Pre-Fabricated Building Envelope Systems in Passive House New Construction

Presented by Karan Gupta for the

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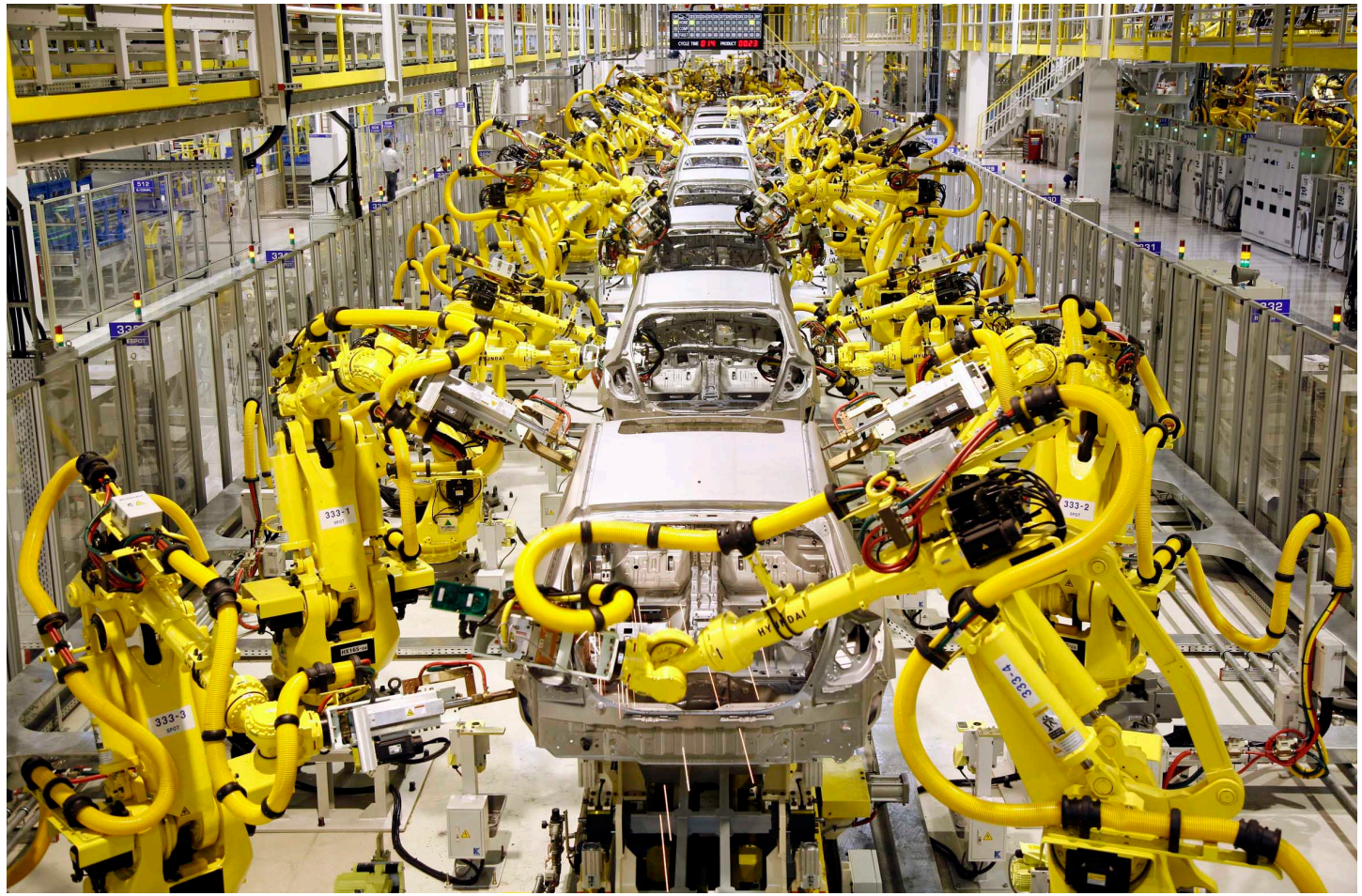
Who is this guy?

