Joseph Lstiburek, Ph.D., P.Eng, ASHRAE Fellow

Building Science

Looking to the Future…Learning from the Past?

www.buildingscience.com

Climate Change

Electrifying Everything

Wind and Solar and the Grid

California and Texas

Covid

Electrifying Heating

Electrifying Heating

- Texas – Wind Was Not There
- Texas – Solar Was Not There
- Texas – Lost a Nuclear Unit
- Texas – Lost Gas Compression

California Is A Real Problem

California Is A Real Problem

- California – Does Not Have a Thermal Problem
- California – Does Not Translate to Cold Places
- California – Supplies Activists not Knowledge

We Need To Build A Wall

- A Wall Around California
- A Wall Between Canada and the US
- A Wall Around Ottawa

Electrifying Heating

- Electric heating and electric battery storage are not compatible

- Electrifying Heating
  - Electric heating and electric battery storage are not compatible
    - Need thermal storage as well as electrical storage

A Trip Down Memory Lane

MIT – Solar I - Cambridge - 1939

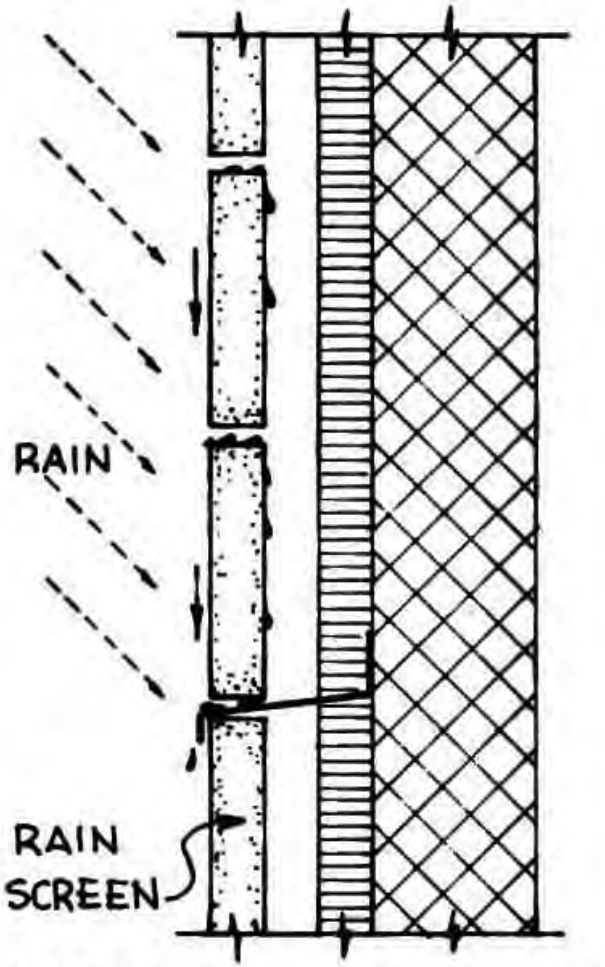
Neil Hutcheon - Canada – 1953

enclosure fundamentals

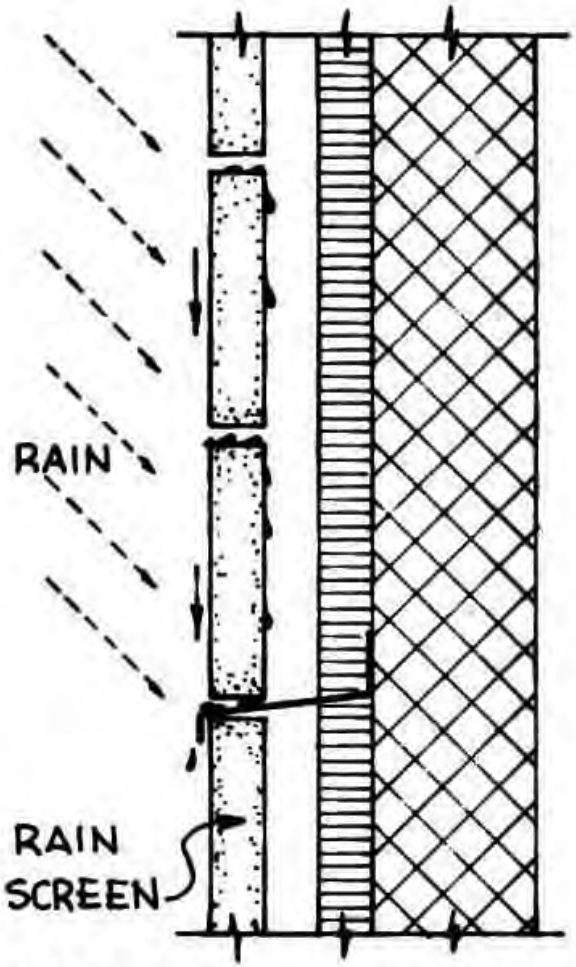
airtightness

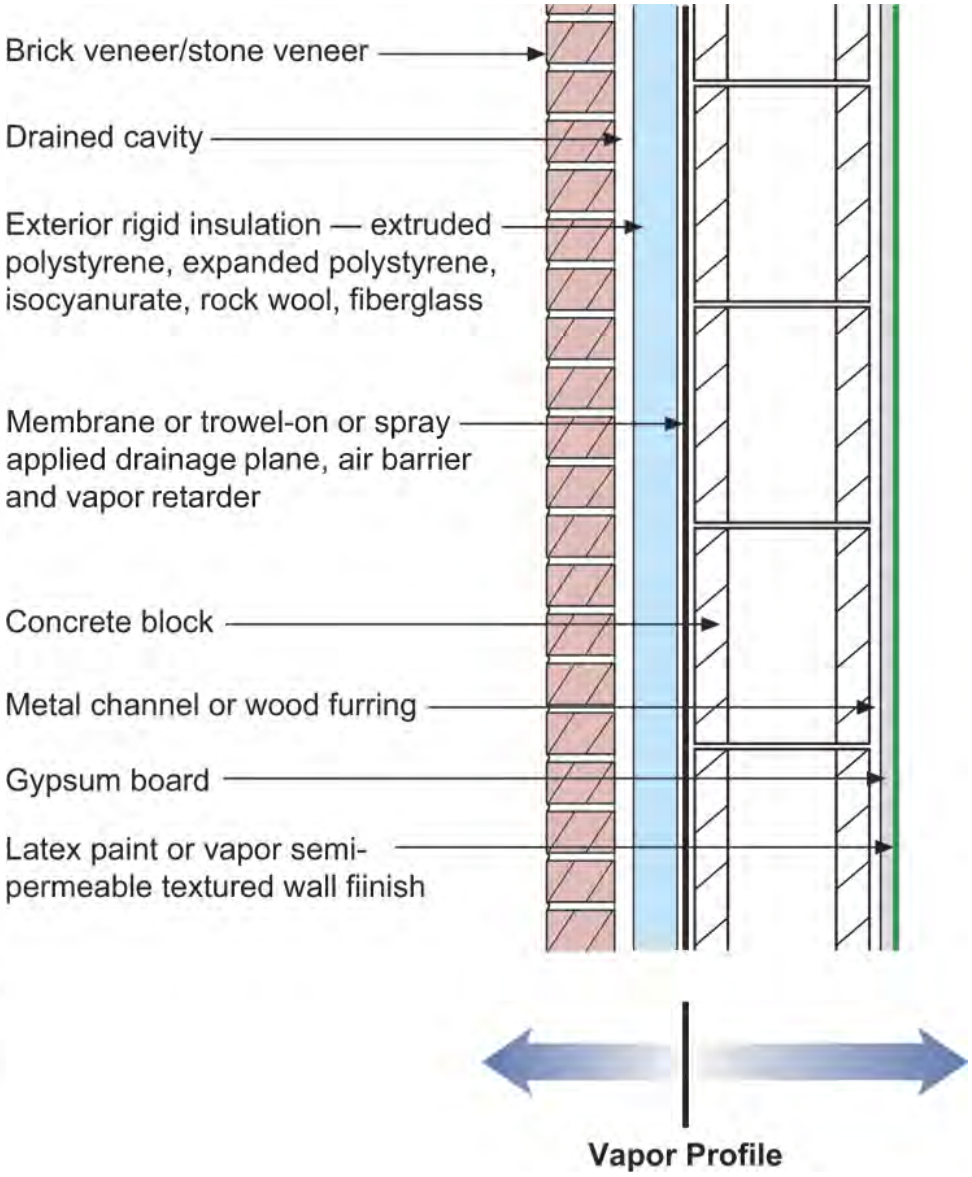
Neil Hutcheon - Canada – 1964

perfect wall



WATER THAT PENETRATES
IS DIVERTED OUTWARD
BY FLASHINGS


RAIN
RAIN SCREEN
WATER THAT PENETRATES IS DIVERTED OUTWARD BY FLASHINGS


Brick veneer/stone veneer
Drained cavity
Exterior rigid insulation — extruded polystyrene, expanded polystyrene, isocyanurate, rock wool, fiberglass
Membrane or trowel-on or spray applied drainage plane, air barrier and vapor retarder
Concrete block
Metal channel or wood furring
Gypsum board
Latex paint or vapor semi-permeable textured wall fiinish
Vapor Profile

Arkansas Project - USA - 1974

Harry Tschumi

Les Blades

Frank Holtzclaw

Arkansas Project - USA - 1974

Harry Tschumi

Les Blades

Frank Holtzclaw

- All About Selling Heat Pumps
- 2x6 Advanced Framing (OVE)
- Double Glazing
- Window Area Limited to 8 Percent
- Plastic Air/Vapor Barriers

