The Pines - preliminary calculations

Quantities, structure, energy and cost, measured from the BIM model (IFC4). Design development; every figure is preliminary and is to be verified by licensed professionals for the actual site.

Summary

Design basis	2021 IRC, 2021 IECC prescriptive; climate zone 5 (assumed; site TBD); snow 30 psf; wind 115 mph Exp. B; frost 42 in
Envelope (IECC R402.1.5 total UA)	Proposed UA 279 vs code reference 330 Btu/h.F: **16% better than code** - PASSES
Window-to-wall ratio	29% of gross exterior wall
Design heat loss (ballpark)	31,000 Btu/h at 70 F difference - roughly a 2.5-ton cold-climate heat pump (not a Manual J)
Structure	5 items need an engineer; 2 to verify; rest OK preliminary
Indicative construction cost	**$1,145,117** ($601/sq ft heated), range $916,094 - $1,431,396; excludes land, site work, utilities, permits and design fees

1. Quantity takeoff

Measured from the model: wall lengths and heights from their extrusions, openings from their fillings, slab and roof areas from footprints, foundations from their solids. Waste factors noted per line.

Division	Item	Qty	Unit	Basis
03 Concrete	Strip footings 20x10in, 3000 psi	16.9	CY	314 LF, +5%
03 Concrete	Pad footings at patio posts	0.5	CY	2 pads 30x30x12in
03 Concrete	Stem walls 8in	17.3	CY	to 42in frost depth
03 Concrete	House slab 4in, 4000 psi, fibre	25.2	CY	1904 SF
03 Concrete	Garage slab 4in	7.0	CY	529 SF
03 Concrete	Patio slab 4in	3.4	CY	260 SF
03 Concrete	Rebar #4 (footings 2 cont., stems 2 horiz. + vert. @24in)	1,726	LF	x1.10 laps
31 Earthwork	Compacted gravel base 4in under slabs	33.2	CY	
07 Thermal	XPS 2in R-10 under house slab	1,999	SF	+5%
07 Thermal	XPS 2in R-10 vertical at slab edge / stem	384	SF	2ft deep
07 Thermal	Vapor retarder 10 mil	2,094	SF	+10% laps
06 Wood	Studs 2x4 x 10 ft SPF	147	EA	+10%
06 Wood	Studs 2x6 x 14 ft SPF	310	EA	+10%
06 Wood	LSL tall-wall studs 1-3/4x5-1/2 x 14 ft	190	EA	WT-2 walls, +10%
06 Wood	Plates (double top + PT sill), 2x6/2x4	1,285	LF	
06 Wood	Wall sheathing 7/16 (4x8, integral WRB, taped)	105	SHT	3045 SF net
06 Wood	I-joists 11-7/8in @16in (wings + garage)	62.0	EA	1322 LF
06 Wood	Glulam beams 5-1/8x15, 24F-V4, 29 ft	6.0	EA	5 @ 8ft over great room + 1 on patio posts
06 Wood	2x10 flush joists between glulams @16in	830	LF	with face-mount hangers
06 Wood	Roof deck 3/4 T&G; plywood (4x8)	93.4	SHT	
06 Wood	Steel posts HSS 4x4x1/4 (patio)	2.0	EA	13ft, base + cap plates
07 Thermal	Mineral wool batts R-21 HD (2x6 cavities)	2,329	SF	
07 Thermal	Mineral wool board 2in ci (WT-1, WT-3)	1,400	SF	
07 Thermal	Mineral wool board 1-1/2in ci (WT-2)	1,045	SF	
07 Thermal	Sound batts 3-1/2in (partitions)	829	SF	
07 Thermal	Tapered polyiso (avg 4in wings, 3-7/8in great room)	2,800	SF	
07 Thermal	HD polyiso cover board 1/2in	2,854	SF	