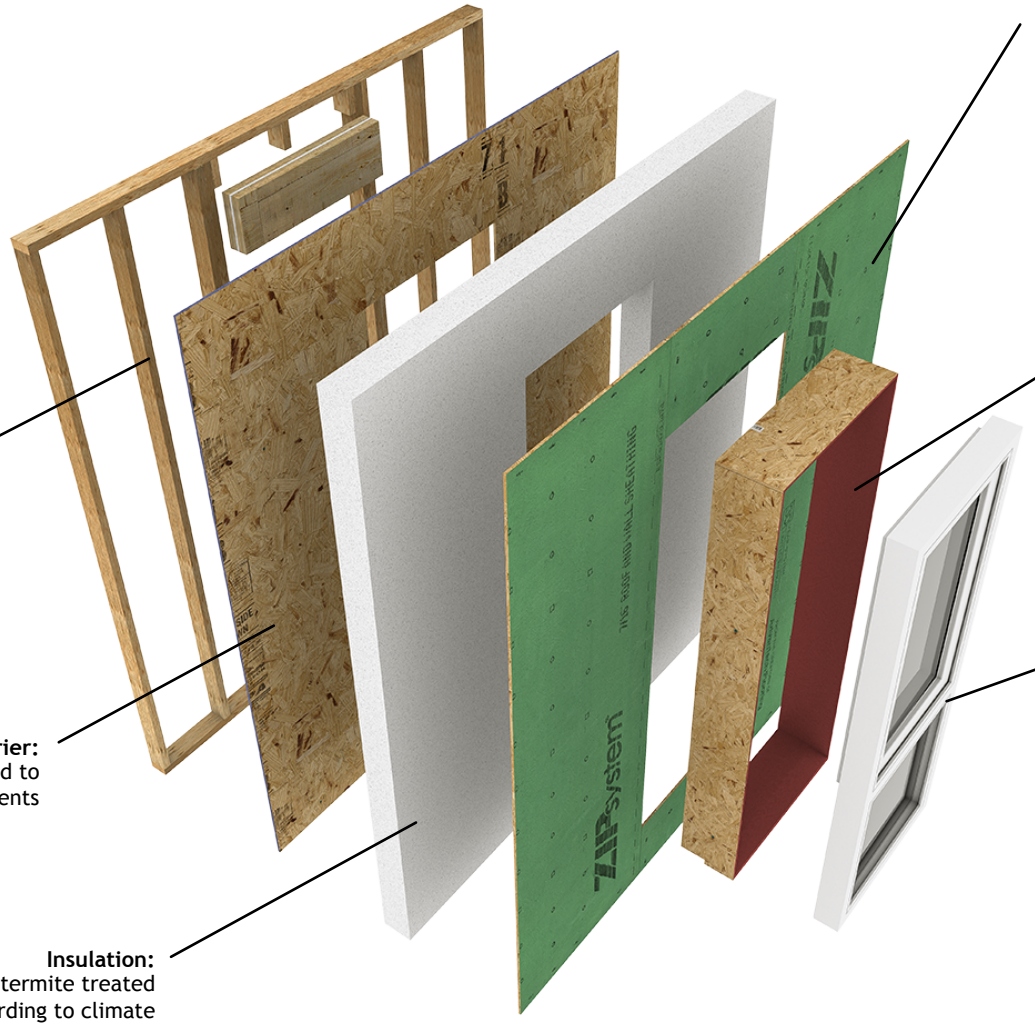
- Karan Gupta
  - pronounced KUH-run
  - you can call me KG
  - Energy Efficient Design Specialist for Build SMART
    - based in Lawrence, KS
    - manufacturer of high-performance, pre-fabricated building envelope systems
  - Certified Passive House Consultant
  - PHIUS Certified Builder

Why Pre-Fabricated?



Why Pre-Fabricated? (continued)

Wall System



Framing:
2x4 to 2x12 engineered lumber framed in a jig system to guarantee precision and stability; allows for cavity insulation for varying climates; familiarity to trades

Air barrier:
Factory sealed OSB joints; fastened to meet shear wall requirements

Insulation:
3.5” to 11.5” termite treated EPS according to climate requirements; factory laminated to OSB

Exterior sheathing:
OSB with integrated weather membrane factory laminated to EPS – no need for house wrap and ready to accept all standard exterior finishes

Flashed window buck:
All the window panels come with a sloped sill and liquid applied flashing around the rough opening to provide a watertight and airtight installation

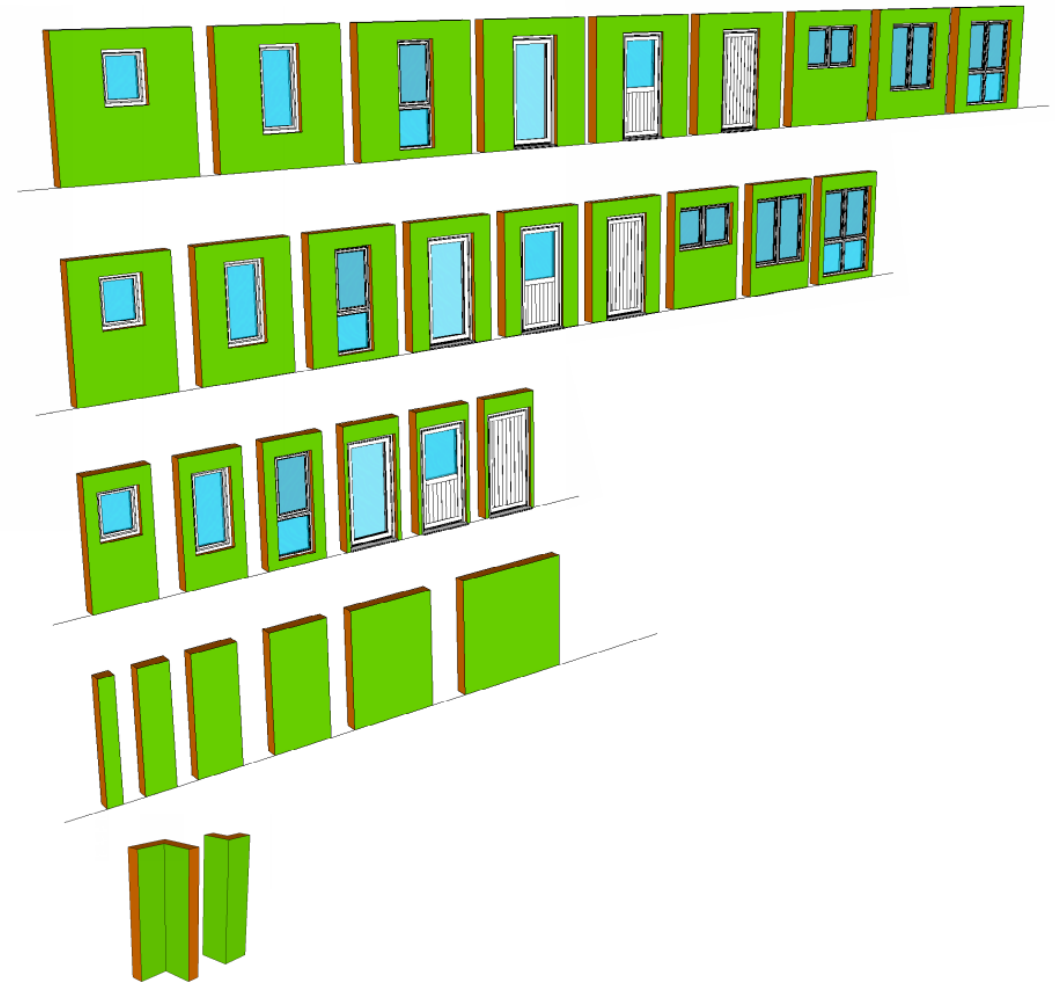
Super efficient windows:
Triple-paned filled with inert gas. The windows and doors are factory installed and sealed to guarantee weather tightness

