OVERCROWDING TO OPPORTUNITY

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Presentation Goals

1. **Consequences of Overcrowding**
2. **The Opportunity**
3. **Design Reponse**
4. **Site Selection & Application**



01 Background

Overcrowding

Can result in higher rates of absenteeism, burnout, and stress amongst students and teachers. Furthermore, students in smaller classes tend to have superior academic achievement and individualized instruction (Earthman, 2002).

18,000 schools nationwide

11 million students

U.S. Department of Education. Condition of America's Public School Facilities: 1999. Government Report NCES 2000-032. National Center for Education Statistics, 2000.



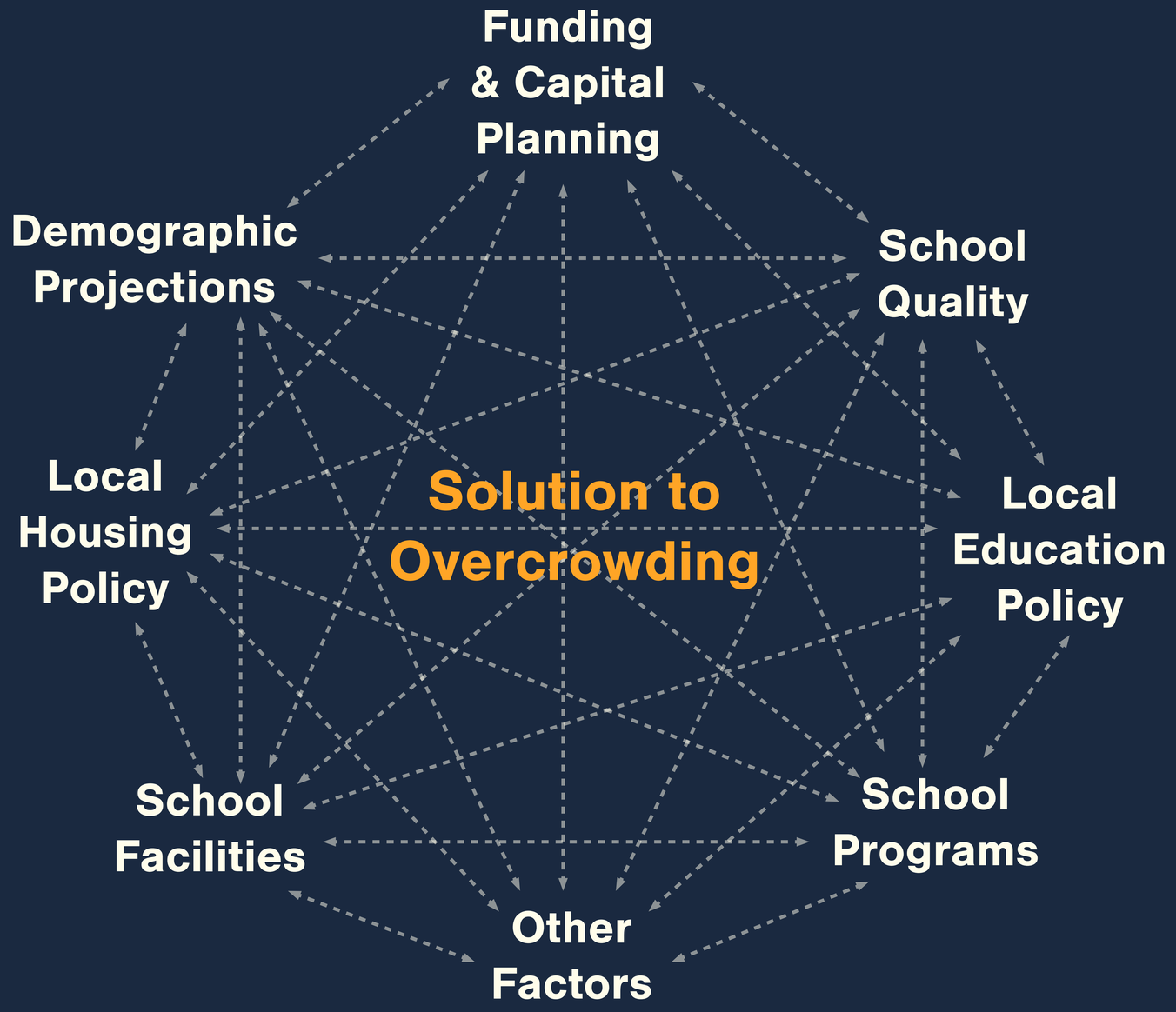
The Washington Post
Democracy Dies in Darkness

Post-U. Md. poll: Maryland parents say crowded classrooms are a problem

October 14, 2018

A majority of Maryland parents give their schools high marks, but they say crowded classrooms are a problem. (Jahi Chikwendiu/Washington Post)

By Donna St. George and Emily Guskin


Funding & Capital Planning
School Quality
Local Education Policy
School Programs
Other Factors
School Facilities
Local Housing Policy
Demographic Projections
Solution to Overcrowding