Lyngby House - Denmark - 1975

Lyngby House - Denmark – 1975

Null-Energi-Haus

Vagn Korsgaard – Technical University of Denmark

Double walls, R-40 walls, R-60 roof

Air to air heat exchanger

Double glazed windows with insulating shutters

Solar thermal – 8,000 gal storage tank

Provident House - Canada – 1976

Provident House - Canada – 1976

Zero Energy House

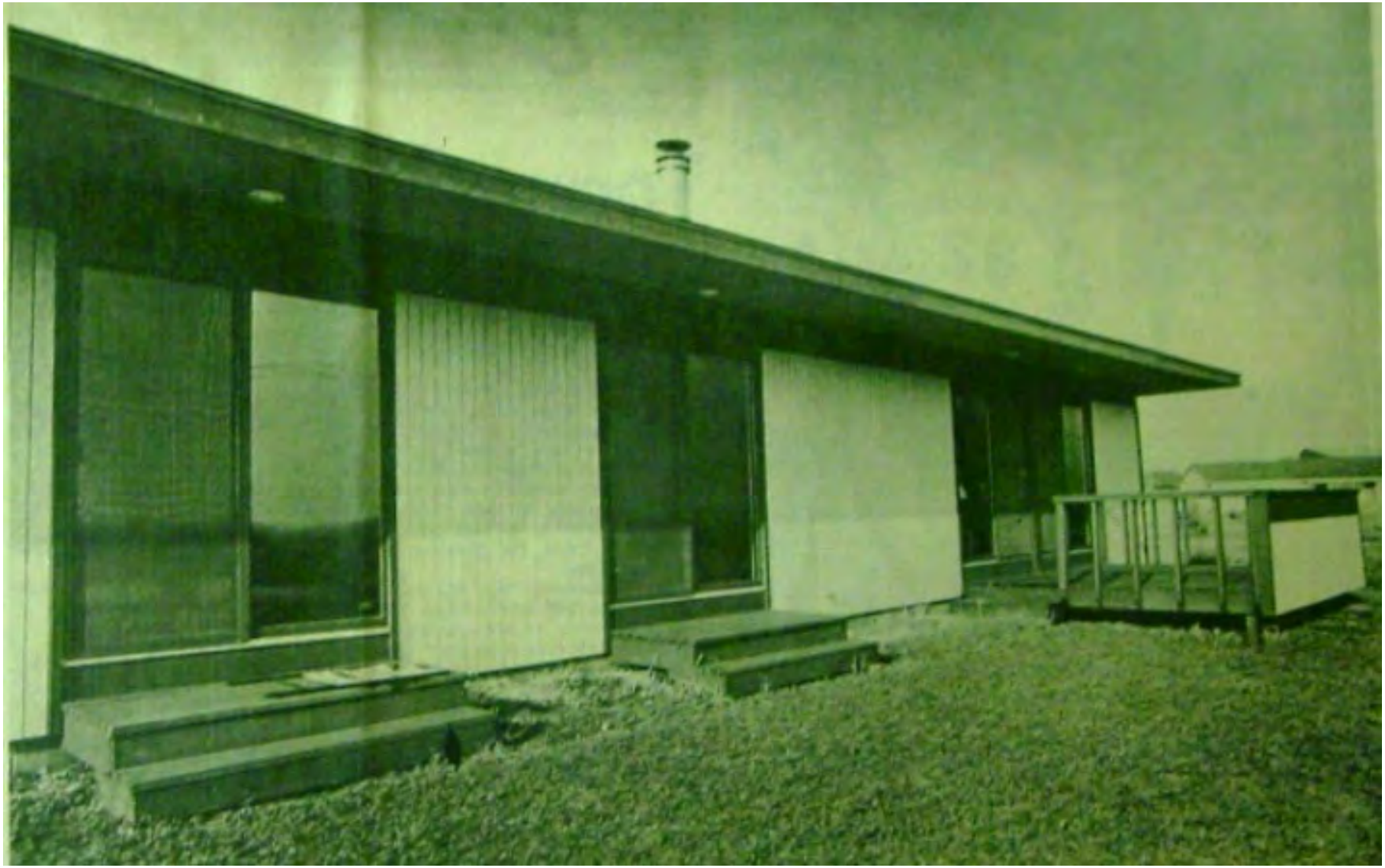
Frank Hooper – University of Toronto

King City

Solar thermal 70,000 gal storage

(entire basement)