Framing

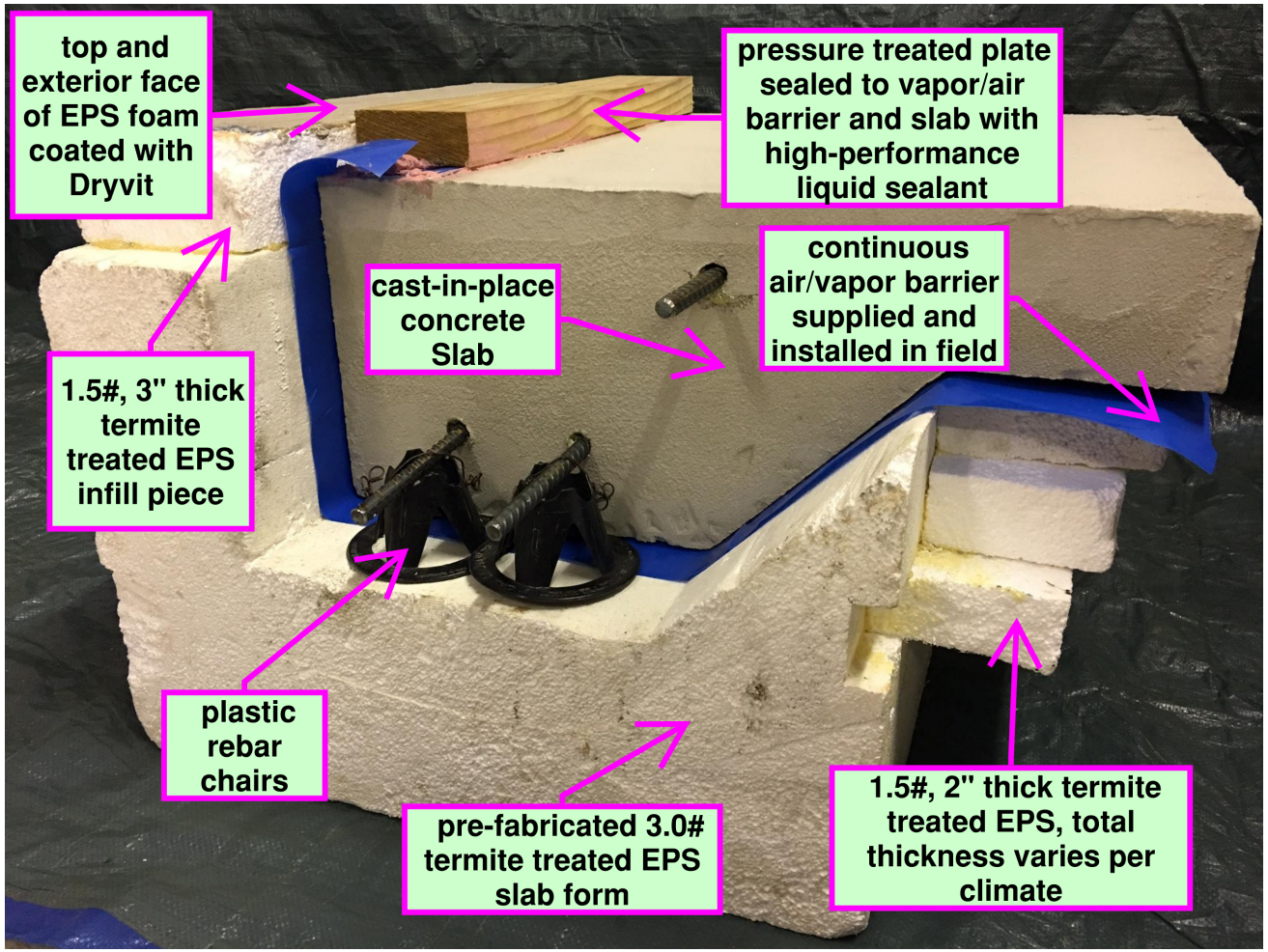
Preinstalled Windows & Doors

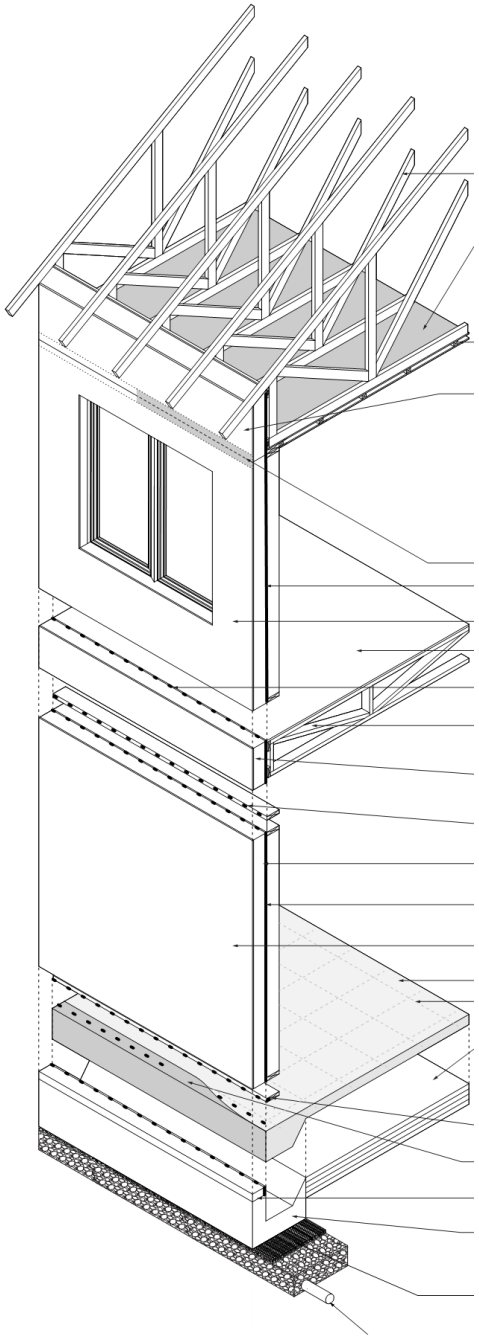
Not SIPs, Not Modular

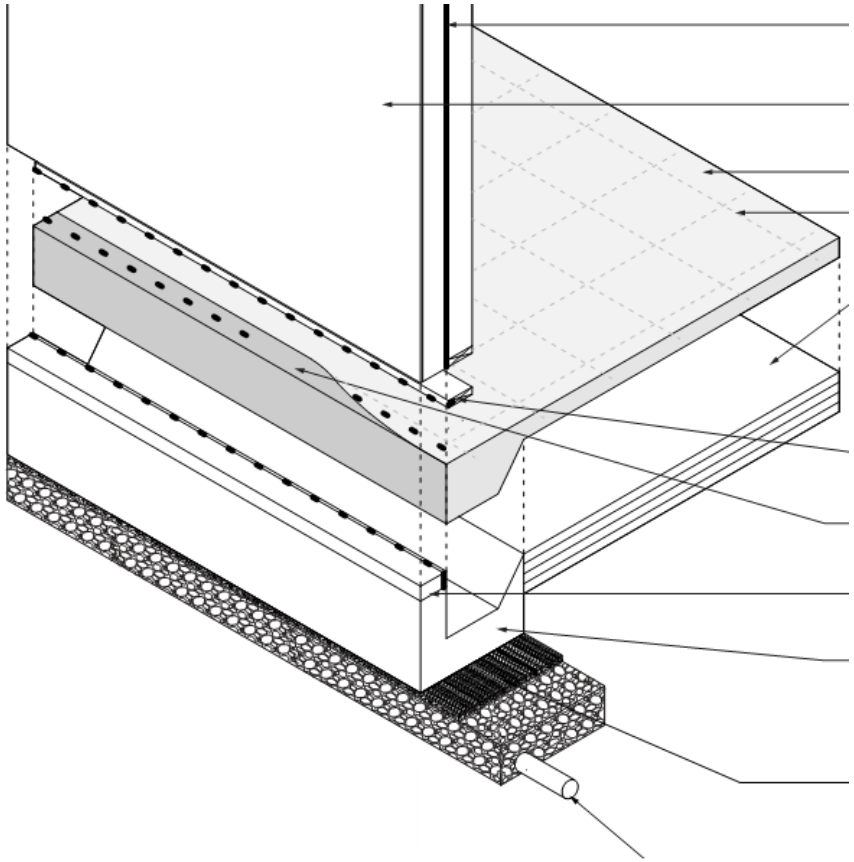
Panel Types

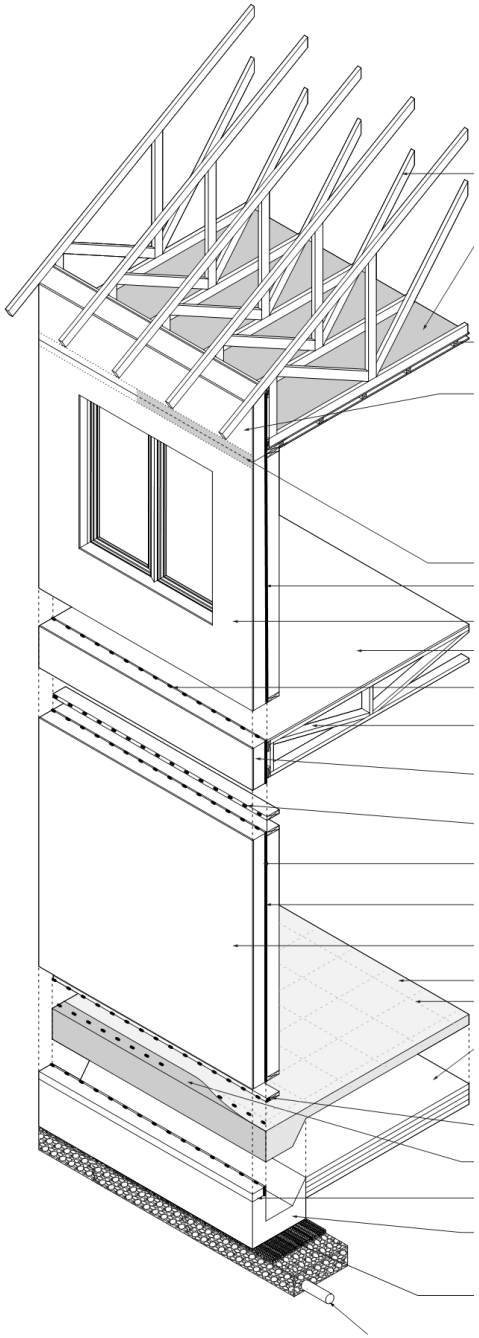


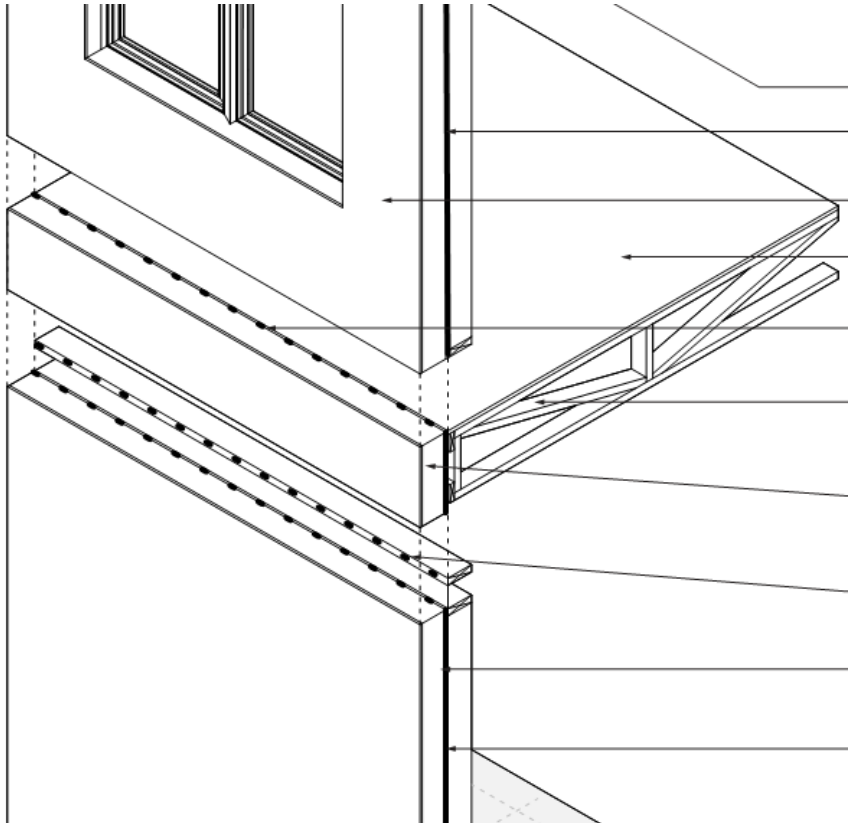
Slab Insulation System

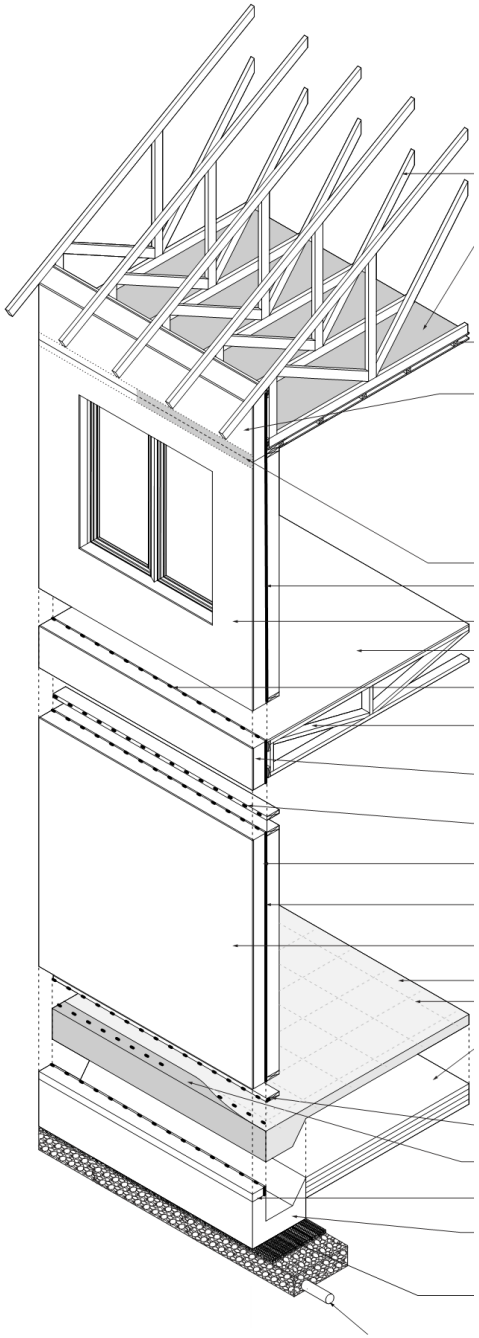