Division	Item	Qty	Unit	Basis
07 Thermal	Closed-cell SPF 5-1/2in in great room joist bays	728	SF	conditioned zone only
07 Roofing	TPO 60 mil fully adhered (field)	2,936	SF	+8% seams
07 Roofing	TPO parapet flashing (up to coping)	332	SF	~19in girth
07 Roofing	Prefinished aluminium coping	207	LF	
07 Roofing	Prefinished aluminium fascia, great room roof	137	LF	20in face
07 Roofing	Scuppers + leaders	6.0	EA	allowance
09 Exterior	3-coat stucco on lath, integral white	201	SY	1805 SF
09 Exterior	Drainage mat + 2-ply WRB behind stucco	1,985	SF	
09 Exterior	FRT western red cedar 1x6 T&G; on rainscreen	451	SF	1057 LF of 1x6 at 5-1/8in face
09 Finishes	Gypsum 5/8 walls, Level 4 (4x12)	97.8	SHT	4192 SF
09 Finishes	Gypsum 5/8 ceilings (4x12)	24.4	SHT	1047 SF
09 Finishes	Gypsum 5/8 Type X, garage wall + ceiling	17.5	SHT	750 SF
09 Finishes	Paint, walls + ceilings (primer + 2 coats)	5,239	SF	
09 Finishes	Engineered white oak 3/4in	1,467	SF	+8% waste
09 Finishes	Porcelain tile floors (baths, laundry)	436	SF	
09 Finishes	FRT cedar T&G; ceiling + soffit, great room	1,260	SF	interior + exterior
08 Openings	Windows, triple-glazed, thermally broken alu.	391	SF	10 units
08 Openings	Lift-and-slide door 22x12	264	SF	1 unit
08 Openings	Exterior doors (front, garage-house)	2.0	EA	
08 Openings	Garage door 16x8 insulated, cedar overlay	1.0	EA	
08 Openings	Interior doors, solid core, white oak veneer	7.0	EA	

2. Structure - preliminary check

Load path (concept): wing roof I-joists span east-west to the end walls and the great-room walls X20/X46; the great room's glulam beams span X20-X46 and the two patio posts. The street and yard walls therefore carry no roof load, which keeps the large openings in them free of heavy headers. Loads: dead 15 psf; snow per ASCE 7-16.

Element	Check	Status
Design flat-roof snow load	pf = 0.7 Ce Ct Is pg = 0.7 x 1.0 x 1.1 x 1.0 x 30 = 23.1 psf	basis
Great room glulam 5-1/8x15 @ 8ft, span 26.5ft	w = (15+23.1) psf x 8 ft = 305 plf; M = 26.8 k-ft; fb = 1670 psi < Fb 2400 psi; snow deflection 0.79in = L/402 (limit L/240)	OK prelim.
Glulam end reaction (to X20/X46)	R = 4.0 k per beam end: needs built-up post in wall	ENGINEER
Snow drift: great room roof onto wing roofs	Roof step 2.4ft: leeward drift on wing roofs along X20/X46	ENGINEER
Wing roof I-joists 11-7/8 @16, spans 20 / 22ft	D 15 + S 23.1 psf: within typical series-230/360 tables	VERIFY mfr table
W/E walls 2x6 @16, ~10.4ft to roof bearing	Exceeds IRC Table R602.3(5) 10ft laterally unsupported height; R602.3.1 alternative limited to 100 mph	CHECK: 2x6 @12 or LSL
Great room walls 13ft+ (LSL)	Tall walls carrying glulam point loads, 115 mph wind	ENGINEER
22ft lift-and-slide head (N1)	Non-bearing in concept; head must hold L/720 for the slider	ENGINEER
Patio posts HSS 4x4x1/4	P = (15+23.1) x 72 sf = 2.7 k each (axial OK); wind uplift + lateral at roof edge	ENGINEER
Strip footings 20in, q_allow 1500 psf (IRC R401.4.1)	X20/X46 line ~1,042 plf -> needs 8.3in; W/E ~578 plf -> 4.6in; 20in provided	OK prelim.
Post pad footings 30x30in	1.8 sf required, 6.25 sf provided	OK prelim.

Headers (preliminary, IRC Table R602.7(1) ranges for bearing walls; non-bearing walls per R602.7.5)

