ASHRAE 2020
Virtual Conference

Energy Efficiency and the Swedish Catalog House

Paper Session 18: Residential Buildings Air Leakage, Catalog Houses, and Energy Model

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Learning Objectives

- Provide an overview of residential air leakage testing code requirements in Florida
- Understand the sensitivity of local climate conditions to levels of urbanization
- Understand the typical methods of prefabrication and energy-efficiency used in Swedish homebuilding factories today, as well as the historical developments leading up to today's methods
- Summarize Florida residential air leakage testing compliance findings and recommendations

Acknowledgements

Scott Hedges assisted the author in this research in a number of ways, including arranging visits to numerous Swedish house factories in 2018 and 2019.

Catalog

Factory

Site

Staffing of large house factory:

1/3 Architects/Drafters

1/3 Construction

1/3 Sales/Marketing

Typical 1.5-story Swedish catalog house

Photo: A. Denzer

Bygga nytt

Går du i byggtankar?
Här hittar du din husleverantör snabbt och enkelt.

Götenehus har funnits i 80 år och har blivit en av Sveriges ledande hustillverkare. Nu presenterar vi något helt nytt – Subline. Ett hus som tål vardagsliv men som ändå är en upplevelse i arkitektur vad gäller ljusflöde, öppna ytor och spännande rumskänsla. En rad smarta funktioner, förpackat i huskroppar som går att flytta och anpassa efter dina behov.

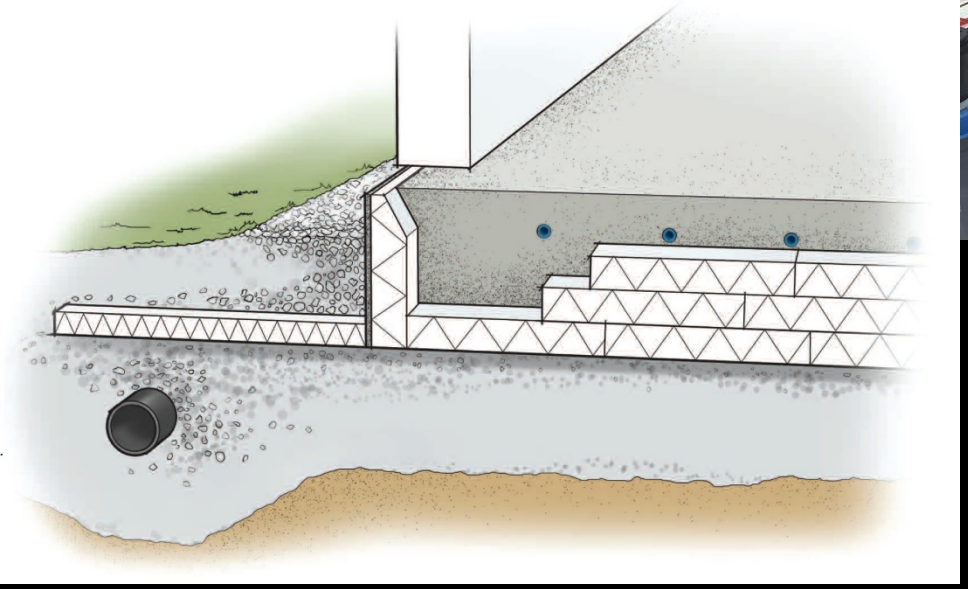
Att skapa sitt hem är som att fysiskt gestalta sin personlighet. Vi realiserar drömmen om ett skräddarsytt hus, byggt efter dina behov och innersta fantasier. Genom att guida dig hela vägen från idé till färdigt hem förverkligar vi ditt livsverk. Med full trygghet genom totalentreprenad. Hämta ditt exemplar av vår nya bok i montern!

Vi gör det riktigt enkelt att bygga hus. På movehome.se hittar du vårt smarta verktyg "Bygg Online" där du formar ditt hus på bara några minuter. Dessutom får du priset direkt. När du är nöjd med ditt hus kontaktar du oss med ett klick, så sköter vi resten. Vi tar fullt ansvar genom totalentreprenad. Att alla våra husmodeller är Svanenmärkta känns extra bra i magen!

Ett arkitektritat hus anpassas efter tomtens speciella förhållanden och den omgivande miljön. Därför har våra fritidshus skapats just utifrån de fantastiska landskapsskiftningar vi har i vårt land - kust, fjäll, skog och sjö. Vi gör allt för att du ska få det optimala fritidsboendet. Kontakta oss gärna för ett kostnadsfritt och förutsättningslöst möte!

Borohus startades 1928 och är ett av Sveriges äldsta trähusföretag och genom tiderna ett av de mest framgångsrika i husbranschen. Vi erbjuder flexibla boendelösningar med hög kvalité. Tillsammans med ett bra pris gör det Borohus till det självklara valet av husleverantör. Besök oss på Husmässan i Botkyrka eller Nybygget i Arlandastad så berättar vi mer.

