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Course Description

Resent changes to Energy Codes in regard to exterior wall and roof insulation requirements as well as air sealing are forcing builders to look hard at alternate framing and insulating techniques. This course will explain the benefits of building with Structural Insulated Panels (SIPs) for residential applications. The attendee will gain a better understanding of SIP products, construction, assembly and detailing in order to properly utilize SIPs for optimum energy efficiency, labor savings, and durability. The attendee will walk away from the course with a better understanding of how SIPs can be a suitable construction method for current building industry standards.

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LEARNING OBJECTIVES

1. Describe and define SIPs and their residential applications
2. Explain energy-efficiency construction strategies utilizing SIPs
3. Illustrate SIP design and engineering methods and standards
4. Illustrate SIP construction methods and applications

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COURSE OUTLINE

- SIP basics
- SIP applications – Walls, Roofs, Floors
- Energy efficiency and green building with SIPs
- Designing with SIPs
- Engineering for SIPs
- SIP manufacturing
- SIP construction

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WHAT ARE SIPS?

- **Originally developed as "stressed-skin" panels in the 1930's - tested at the Forest Products Laboratory in Madison, WI**
- **The concept was to minimize and eventually eliminate the framing by using the skins to carry the loads**
- **Foam cores were introduced in 1969 to form the modern structural insulated panel**

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WHAT ARE SIPS?

SIP = Structural Insulated Panel

- **Composite structural panel**
- **Rigid foam core - EPS, GPS, or PUR**
- **Structural facings - usually 7/16" OSB**
- **Structural adhesive**

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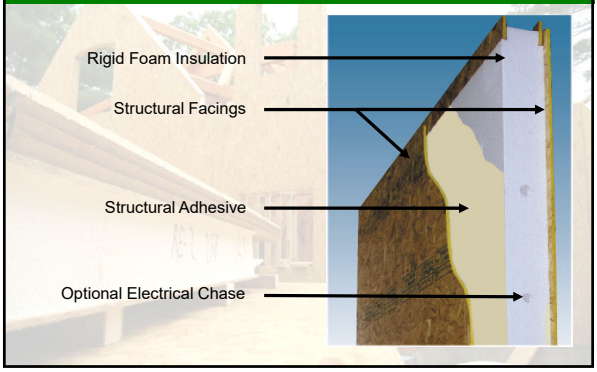
WHAT ARE SIPS?



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WHAT ARE SIPS?

SIP R-Values

SIP Panel Thickness	4-5/8"	6-1/2"	8-1/4"	10-1/4"	12-1/4"
EPS	15	23	29	37	45
GPS	18	28	36	45	55
Polyurethane	27	41	N/A	N/A	N/A

Consult panel manufacturer to verify R-values. R-values can vary between manufacturers.

Calculated R-Values include 7/16" OSB on each side. EPS is Type I per ASTM C578-07

R-Values are at mean temperature of 75 degrees F

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WHAT ARE SIPS?

- **Pre-fabricated, pre-insulated stud wall panels are <u>not</u> SIPs**
- **SIPs replace traditional wall studs to provide a better R-value over the entire wall surface (whole-wall R-value)**
- **The idea is to use the OSB as the load bearing element, instead of studs. The bearing area provided by a SIP wall is equivalent to 2x10 studs @ 16"oc**

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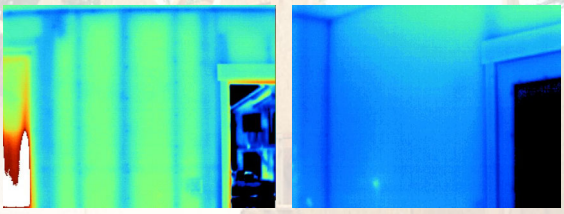
WHY SIPS?