Lo Cal House - USA - 1976



Lo Cal House - USA – 1976

Wayne Shick and Bud Konzo

R-30 double stud walls

R-30 vented roof

Triple glazed windows

Air to air heat exchanger

Saskatchewan Conservation House - 1977

Saskatchewan Conservation House – 1977

R-40 double stud walls

R-60 ceiling

Triple glazed windows

Air to air heat exchanger

0.8 ach@50 Pa

Leger House - USA - 1977

Leger House - USA – 1977

Double wall – R 40 walls R 60 ceiling

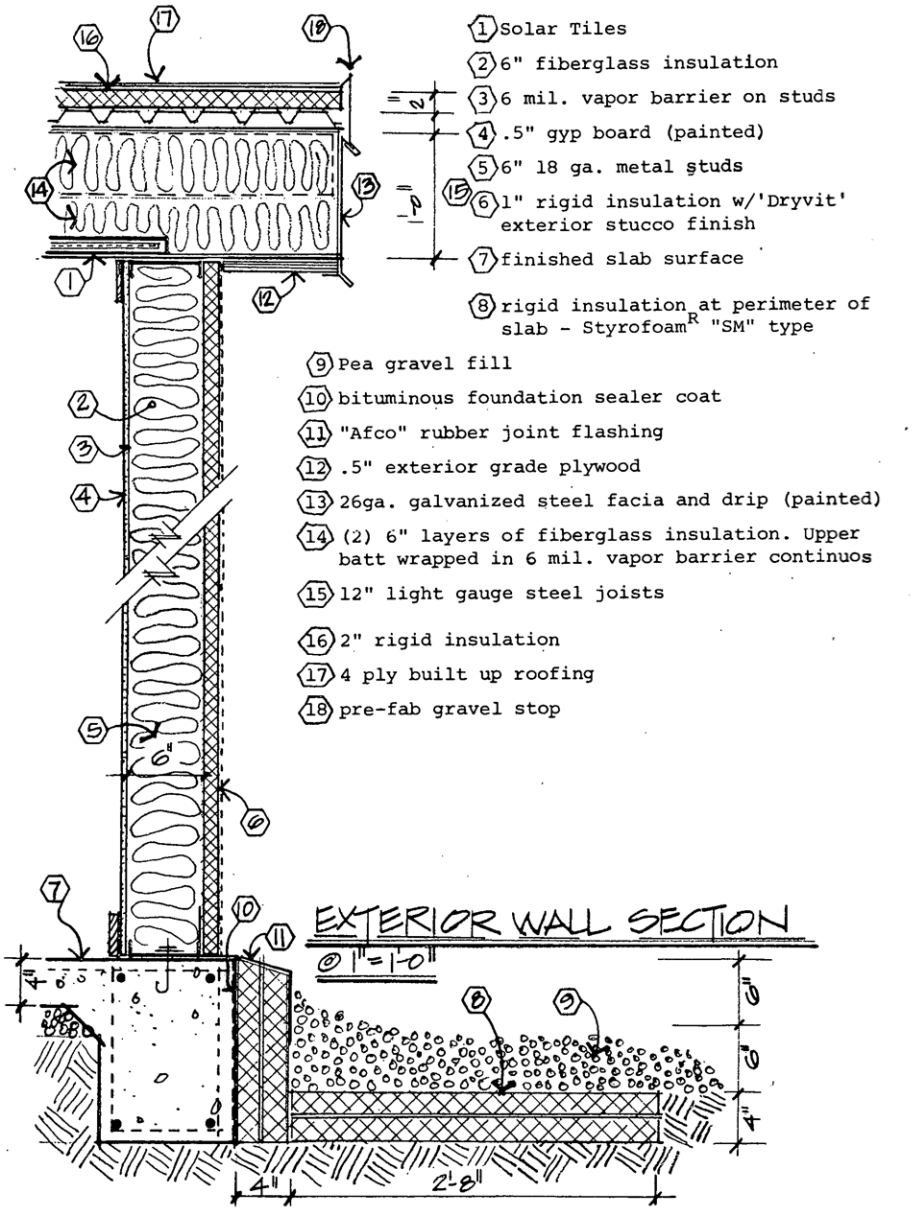
Airtight construction

Air to air heat exchanger

MIT – Solar V - Cambridge - 1978

MIT – Solar V - Cambridge – 1978

Phase Change Ceiling


1 Solar Tiles
2 6" fiberglass insulation
3 6 mil. vapor barrier on studs
4 .5" gyp board (painted)
5 6" 18 ga. metal studs
6 1" rigid insulation w/'Dryvit' exterior stucco finish
7 finished slab surface
8 rigid insulation at perimeter of slab - Styrofoam R "SM" type
9 Pea gravel fill
10 bituminous foundation sealer coat
11 "Afco" rubber joint flashing
12 .5" exterior grade plywood
13 26ga. galvanized steel facia and drip (painted)
14 (2) 6" layers of fiberglass insulation. Upper batt wrapped in 6 mil. vapor barrier continuos
15 12" light gauge steel joists
16 2" rigid insulation
17 4 ply built up roofing
18 pre-fab gravel stop
EXTERIOR WALL SECTION
1"=1'-0"
6"
4"
2'-8"