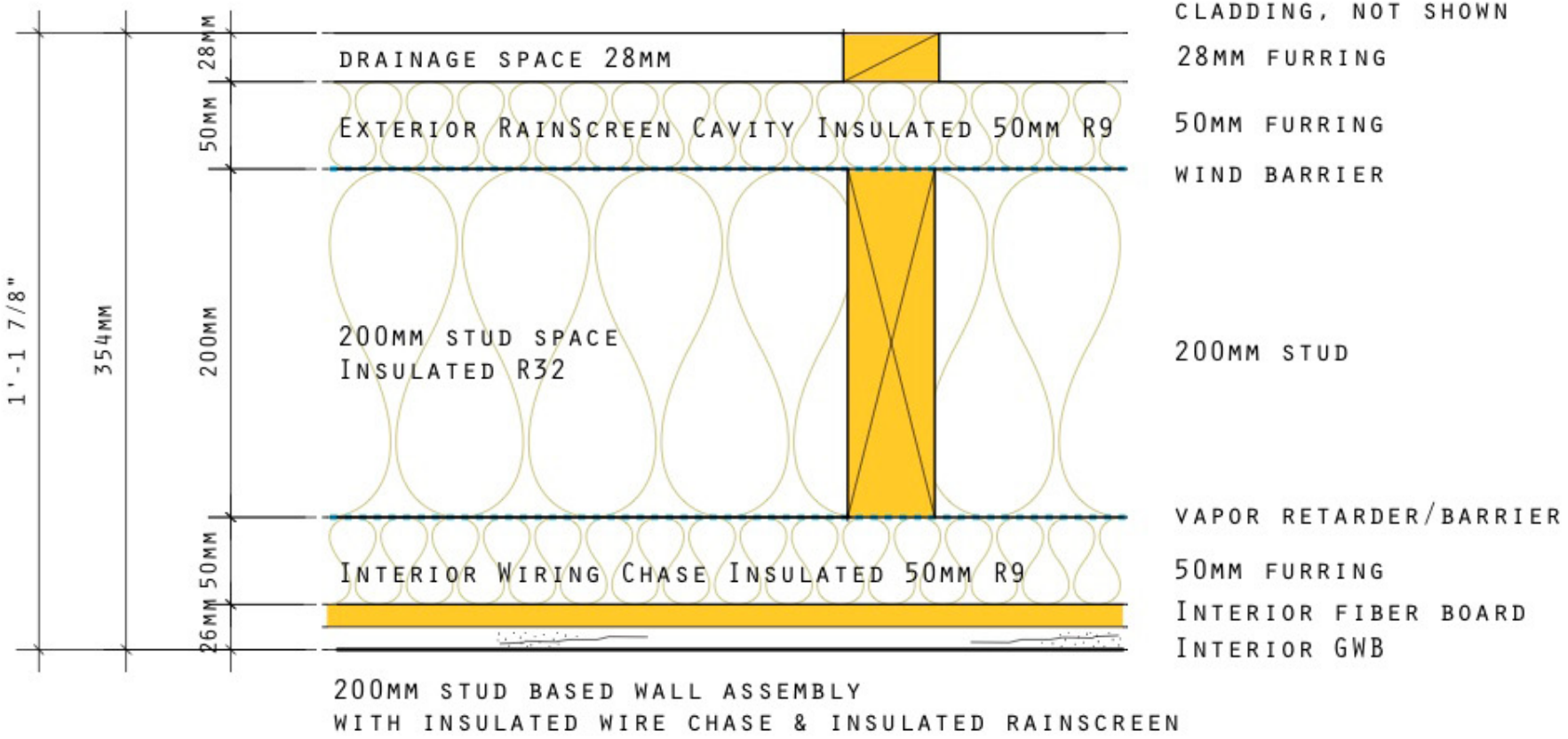
Med VästkustVillan kan du bli din egen arkitekt. Klipp och klistra, rita till och dra ifrån eller varför inte börja med ett helt tomt ark? Med dina idéer och vår erfarenhet skapar vi ditt drömhem. Precis så som du vill ha det. Besök oss på Husmässan i Botkyrka, 070-245 70 04, eller Nybygget i Arlandastad, 0709-84 64 29, så berättar vi mer.



Platta på mark (slab-on-grade)