Thermal Bridging



Wood framing

SIPs

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SIP WALLS

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SIP WALLS

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SIP WALLS

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SIP ROOFS

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SIP ROOFS

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SIP ROOFS

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SIP FLOORS

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SIP WALLS

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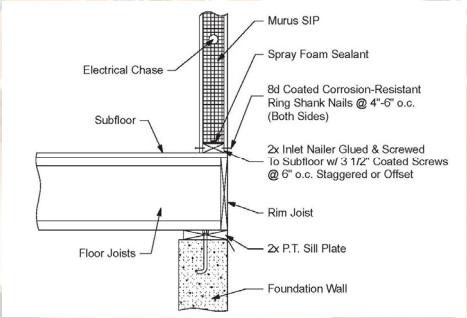
SIP DETAILS



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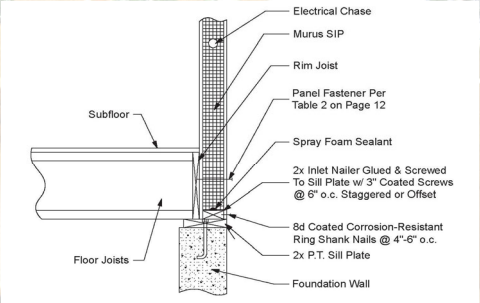
SIP DETAILS



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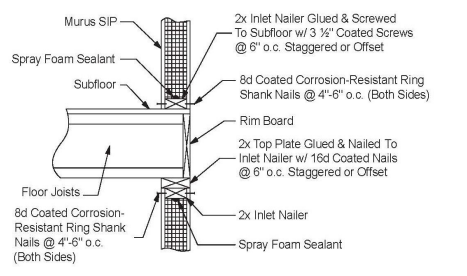
SIP DETAILS



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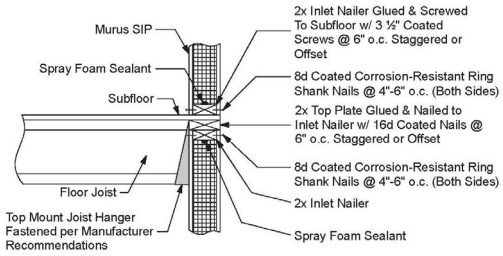
SIP DETAILS



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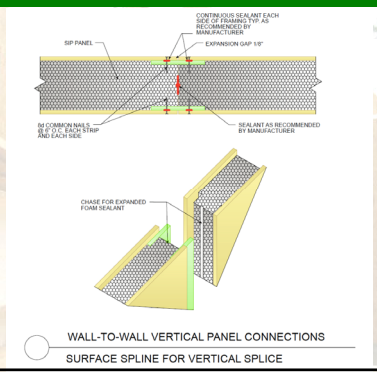
SIP DETAILS



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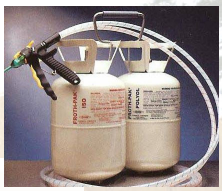
SIP DETAILS

Foam Everything

- **Panel joints**
- **Windows and doors**
- **Plumbing stacks**
- **Chimneys**



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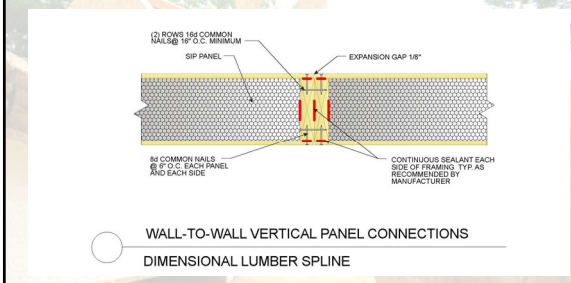
SIP DETAILS



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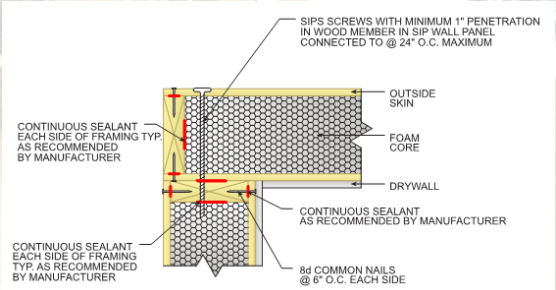
SIP DETAILS