Wall	Opening	Width	Header
S0	Primary bath clerestory	4.0 ft	flat 2x6 + cripples (non-bearing)
S1	Kitchen window	7.0 ft	(2) 1-3/4x11-7/8 LVL (wind, wall above)
S1	Front door	3.5 ft	flat 2x6 + cripples (non-bearing)
S1	Front door sidelight	2.0 ft	flat 2x6 + cripples (non-bearing)
S1	Great room clerestory	14.0 ft	(2) 1-3/4x11-7/8 LVL (wind, wall above)
S2	Bath 2 clerestory	3.0 ft	flat 2x6 + cripples (non-bearing)
S2	Door - laundry to garage	3.0 ft	flat 2x6 + cripples (non-bearing)
N0	Primary bedroom glass wall	16.0 ft	(2) 1-3/4x11-7/8 LVL (wind, wall above)
N1	Great room sliding wall	22.0 ft	ENGINEER (L/720 for slider)
N2	Bedroom 2 window	8.0 ft	(2) 1-3/4x11-7/8 LVL (wind, wall above)
N2	Bedroom 3 window	8.0 ft	(2) 1-3/4x11-7/8 LVL (wind, wall above)
W	Primary bedroom side window	6.0 ft	(2) 2x10
E	Bedroom 3 side window	5.0 ft	(2) 2x10
X20	Door - primary suite	3.0 ft	(2) 2x8
X46	Hall opening	3.5 ft	(2) 2x8
GS	Garage door	16.0 ft	(2) 1-3/4x11-7/8 LVL (wind, wall above)

3. Envelope - IECC 2021 total UA alternative (R402.1.5), climate zone 5

Proposed U-factors are effective assembly values (parallel path, ASHRAE); the reference uses Table R402.1.2 maxima: frame wall U-0.045, ceiling U-0.024, fenestration U-0.30. Slab is shown separately (R-10 under slab + edge meets the prescriptive slab requirement).

Component	Area (sf)	U proposed	UA proposed	U ref	UA ref
S0 (WT-1)	214	0.038	8.1	0.045	9.6
Primary bath clerestory	6	0.250	1.5	0.300	1.8
S1 (WT-2)	274	0.041	11.2	0.045	12.3
Kitchen window	24	0.250	6.1	0.300	7.3
Front door	28	0.250	7.0	0.300	8.4
Front door sidelight	16	0.250	4.0	0.300	4.8
Great room clerestory	28	0.250	7.0	0.300	8.4
S2 (WT-3)	217	0.037	8.0	0.045	9.8
Bath 2 clerestory	4	0.250	1.1	0.300	1.3
Door - laundry to garage	20	0.250	5.0	0.300	6.0
N0 (WT-1)	92	0.038	3.5	0.045	4.1
Primary bedroom glass wall	128	0.250	32.0	0.300	38.4
N1 (WT-2)	106	0.041	4.4	0.045	4.8
Great room sliding wall	264	0.280	73.9	0.300	79.2
N2 (WT-1)	130	0.038	4.9	0.045	5.8
Bedroom 2 window	56	0.250	14.0	0.300	16.8
Bedroom 3 window	56	0.250	14.0	0.300	16.8
W (WT-1)	248	0.038	9.4	0.045	11.2
Primary bedroom side window	42	0.250	10.5	0.300	12.6
E (WT-1)	260	0.038	9.9	0.045	11.7
Bedroom 3 side window	30	0.250	7.5	0.300	9.0
X20 (WT-2)	79	0.041	3.2	0.045	3.5
X46 (WT-2)	79	0.041	3.2	0.045	3.5
Roof - west wing	507	0.016	8.2	0.024	12.2
Roof - east wing	560	0.016	9.1	0.024	13.4
Roof - great room (conditioned part)	728	0.017	12.3	0.024	17.5
TOTAL	**4,198**		**279**		**330**

Design heat loss (ballpark, not a Manual J)

Term	Value
Envelope UA (walls, glazing, roof)	279 Btu/h.F
Slab edge F x P	0.54 x 192 ft = 104 Btu/h.F
Infiltration (ACH50 3.0 -> 0.17 natural, 21,224 cf)	64 Btu/h.F
Total x 70 F	31,250 Btu/h

4. Indicative construction cost

Model quantities x 2026 US national-average installed unit costs (material + labour), plus allowances for what the model does not yet contain (kitchen, baths, MEP). Apply a regional factor for the actual site. Accuracy about -20% / +25%.