Photos: Scott Hedges

Typ.: 14” wide
R-36 to R-50



Typical wall section of Swedish factory house

drawing: Gregory La Vardera Architect

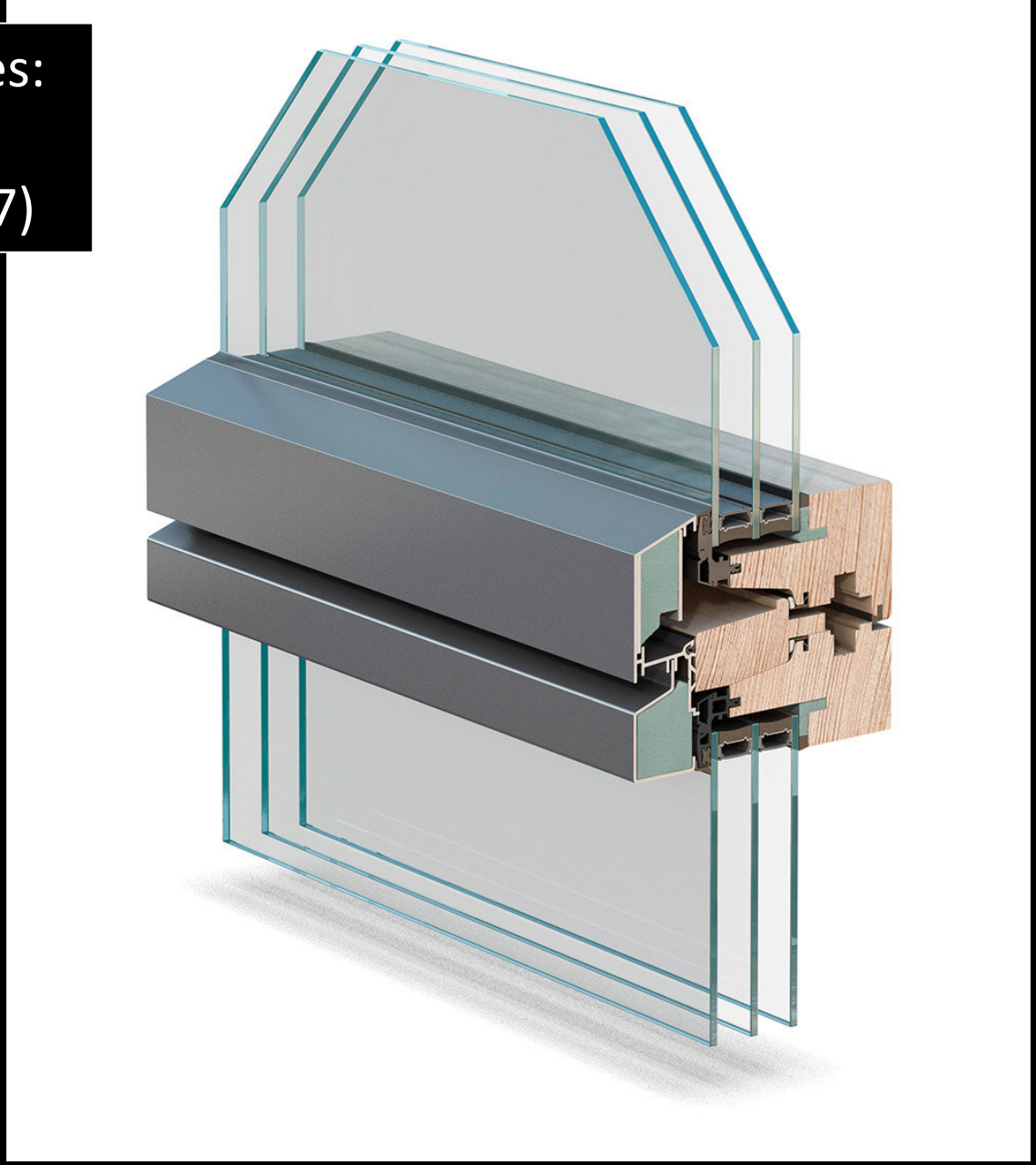
Typical Swedish wall