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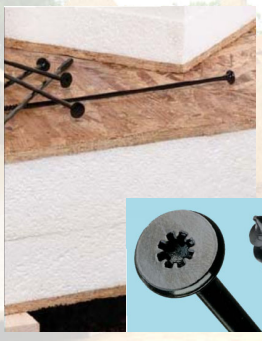
SIP DETAILS



- **SIP screws go through the panels into structure**
- **Thread point for wood**
- **Light drill point for metal/light gauge**
- **Heavy drill point for steel/iron**

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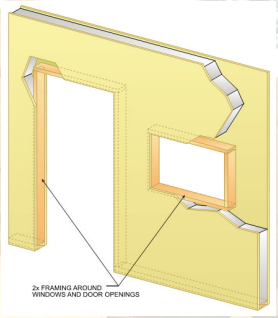
SIP WALLS

- Openings can be cut within panels, at panel edges, etc.
- The foam core is recessed 1½" at the edges of openings to accept 2x framing
- SIP can serve as the header in many cases. Structural headers can also be added when necessary



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SIP ROOFS

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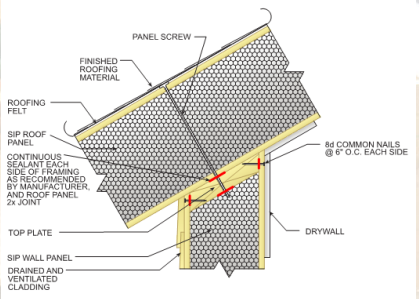
SIP DETAILS



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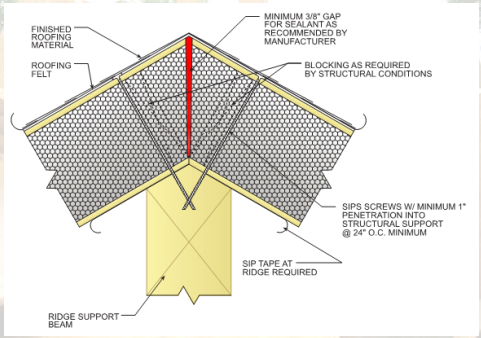
SIP DETAILS



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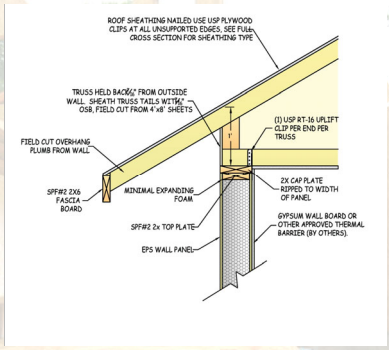
SIP DETAILS



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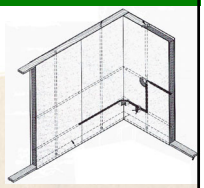
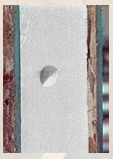
SIP DETAILS

SIPs Electrical

- **Wall panels can have 1” to 1 1/2” diameter electrical chases.**
- **Horizontally at switch & outlet heights**
- **Vertically, typically 4’ OC**
- **Top and bottom plates are drilled during installation to access the vertical electrical chases**





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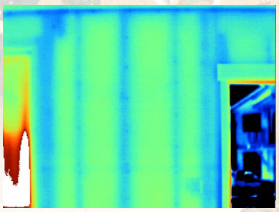
CHARACTERISTICS OF SIPS

Thermal Bridging



Wood framing

SIPs

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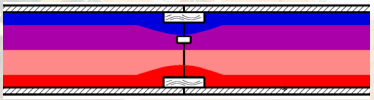
CHARACTERISTICS OF SIPS

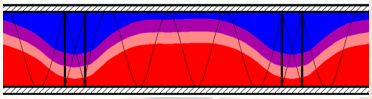
A more consistent, symmetric R-value



SIP with surface spline

Framing factor*:
- Optimum value framing: 16%
- Stick framing: 23-25%
- SIPs: 6-8.5%**

Cold
Hot



Wood frame with fiberglass

* Straube and Smegal. *Building America Special Research Project: High-R Walls Case Study Analysis*. March, 2009.