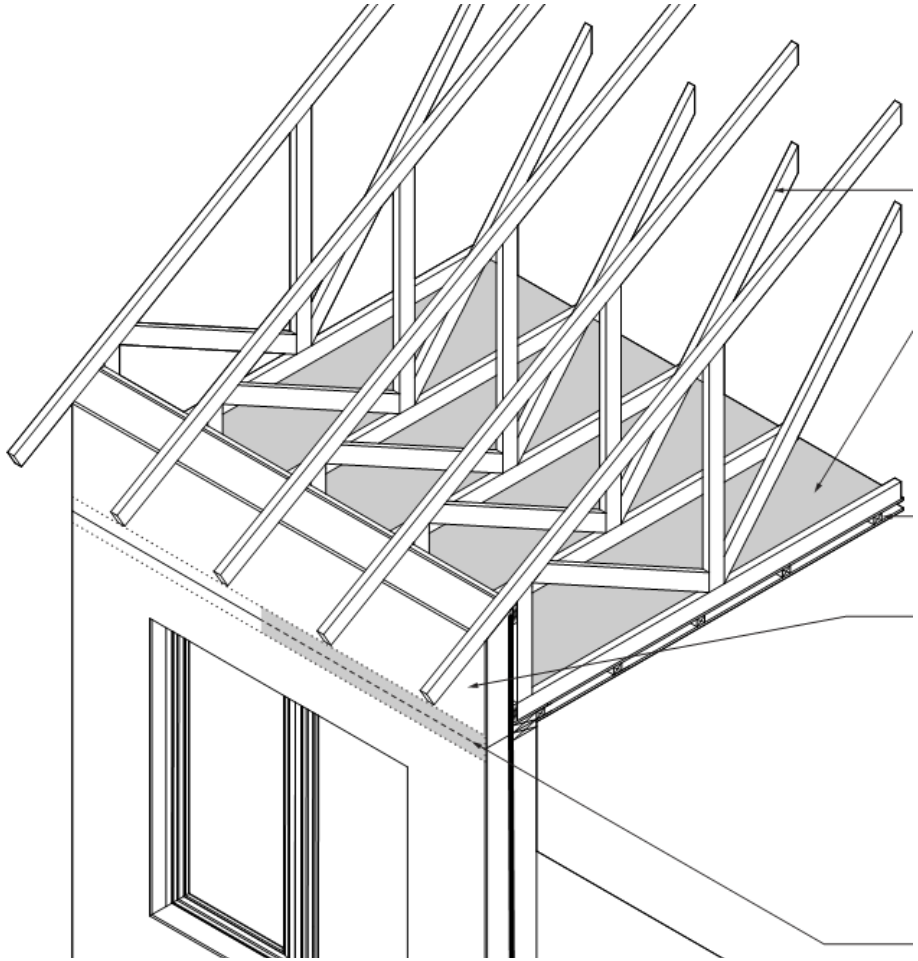






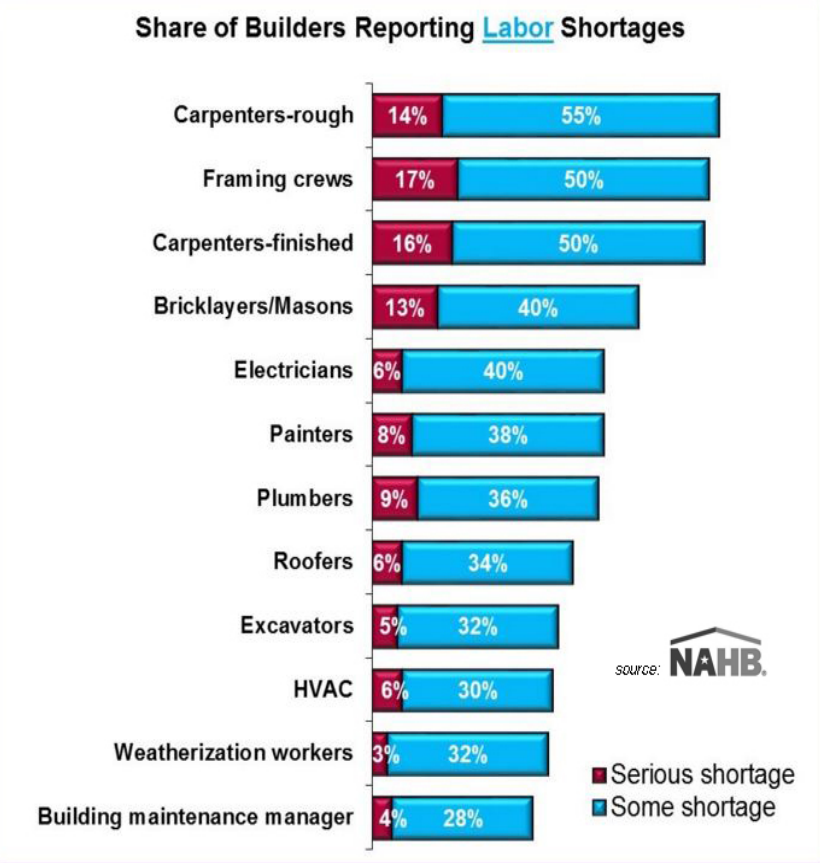







NO
TURNS
FROM
SHOULDER
WHITEHALL INN
PARK RD

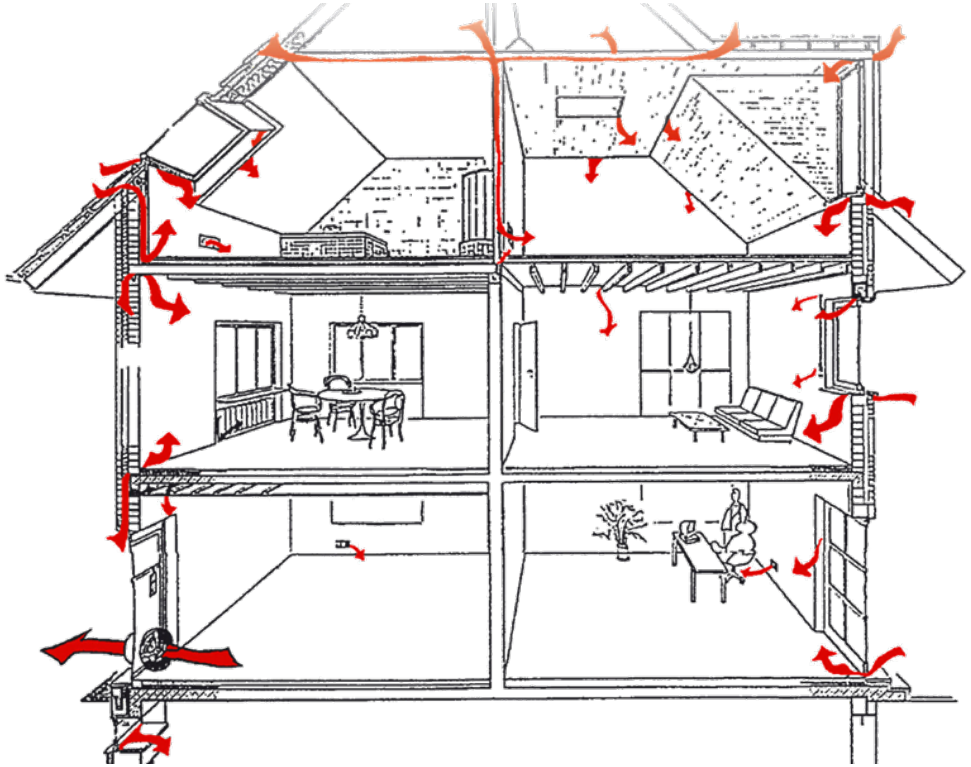
Benefits of Pre-fabrication



- A stick-framed house creates **nearly 30x more jobsite waste** than a component-framed house.