image: Trivselhus catalog

Wall construction starts with window

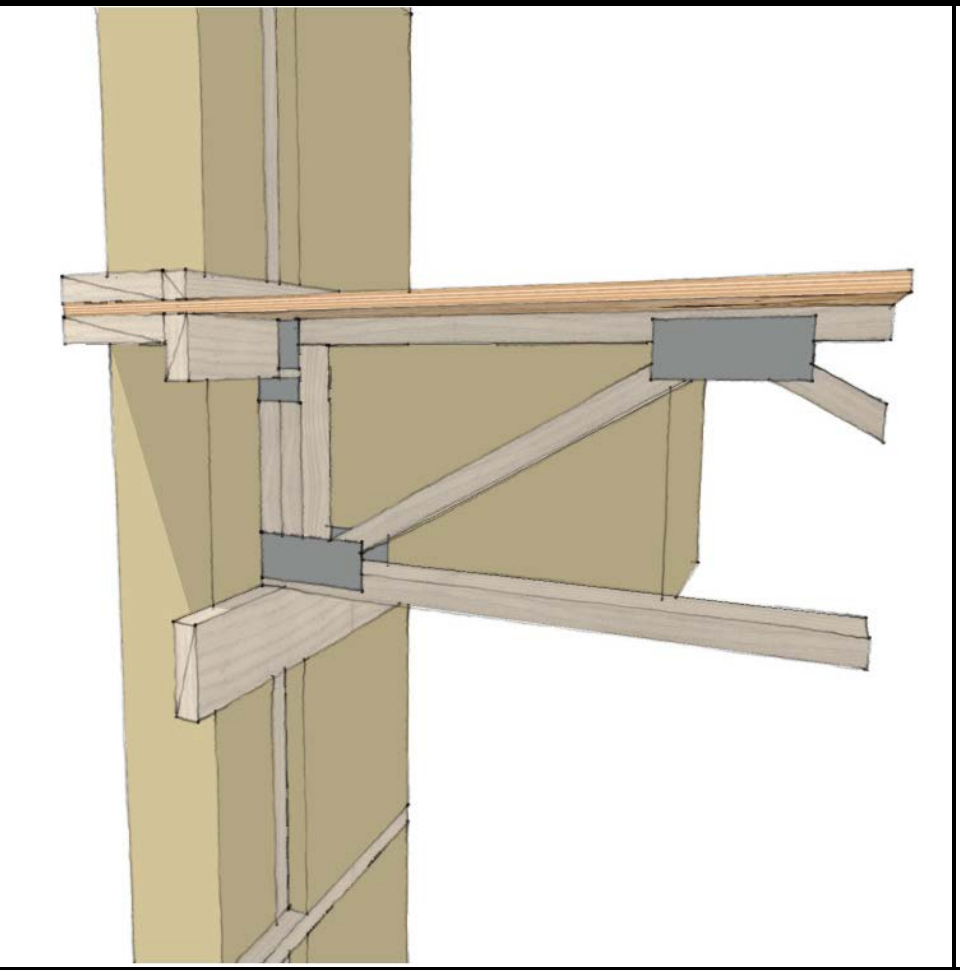
Photos: A. Denzer

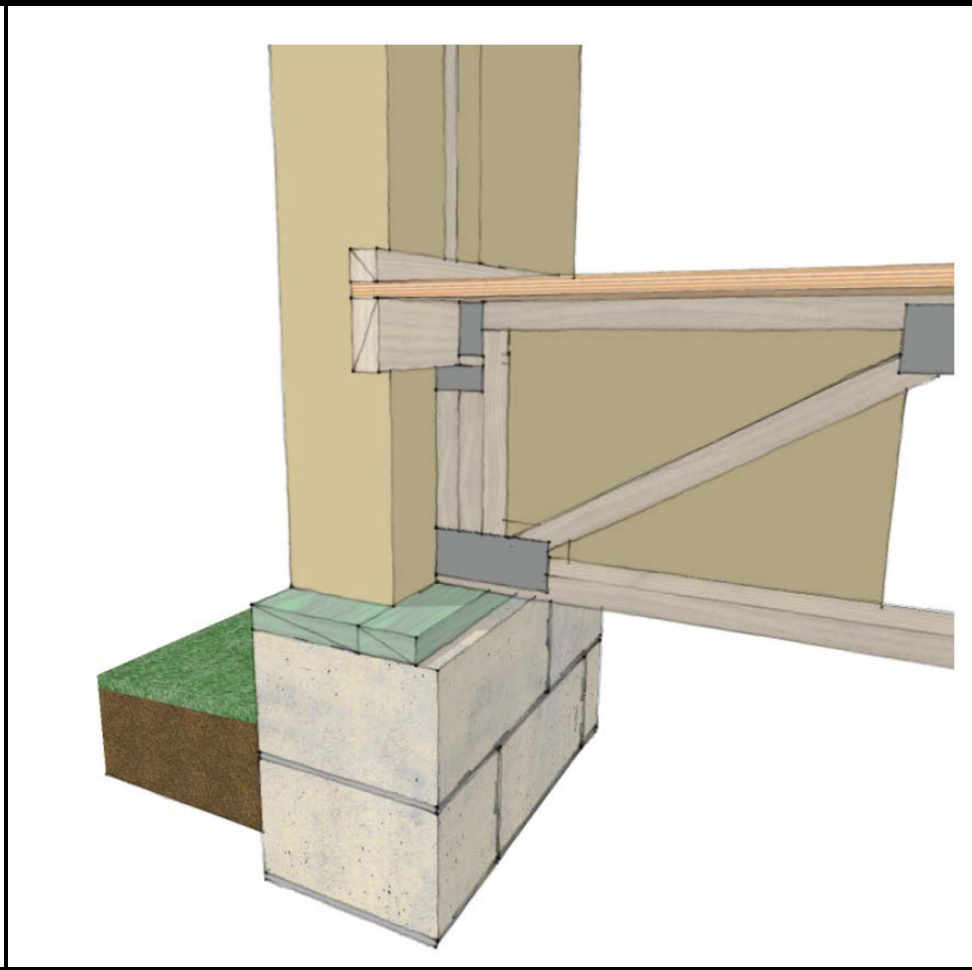
Typ. U-values:
1.2 to 0.8
(R-4.7 to R-7)