Balcomb House – Santa Fe - 1979

Balcomb House – Santa Fe – 1979

Mass and glass

Sun spaces and solar orientation

Rock bed heat storage

Parade of Homes - Saskatoon - 1980

R-2000 Program – 1982


CANADA INC

Buffalo Homes - Montana - 1985

Dumont House - Saskatoon - 1990

Passivhaus – Darmstadt - Kranichstein – 1991

Passivhaus – Darmstadt - Kranichstein – 1991

Super Insulated

Air tight

Air to air heat exchanger

Subsoil heat exchanger

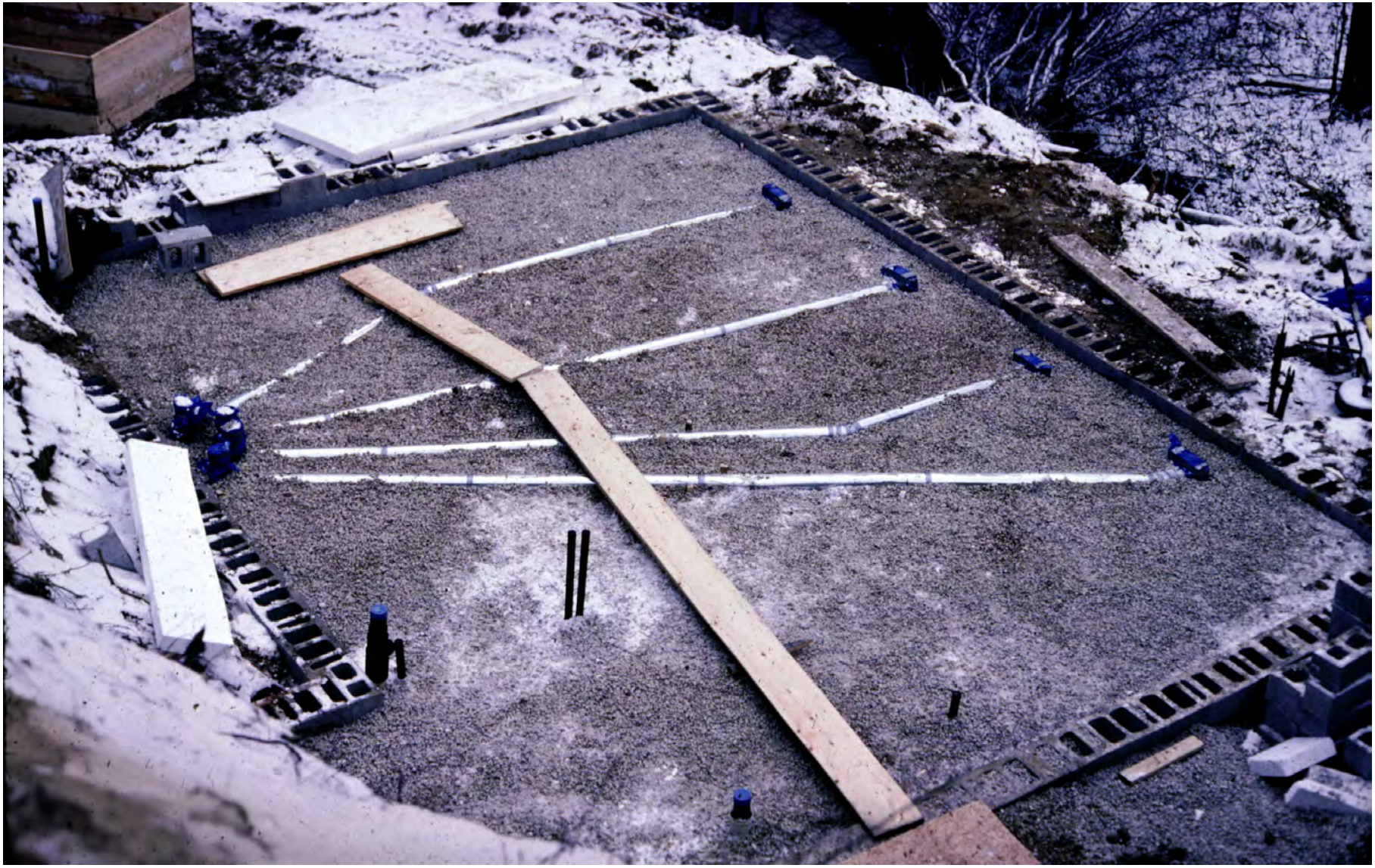
How I Spent 1979, 1980 and 1981

Carnarvon

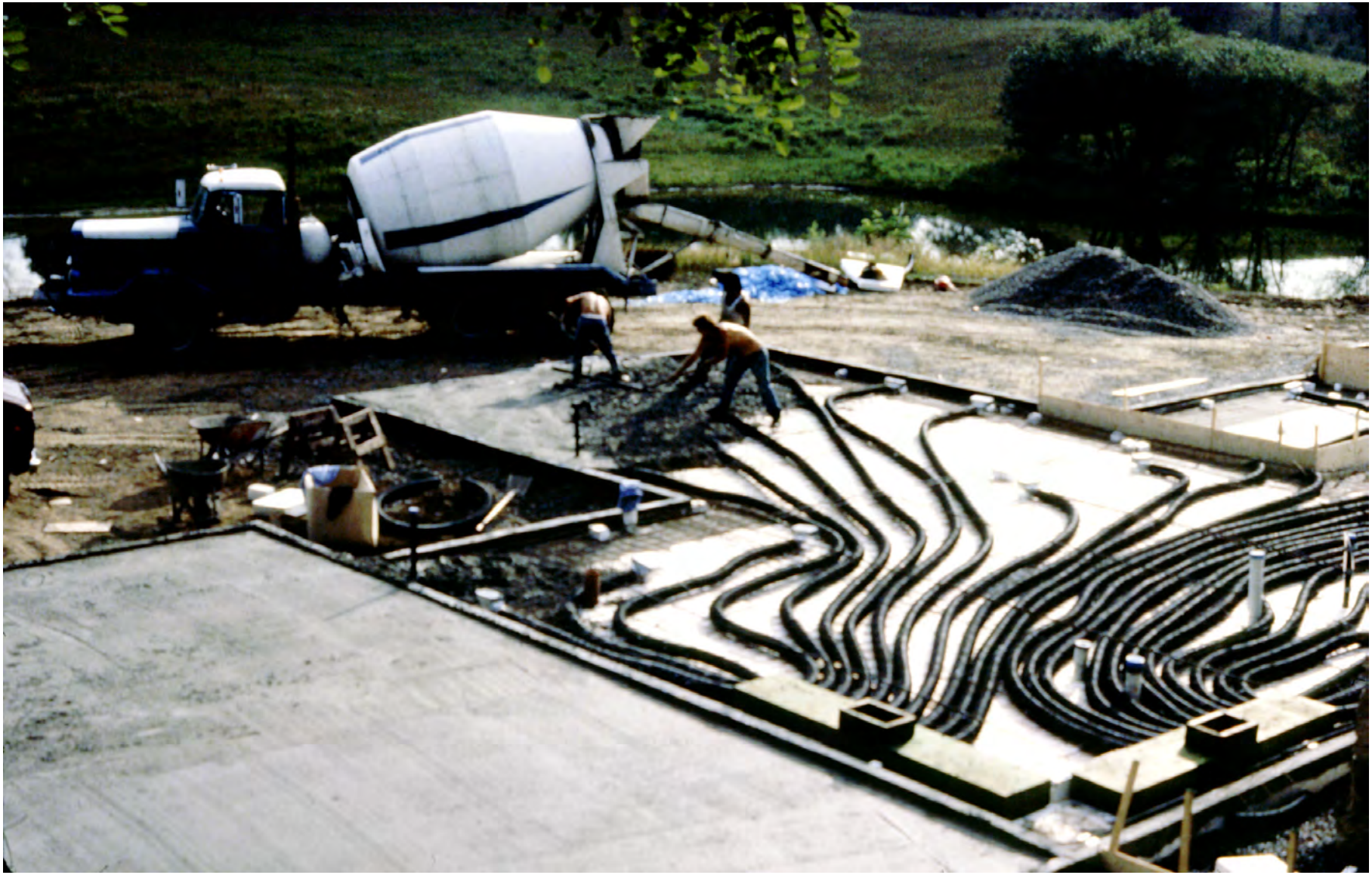
Schomberg

Collingwood


255



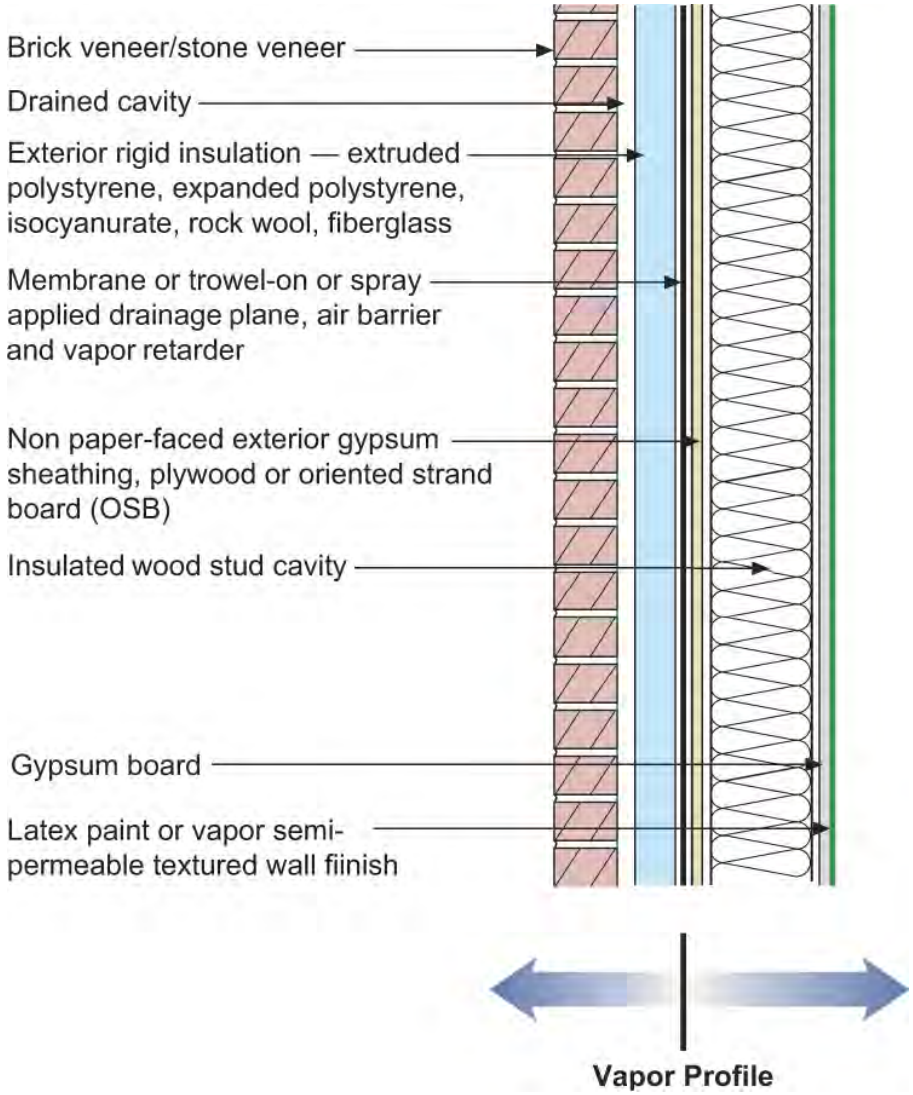
Newmarket



Creemore

Ten Years Later…..1990

Building America Program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Drained cavity
Exterior rigid insulation — extruded polystyrene, expanded polystyrene, isocyanurate, rock wool, fiberglass
Membrane or trowel-on or spray applied drainage plane, air barrier and vapor retarder
Non paper-faced exterior gypsum sheathing, plywood or oriented strand board (OSB)
Insulated wood stud cavity
Gypsum board
Latex paint or vapor semi-permeable textured wall fiinish
Vapor Profile


Celotex
Celotex
Celotex


Symbiont

Thirty Years Later…..

NIST Net Zero Demonstration…..


United Rentals
DANGER
HARD HAT
AREA


DOW
TUFF-R


TUFF-R
TALS UNLIMITED INC.


DOW
DOW
TUFF-R

Thoughts on Where We Might Want to Go…..

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It is Obvious That We Can No Longer Rely on Governments to Provide Reliable Energy….

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Solar and Wind Are Not Reliable…

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Ultra Efficiency Wins…

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Solar and Wind Are Not Reliable…

Ultra Efficiency Wins…

Need Some Storage – Electrical and Thermal

Some Storage Thoughts….

Don’t Forget the Generator….

And a Fireplace….

And a Bed Warmer….

Covid