- **2.5x faster.** A crew can frame two and half homes with structural building components in the time it takes to stick-frame one house.
- It takes **75% more lumber** wood product to stick frame a structure than to frame it with components.


ZIPsystem
STRUCTURAL 1

Airtightness



Blower Door Results

Gross Envelope Area	63641	ft^2			
dry-in (9/26/2017)	3550	CFM_{50}	=	0.056	CFM_{50}/ft^2 gross envelope area
completion (4/17/2017)	2996	CFM_{50}	=	0.047	CFM_{50}/ft^2 gross envelope area

What about cost?

2				
3	Wa First and Second Floor			
4	Build MART Package (Walls, Structural Sheathing, tight Layer, Windows & Doors, Ext.	M	00	LS
5	Window Package	M	1.00	LS
6	Door Package	M	1.00	LS
7	Window Package Shipp		1.00	LS
8	Door Package Shipping	M	1.00	LS
9	Window Package Handling	L	1.00	LS
10	Door Package Handling	L	1.00	LS
		M	1.00	LS
		M	1.00	LS
	vall	L,M	1,200.00	Lf
		M	106.30	Tubes
	ker Rod		2,126.00	Lf
		L	116.00	Ea
		M	1,800.00	Ea
		L	200.00	Lf
	n	M	00	Tubes
		L	1,200	Lf
		M	10,800.00	Sf