Triple-pane is standard

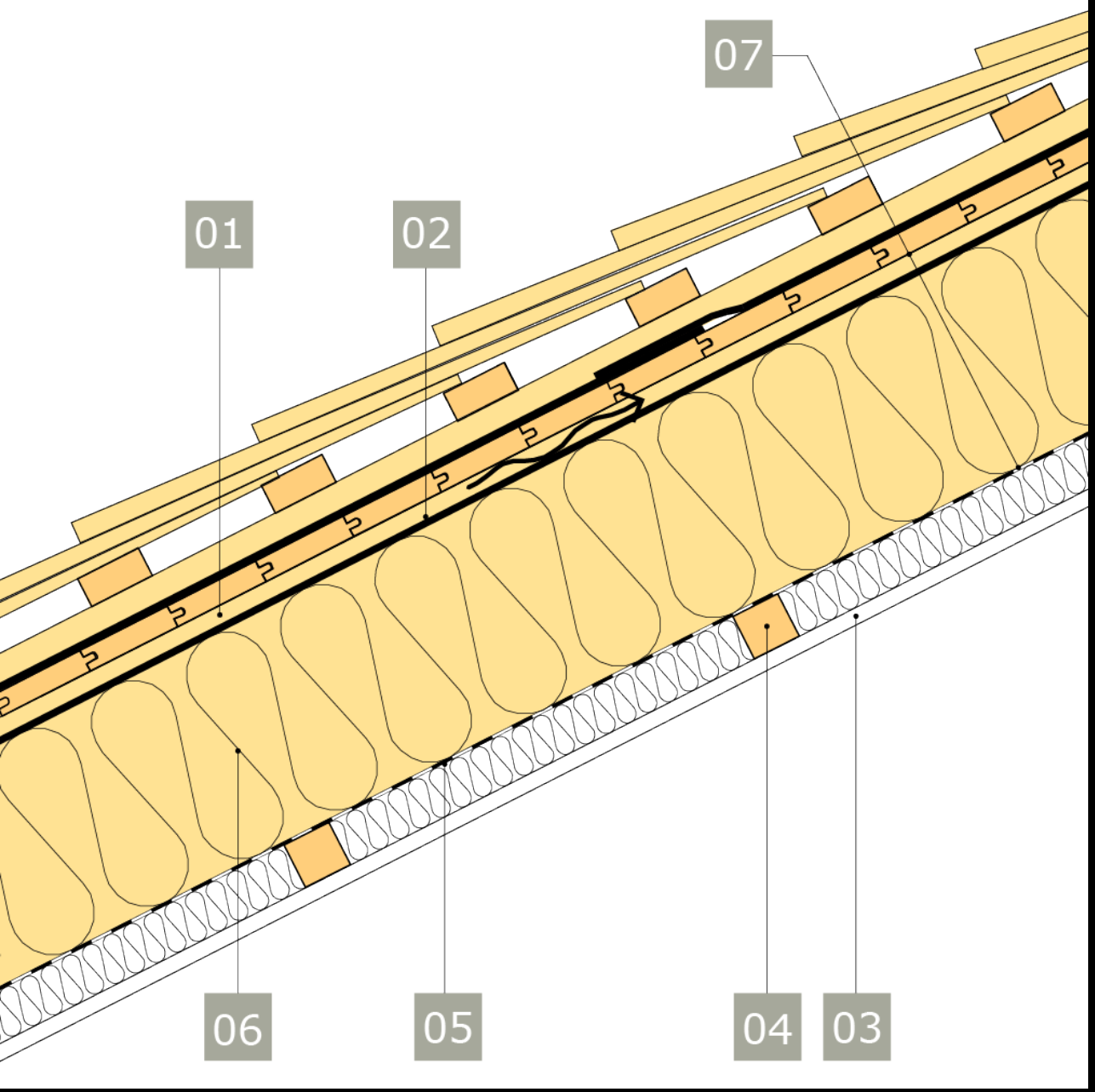
Photo: Build Well Scandinavia AB

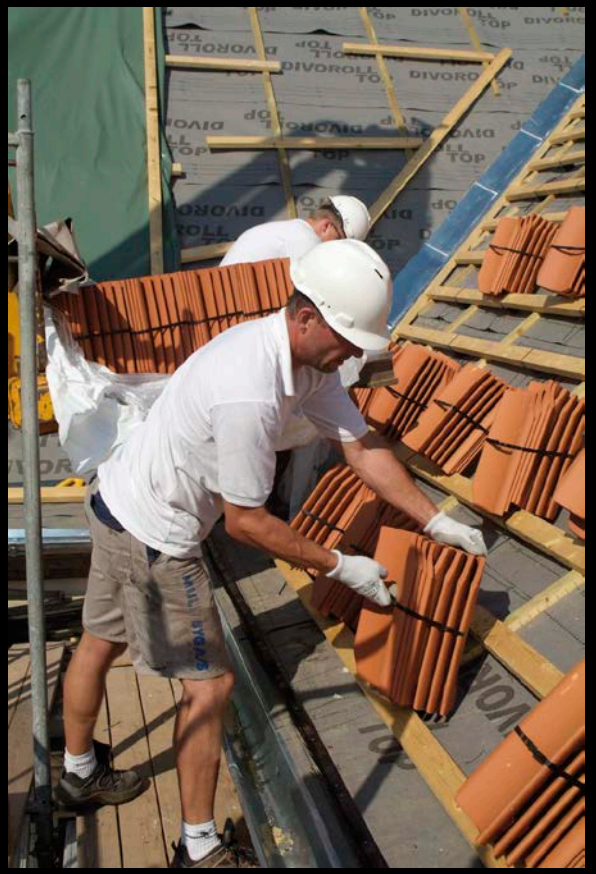




Typical floor construction of Swedish factory house

drawing: Gregory La Vardera Architect

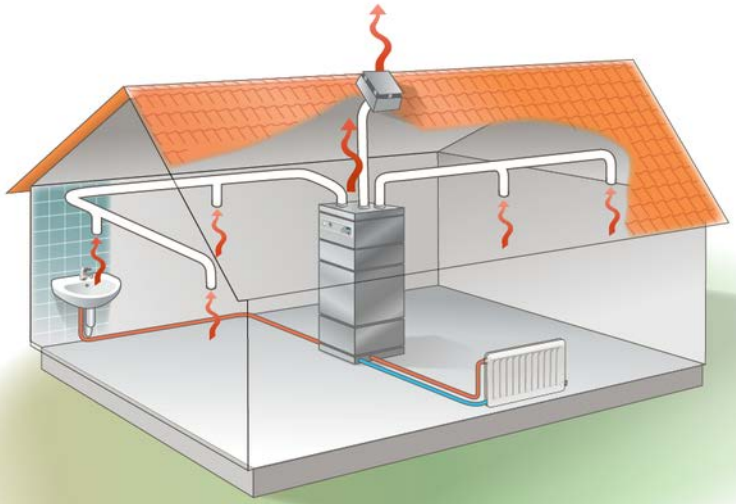




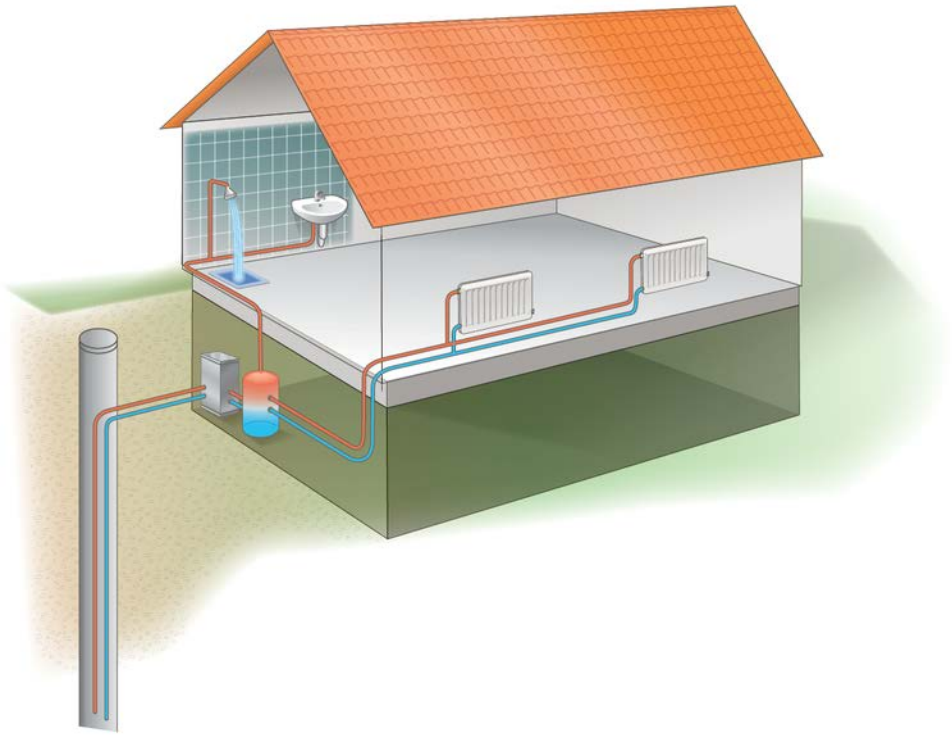
Typical Swedish roof

drawing: Svenskt Trä

Exhaust Air Heat Pump



Geothermal Heat Pump



Typical heating systems

Images: Energikontoret Skåne

Photo: Andersson Nielsen AB

Swedish Energy Codes: Today

2018 (BBR 25)