** Oak Ridge National Laboratory ZEBRAlliance research project

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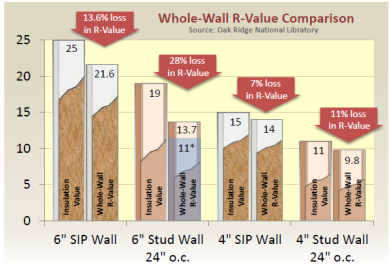
CHARACTERISTICS OF SIPS

Oak Ridge National Laboratory Studies

4" SIP wall outperforms 2x6 stud wall with R-19 fiberglass



* 2X6 @ 24" o.c. with batts with rounded shoulders, 2% cavity voids, no compression around wiring, paper facer stapled to inside of stud

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CHARACTERISTICS OF SIPS

More than 40% of a home's total envelope loss is due to infiltration!

SIPs have:

- Very few gaps
- Industry standard sealing details
- Superior indoor air quality

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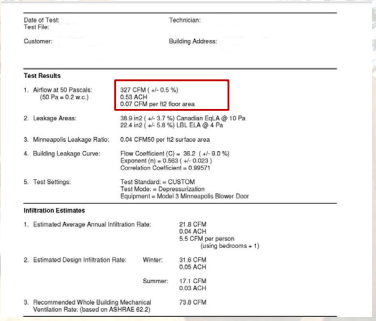
CHARACTERISTICS OF SIPS

Air Tightness

SIPs can make homes tight enough to meet the Passive House air tightness standard (0.6 ACH50), which is one of the highest in the industry



Date of Test: Technician:
Test File:
Customer: Building Address:

Test Results

1. Airflow at 50 Pascals (50 Pa = 0.2 w.c.): 327 CFM (+/- 0.5 %) 0.53 ACH 0.07 CFM per ft2 floor area
2. Leakage Areas: 38.9 in2 (+/- 3.7 %) Canadian EqLA @ 10 Pa 22.4 in2 (+/- 5.8 %) LBL ELA @ 4 Pa
3. Minneapolis Leakage Ratio: 0.04 CFM50 per ft2 surface area
4. Building Leakage Curve: Flow Coefficient (C) = 36.2 (+/- 9.0 %) Exponent (n) = 0.563 (+/- 0.023) Correlation Coefficient = 0.99571
5. Test Settings: Test Standard: = CUSTOM Test Mode: = Depressurization Equipment = Model 3 Minneapolis Blower Door

Infiltration Estimates

1. Estimated Average Annual Infiltration Rate: 21.8 CFM 0.04 ACH 5.5 CFM per person (using bedrooms + 1)
2. Estimated Design Infiltration Rate: Winter: 31.6 CFM 0.05 ACH; Summer: 17.1 CFM 0.03 ACH
3. Recommended Whole Building Mechanical Ventilation Rate: (based on ASHRAE 62.2) 73.8 CFM

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ENERGY STAR

SIPs recognized by ENERGY STAR as method to reduce thermal bridging

No blower door test required because of superior air sealing

Makes qualifying easier and more affordable

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HERS Index

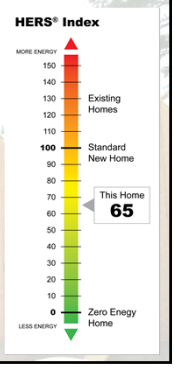
The HERS Index is a scoring system established by the Residential Energy Services Network (RESNET)

The HERS Reference Home is built to the 2006 IECC and has a HERS Index of 100

Net Zero Energy home scores a HERS Index of 0

Each 1-point decrease in the HERS Index corresponds to a 1% reduction in energy consumption compared to the HERS Reference Home

HERS 85=15% more energy efficient



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GREEN BUILDING

Green Building Program Applications

SIPs can help you achieve the highest levels in all green building programs such as LEED for Homes, the NAHB Green Building Program, EarthCraft, and other state green building programs.

