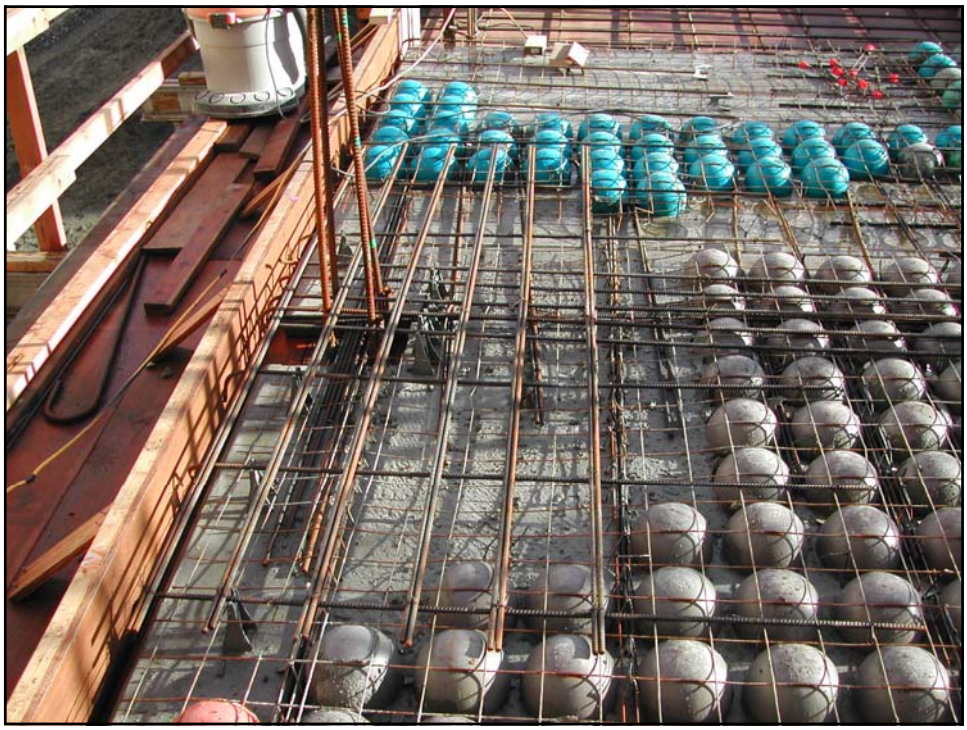

C&W HEALTH CENTRE OF BC

BUBBLEDECK

Advantages

- Lightweight system capable of large spans
- Lighter systems translates to less gravity and seismic load = smaller columns and footings
- Precast base allows use of high SCM concrete without affecting schedule
- Easy to erect on site, no formwork erection, little site rebar placement
- Precast soffit can be exposed

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ENERGY USE AND CONCRETE

THE CRESCENT, BATH UK

Using the mass of structure to reduce energy demand:

•Radiant floor heating
•Use of structure to form ducts:
  • termodeck

BC GAS BUILDING, SURREY

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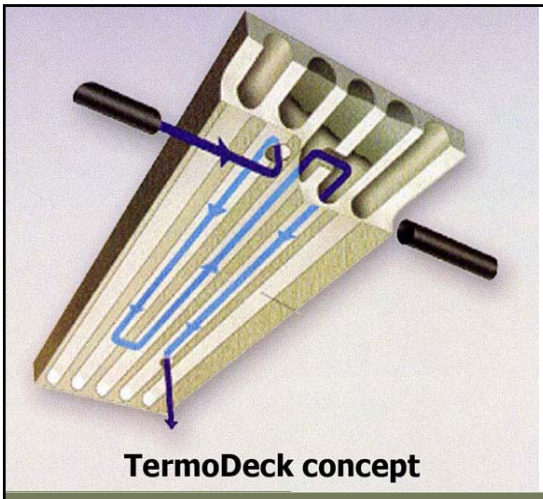

TermoDeck concept

- Use of standard hollow core slabs
- Developed in Scandinavia in 1970s
- Hollow cores are connected to air handling ducts

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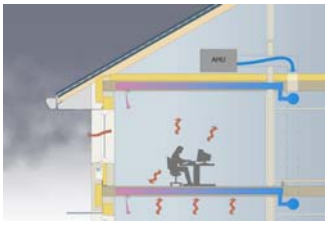
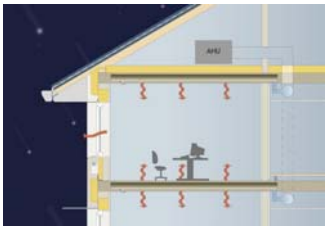
THERMODECK

Cold Climates



Day time

- Supply air fans are running with warm air
- Building structure stores the surplus heat



Night time

- Supply fans are off
- Stored energy is retained, providing comfort the next morning
- On very cold nights, warm air may be circulated through slabs

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Centre for Manufacturing and Design Technologies, Sheridan College

Brampton, Ontario

Diamond & Schmitt Architects with RJC

- **Floor and roof slabs efficiently absorb heat generated from lighting, machinery and re-radiated solar gains in classrooms**
- **Distribute heat to the space in locations and times that heating is req'd**
- **Fans bring cool outside air into the cores of the concrete floor slabs during the evening and cool the slabs for distribution of this cooling to the space at the time and location req'd**
- **Second time use in Canada, but the system has been in use in Europe for about 10 years**

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•Balcony / Structural Penetrations

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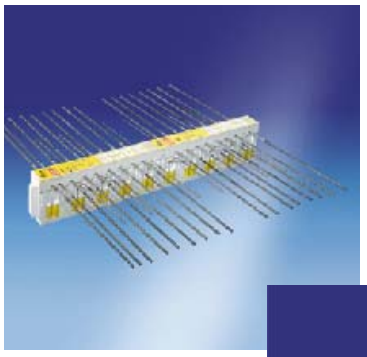
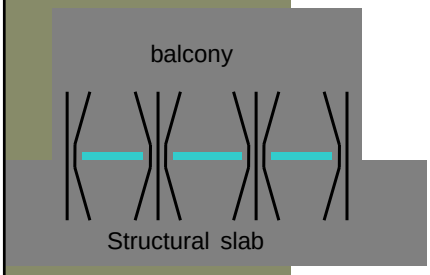
BUILDING ENVELOPE



Concrete-concrete

Steel - steel



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BUILDING ENVELOPE

IK BARBER LEARNING CENTRE, UBC – Precast concrete

Exterior-insulated Concrete Walls:

Advantages

- Concrete Wall adds mass
- Concrete on inside provides thermal mass increasing thermal comfort
- No thermal bridging from concrete

LIFE SCIENCES CENTRE, UBC

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SUMMARY

- Work together to find creative solutions
- Develop cost effective ways to eliminate early strength issues
- Explore and understand interaction and synergies of systems

AMBULATORY BUILDING, CHILDREN'S AND WOMENS HEALTH CENTRE OF BC

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THANK YOU

DIANA KLEIN,
P.ENG, LEED AP

"Meeting the needs of the present generation without compromising the ability of the future generations to meet their needs."

- Oxford 1987, The world commission of environment and development

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