ramed Shell | Sheet1

52	Install Band	L	592.00	Lf
53	Build SMART Roof Band			
54	1/2" #9 Screws 12" o.c. 4 PLF	M	4,800.00	Ea
55	Construction	M	80.00	Tu
56	Instal and	L	1,200.00	
57				
58	Airtight Ba Prosoco Joint & Seam	M	3 00	Tubes
59	Airtight OSB	L	2.00	Lf
60	Rockwool @ Fra Wall (5		184.00	Sf
61	Cascadia Clip @ Fra d Wall	M	592.00	Ea
	ieu of C cadia Clip	M	592.00	Ea
	Heco Scr		592.00	LF
	Cascadia Cli	L	365.00	Lf
	Heco Screw	L	365.00	Lf
	2" EPS, 1/2" OSB)	M	1,184.00	Sf
	Adhesive	M	14.00	5 Gal
	ws	M	339.00	Ea
	eq	L,M	1,086.00	Sf
		M	792.00	Lf
		L,M	1.00	LS
		L,M	1.00	LS
		L,M	1.00	LS
		L,M	00	LS

undation | Framed Shell | Sheet1

22	Cascadia Clip @ Framed Wall	M	3,600.00	Ea
23	Heco Screws in lieu of Cascadia Clip	M	7,200.00	Ea
24	x 4 Battens @ Heco Screws	M	6,000.00	Lf
25	kwool Install Cascadia Clip	L	1,200.00	Lf
26	Rock ol Install Heco Screw	L	1,200	Lf
27	6" Nailb (5 1/2" EPS, 1/2" OSB)	M	10 00	Sf
28	Adeps Nail e Adhesive	M	20.00	5 Gal
29	8" Nailbase Sc ws	M	3,086.00	Ea
34	WRB - Tyvek or e	L,M	10,800.00	Sf
35	Second Floor Band			
36	Airtight Band - Prosoco t & Seam	M	30.00	Tubes
37	Airtight OSB	L	592.00	Lf
38	Rockwool @ Framed Wall (		1,184.00	Sf
39	Cascadia Clip @ Framed Wall	M	592.00	Ea
40	Heco Screws in lieu of Cascadia	M	592.00	Ea
41	1 x 4 Battens @ Heco Screws	M	592.00	Lf
42	Rockwool Install Cascadia	L	592.00	Lf
43	Rockwool Install Heco S w	L	592.00	Lf
44	6" Nailbase (5 1/2" E 1/2" OSB)		1,184.00	Sf
45	Adeps Nailbase A sive	M	14.00	5 Gal
46	8" Nailbase Sc ws	M	339.00	Ea
47	Install Nailb	L	592.00	Lf
48	WRB - T k or eq	L,M	00	Sf
49	Build S RT Second Floor Band			
50	2 1 #9 Screws 12" o.c. 4 PLF	M	2,368.00	a
51	nstructio	M	40.00	s
52	Install Band	L	592.00	Lf

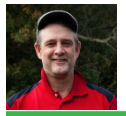
Foundation | Framed Shell | Sheet1

Cost Comparison

	Pre-2012 code	Field install Passive House	Pre-fabricated wall panels Passive House
1-Window & Door Materials Cost	$144,220	$ 292,660	$ 220,000
2-Wall Materials Cost	$ 40,652	$ 221,336	$ 267,070
3-Window Door Wall Cost	$ 184,872	$ 513,996	$ 487,070
4-Cost per Floor Sq Ft	$ 3.50	$ 9.74	$ 9.22
5-Wall, Window & Exterior Door Labor Cost	$144,350	$ 214,125	$ 99,025
6-Total Wall, Window & Exterior Door Labor & Materials Cost	$329,222	$ 728,121	$ 586,095
7-Cost per Floor Sq Ft	***$ 6.24***	***$ 13.80***	***$ 11.10***

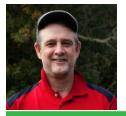
Impact of Lower Utility Costs on Underwriting

- *Total Tenant Payment Must Be Less than or Equal to the Max Tax Credit Rent or FMR*
- *Total Tenant Payment = Rent + Utilities*
- *Rent = Total Tenant Payment – Utilities…..Utilities Often Underwritten using Housing Authority Allowances*
- *We had Qualified Expert Calculate the difference between typical Housing Authority Allowances and Passive House projected utility allowances*



Impact of Utility Costs on Borrowing Capacity

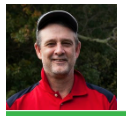
	Housing Authority Allowances	Calculated Passive House
Net Operating Income	$99,116	$136,292
Debt Coverage Ratio*	1.8	1.8
Payment (NOI/DCR)	$55,064	$75,718
Max Mortgage (30 yrs @ 5.5%)	$800,000	$1,100,000
*1.07 in Year 15		



CHIP: "Passive House lets you borrow/leverage more money to build more housing."

Impact of Utility Costs on Developer Fee

	Housing Authority Allowances	Calculated Passive House
Total Development Cost	$12,750,000	$12,750,000
LIHTC Equity	$11,000,000	$11,000,000
Soft Debt/Grants	$450,000	$450,000
Mortgage	**$800,000**	**$1,100,000**
Total	$12,250,000	$12,550,000
Deferred Fee Required	$500,000	$200,000
Gross Fee	$1,500,000	$1,500,000
Net Fee	**$1,000,000**	**$1,300,000**



CHIP: "We're a nonprofit, which means we don't put the net fee in our pockets. We put that money into new developments. Higher net fees mean we can house more people."

UTILITY ANALYSIS: PASSIVE HOUSE MAKES US MONEY!!

"WOULD WE DO IT AGAIN?"

1. We built it within the budget we proposed

2. Significant savings on utilities allows us to leverage fees to build more housing

3. No major screw-ups during construction (related to Passive House)

4. Healthier, more comfortable environment for our tenants

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