Performance-based:

- *Baseline:*
  90 kWh/m²/yr (28.5 kBtu/ft²/yr)
- *Adjustment factors for climate:*
  0.8 in mild areas (such as Malmö)
  1.9 in the coldest climate (Kiruna)
- *Adjustment factors for source:*
  1.6 for electricity
- *Modeling required*
- *Indoor temperature: 21°C (70°F)*

Swedish Energy Codes: Historical

1975 (SBN75)

R-19 walls; R-28 roofs

1978 amend.

3.0 ach/h at 50 Pa

triple-pane windows

comparable to IECC 2009

1984 (ELAK)

for electric-heated homes:

R-33 walls; R-47 roofs

HRV required

comparable to IECC 2015

Sample Advertised Energy Use for Heating and Hot Water

in Luleå

15.5 kBtu/ft²/yr

in Stockholm

10.0 kBtu/ft²/yr

in Malmö

7.9 kBtu/ft²/yr

Sample Advertised Energy Use for Heating and Hot Water

in Östersund

14.3 kBtu/ft²/yr

in Uppsala

11.4 kBtu/ft²/yr

in Malmö

9.2 kBtu/ft²/yr

Sample Advertised Energy Use for Heating and Hot Water

in Luleå

20.3 kBtu/ft²/yr

in Sundsvall

17.0 kBtu/ft²/yr

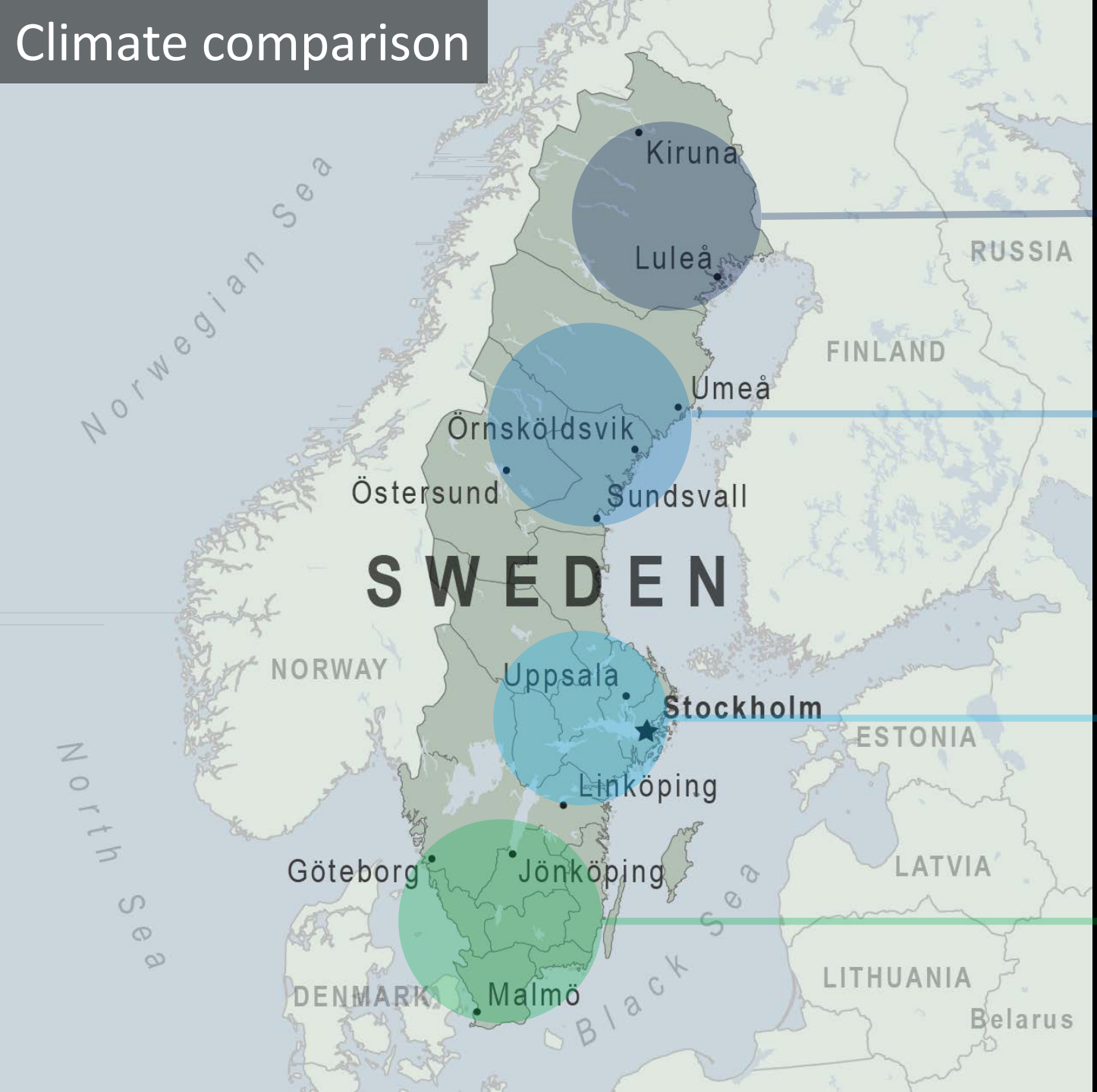
in Uppsala

12.9 kBtu/ft²/yr

in Malmö

9.4 kBtu/ft²/yr

Climate comparison



Edmonton

Winnipeg

Duluth
Montreal

Buffalo
Minneapolis

Sample Turnkey Costs

$134/ft^2

$159/ft^2

$169/ft^2

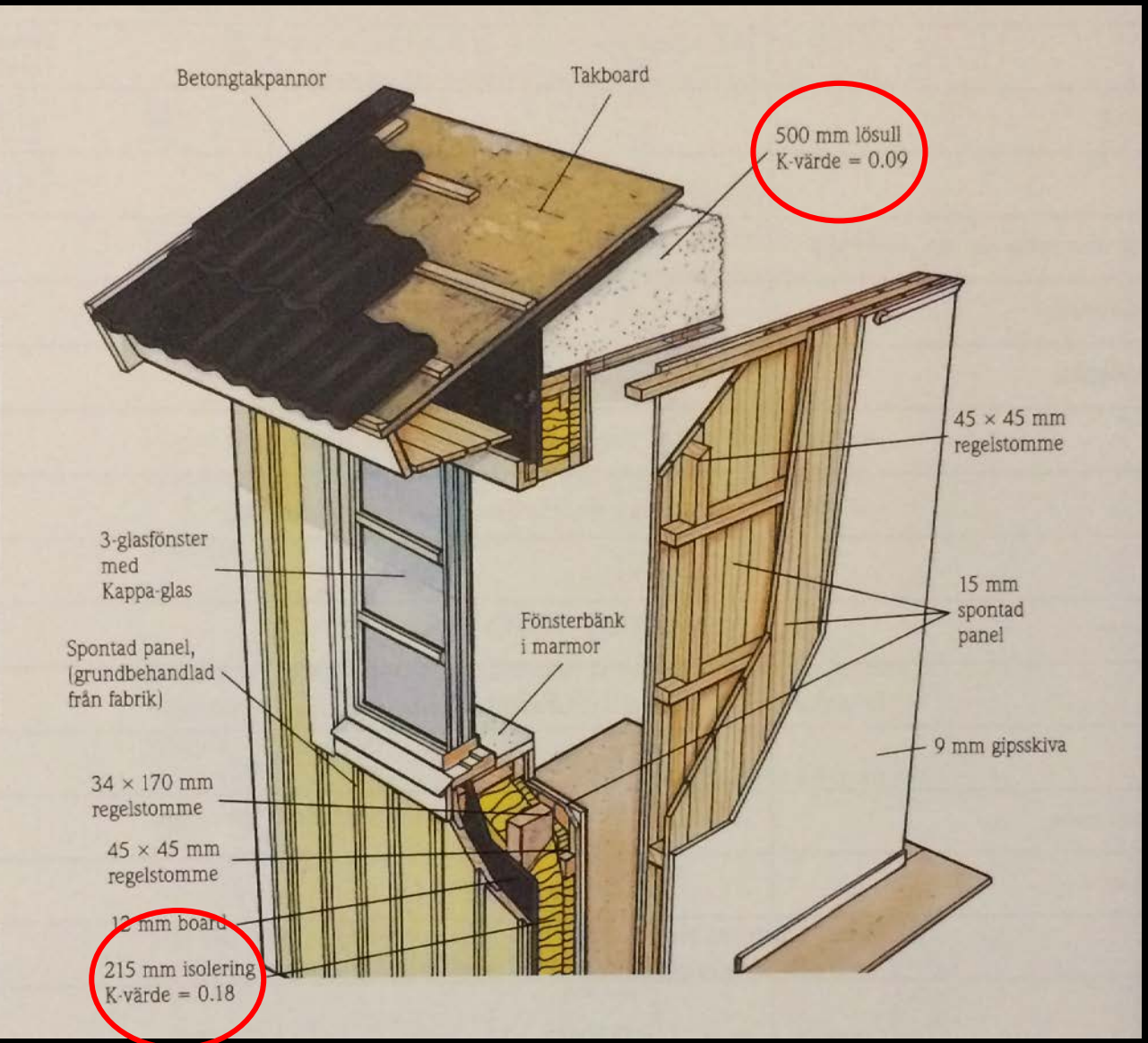
$169/ft^2

$239/ft^2

$239/ft^2

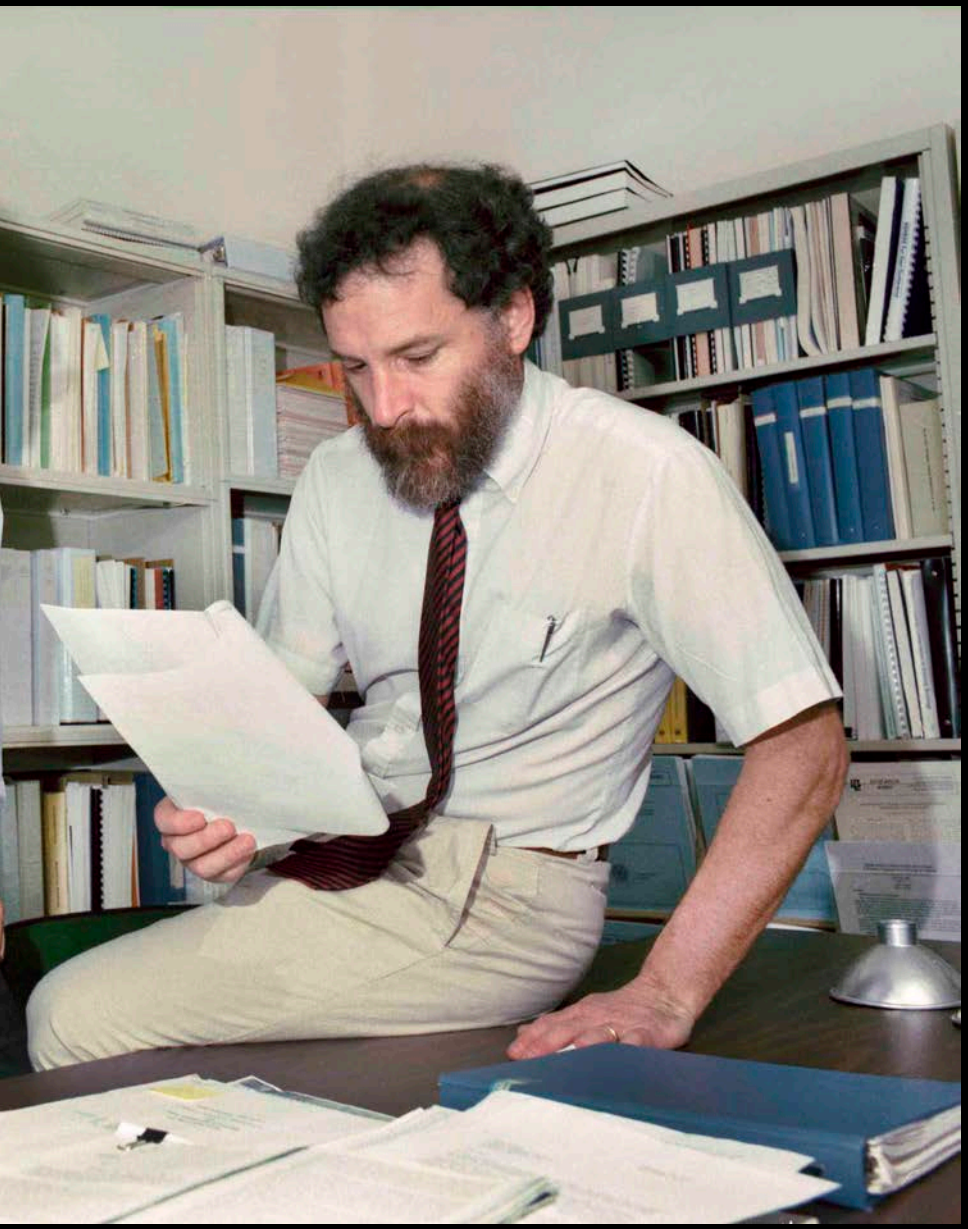
Ågatan

1990s catalog house



R-60 in roof

R-31.5 in wall



Lee Schipper

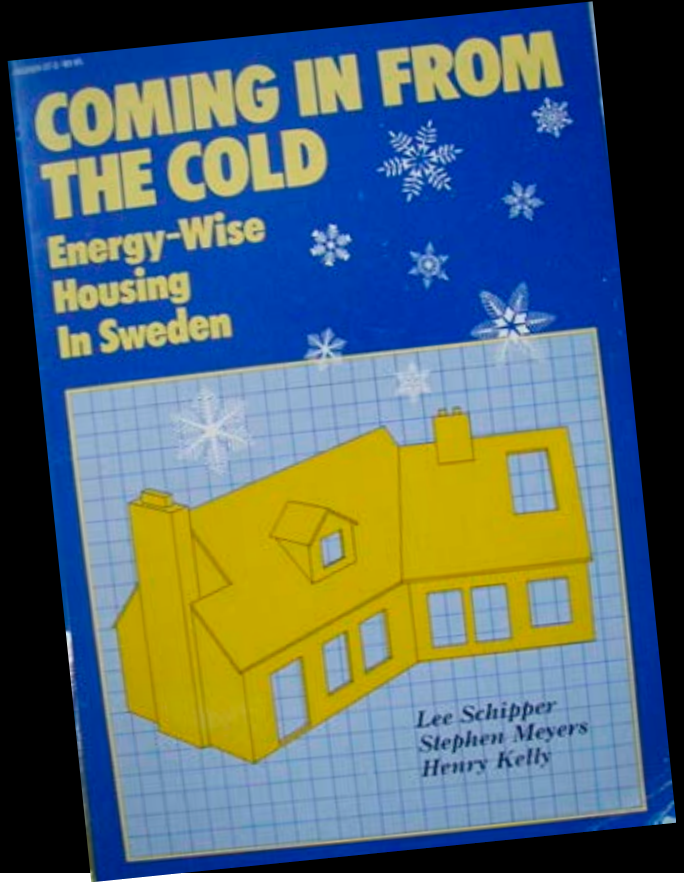
Lawrence Berkeley Nat'l Lab

Schipper to Congress (1984):

"…rather stunning performance of the Swedish housing industry."

"In 1981, homes in Sweden had on average twice the effective levels of wall insulation as homes in Minnesota!"

1984



Swedish houses today are built to the world's highest standard. The average Swedish home has fewer defects in workmanship and is more free of drafts than its equivalent in North America or the rest of Europe. It is heated to a higher temperature, yet consumes considerably less energy for heating. Its superior performance is largely due to the technological sophistication of the Swedish product, not to significant compensatory differences in the size or comfort of homes, the behavior of occupants, or energy prices. The point is not that the best Swedish house is better than the best U.S. house, for example, but that the average new Swedish house is so much better than the average U.S. product.

Conclusion

"One could consider Sweden as a 'crystal ball', showing what American House Building might look like if we had spent the past 40 years committed to improving efficiency."

—Hedges and La Vardera, 2013

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Questions?

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