- SIPs cut down on job site waste
- Low HERS index / more energy efficient helps you achieve more points in most green building programs
- Resource efficiency for engineered wood products

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LEED v4 FOR HOMES

EA - Energy and Atmosphere		
	EA Credit: Annual Energy Use	Max 30 pts
MR – Materials and Resources		
	MR Credit: Environmentally Preferable Products (sheathing) for FSC certified OSB	1 pt
	MR Credit: Construction Waste Management	Max 3 pts
	MR Credit: Material-Efficient Framing	Max 2 pts
EQ – Environmental Quality		
	EQ Credit: Low-Emitting Products	1.5 pts

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SIP DESIGN

SIP Walls have been in the IRC since 2007

Currently Section R610

Basically minimum / prescriptive values but establishes acceptance for Code Officials and standards for manufacturers

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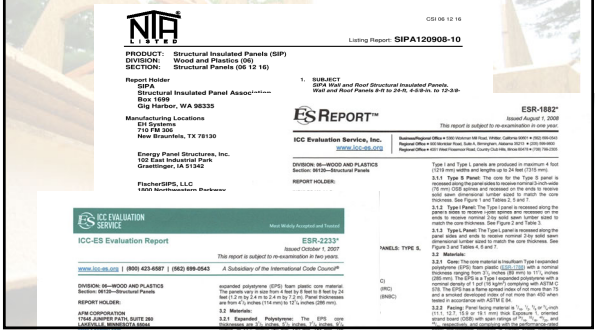
SIP DESIGN

Structural code compliance - code reports



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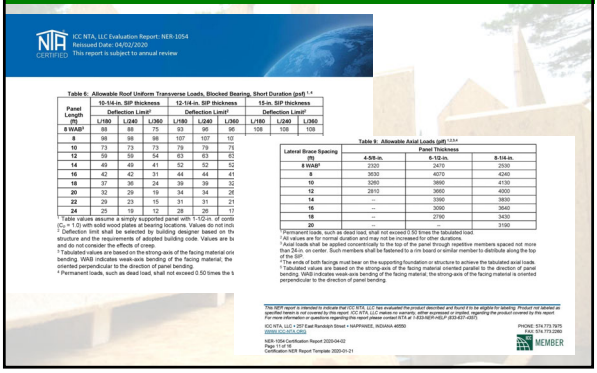
SIP DESIGN



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SIP DESIGN

Residential energy code compliance
PA - 2015 IECC Chapter 4 (RE)

- Avoid prescriptive requirements for exterior insulation
- Total UA Alternative method using ResCheck

- OR -

- Performance method (HERS rating in 2015 IECC)

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SIP DESIGN

"RIGHT SIZING" of HVAC Equipment - Oversizing equipment jeopardizes building and equipment durability while needlessly increasing costs

Airtightness: A pre-construction estimate of less than 2 ACH is appropriate, and it is common to achieve less than 1 ACH50.

High-performance structures designed and built extremely airtight must have mechanical make-up air via HRV, ERV, or other means

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SIP MANUFACTURING

MURUS Virtual Plant Tour.mp4

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SIP APPLICATIONS

- SIP walls and roof
- SIP walls with truss roof
- SIPs over timber frame
- SIPs and ICF
- Hybrid construction of any kind

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SIP APPLICATIONS

Affordable, effective renovation applications

Historic home built in 1872 - 4,467 sqft conditioned space including basement, 1st and 2nd floors. SIPs ready to assemble with all window and door openings precut made for smooth installation.

Beineke Residence, Marion, OH

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SIP APPLICATIONS

Affordable, sustainable, cost-effective housing

South Chicago Work Force housing, Chicago, IL

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SIP APPLICATIONS

Affordable, disaster-resistant, LEED Certified housing

Make it Right, New Orleans, LA

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SIP APPLICATIONS

Modern, sustainable designs

Evoke Quadrant Model Home, Issaquah, WA

Ellmann Residence, Grand Haven, MI

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SIP APPLICATIONS

Timber frame

Christensen Residence, Clarkfield, MN

Twin Mountain Home, Carroll, NH

SIP APPLICATIONS

Craftsman design

Kenilworth Bungalow, Minneapolis, MN

Inspiration Home, Olympia, WA

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SIP APPLICATIONS

Complex designs made easy

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SIP QUESTIONS?

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