Item	Qty	Unit	Unit $	Total
Strip footings 20x10in, 3000 psi	16.9	CY	780	$13,218
Pad footings at patio posts	0.5	CY	900	$438
Stem walls 8in	17.3	CY	850	$14,727
House slab 4in, 4000 psi, fibre	25.2	CY	300	$7,545
Garage slab 4in	7.0	CY	280	$1,955
Patio slab 4in	3.4	CY	360	$1,236
Rebar #4 (footings 2 cont., stems 2 horiz. + vert. @24in)	1,726	LF	1.60	$2,761
Compacted gravel base 4in under slabs	33.2	CY	85	$2,826
XPS 2in R-10 under house slab	1,999	SF	2.60	$5,198
XPS 2in R-10 vertical at slab edge / stem	384	SF	3.20	$1,229
Vapor retarder 10 mil	2,094	SF	0.45	$942
Studs 2x4 x 10 ft SPF	147	EA	26	$3,832
Studs 2x6 x 14 ft SPF	310	EA	52	$16,130
LSL tall-wall studs 1-3/4x5-1/2 x 14 ft	190	EA	95	$18,078
Plates (double top + PT sill), 2x6/2x4	1,285	LF	4.50	$5,781
Wall sheathing 7/16 (4x8, integral WRB, taped)	105	SHT	115	$12,038
I-joists 11-7/8in @16in (wings + garage)	62.0	EA	210	$13,020
Glulam beams 5-1/8x15, 24F-V4, 29 ft	6.0	EA	4,200	$25,200
2x10 flush joists between glulams @16in	830	LF	9.50	$7,880
Roof deck 3/4 T&G; plywood (4x8)	93.4	SHT	120	$11,213
Steel posts HSS 4x4x1/4 (patio)	2.0	EA	3,500	$7,000
Mineral wool batts R-21 HD (2x6 cavities)	2,329	SF	2.20	$5,124
Mineral wool board 2in ci (WT-1, WT-3)	1,400	SF	4.40	$6,162
Mineral wool board 1-1/2in ci (WT-2)	1,045	SF	3.80	$3,972
Sound batts 3-1/2in (partitions)	829	SF	1.60	$1,327
Tapered polyiso (avg 4in wings, 3-7/8in great room)	2,800	SF	7.50	$20,998
HD polyiso cover board 1/2in	2,854	SF	1.70	$4,852
Closed-cell SPF 5-1/2in in great room joist bays	728	SF	5.50	$4,004
TPO 60 mil fully adhered (field)	2,936	SF	7.00	$20,550
TPO parapet flashing (up to coping)	332	SF	12	$3,979
Prefinished aluminium coping	207	LF	40	$8,290
Prefinished aluminium fascia, great room roof	137	LF	48	$6,576
Scuppers + leaders	6.0	EA	650	$3,900
3-coat stucco on lath, integral white	201	SY	120	$24,064
Drainage mat + 2-ply WRB behind stucco	1,985	SF	1.60	$3,176
FRT western red cedar 1x6 T&G; on rainscreen	451	SF	28	$12,638
Gypsum 5/8 walls, Level 4 (4x12)	97.8	SHT	180	$17,607
Gypsum 5/8 ceilings (4x12)	24.4	SHT	205	$5,007
Gypsum 5/8 Type X, garage wall + ceiling	17.5	SHT	190	$3,325
Paint, walls + ceilings (primer + 2 coats)	5,239	SF	1.90	$9,954
Engineered white oak 3/4in	1,467	SF	17	$24,942
Porcelain tile floors (baths, laundry)	436	SF	24	$10,454

Item	Qty	Unit	Unit $	Total
FRT cedar T&G; ceiling + soffit, great room	1,260	SF	26	$32,761
Windows, triple-glazed, thermally broken alu.	391	SF	175	$68,425
Lift-and-slide door 22x12	264	SF	325	$85,800
Exterior doors (front, garage-house)	2.0	EA	6,800	$13,600
Garage door 16x8 insulated, cedar overlay	1.0	EA	11,000	$11,000
Interior doors, solid core, white oak veneer	7.0	EA	1,100	$7,700
Allowance: Kitchen cabinets, quartz tops, island	1	LS	48,000	$48,000
Allowance: Bath fit-out x2 (tile, vanities, glass, fixtures)	1	LS	42,000	$42,000
Allowance: Plumbing rough-in + water heater	1	LS	26,000	$26,000
Allowance: Electrical, lighting, panel, EV-ready	1	LS	38,000	$38,000
Allowance: HVAC: ducted cold-climate heat pump + ERV	1	LS	36,000	$36,000
Allowance: Appliances	1	LS	18,000	$18,000
Allowance: Interior trim, closets, hardware	1	LS	14,000	$14,000
Allowance: Air sealing, blower door, insulation QA	1	LS	3,500	$3,500
Allowance: Low-voltage, smoke/CO, security prewire	1	LS	5,000	$5,000
Direct cost				$822,937
General conditions 10%				$82,294
Overhead & profit 15%				$135,785
Contingency 10%				$104,102
TOTAL ($601/sq ft heated)				**$1,145,117**