The Portable Classroom

Allows schools to mitigate overcrowding, meet class size restrictions, and move students during a renovation



Photo by author



Portable classroom circa 1964 (Frank Ciriotti, 1964)



Portable classroom, College Park, MD, 2025 (photo by author)

“Even the best of these units is sub-optimal... they have not been designed for maximum educational effectiveness: instead, [they] been optimized for transportability, minimum cost, and rapid deployment”

Nils Gore, University of Kansas School of Architecture

$647,000

avg. cost to obtain & install a
portable, based on 2025 MCPS data



Portable exterior, Blair High School, Silver Spring, 2026 (photo by author)

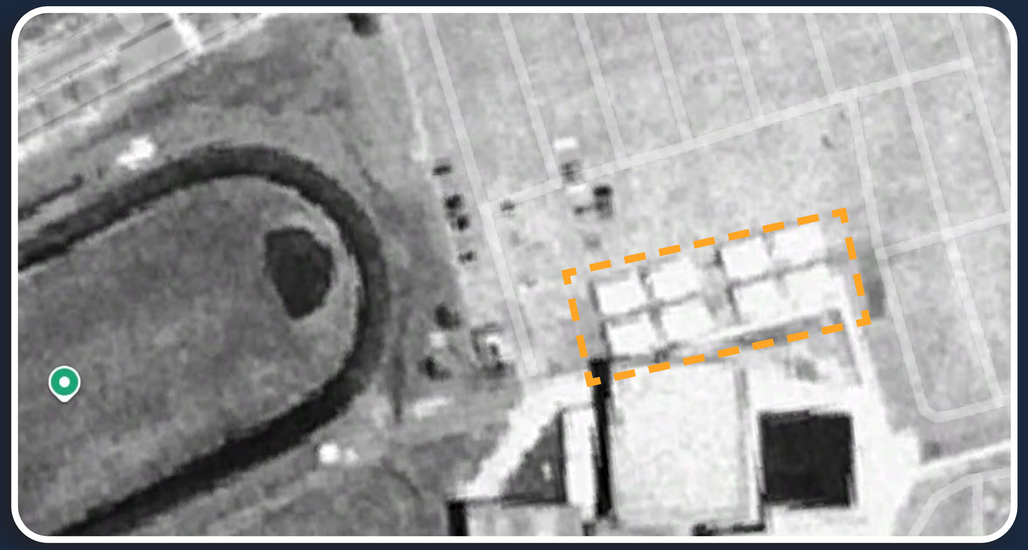


Portable interior, Blair High School, Silver Spring, 2026 (photo by author)

Portables are Permanent

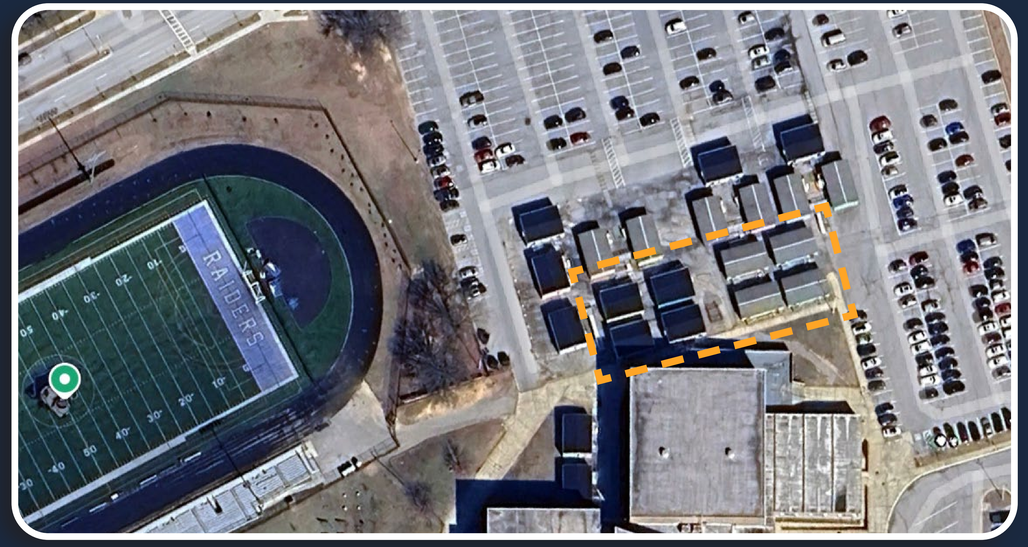
Reported by institutions such as **UCLA & UC Berkeley** (Shendell et al., 2004), **Kennesaw State University** (Chan, 2009 & Patterson et al., 2009), **University of Kansas** (Gore, 2012), and **Western University** (Riveros, 2023 & Riveros and Zhou, 2025).

1993 (Oldest imagery available)



Eleanor Roosevelt High School, Greenbelt, MD (Google Earth)

2026



Eleanor Roosevelt High School, Greenbelt, MD (Google Earth)

At least 33 years - 2 full generations



$85 Billion

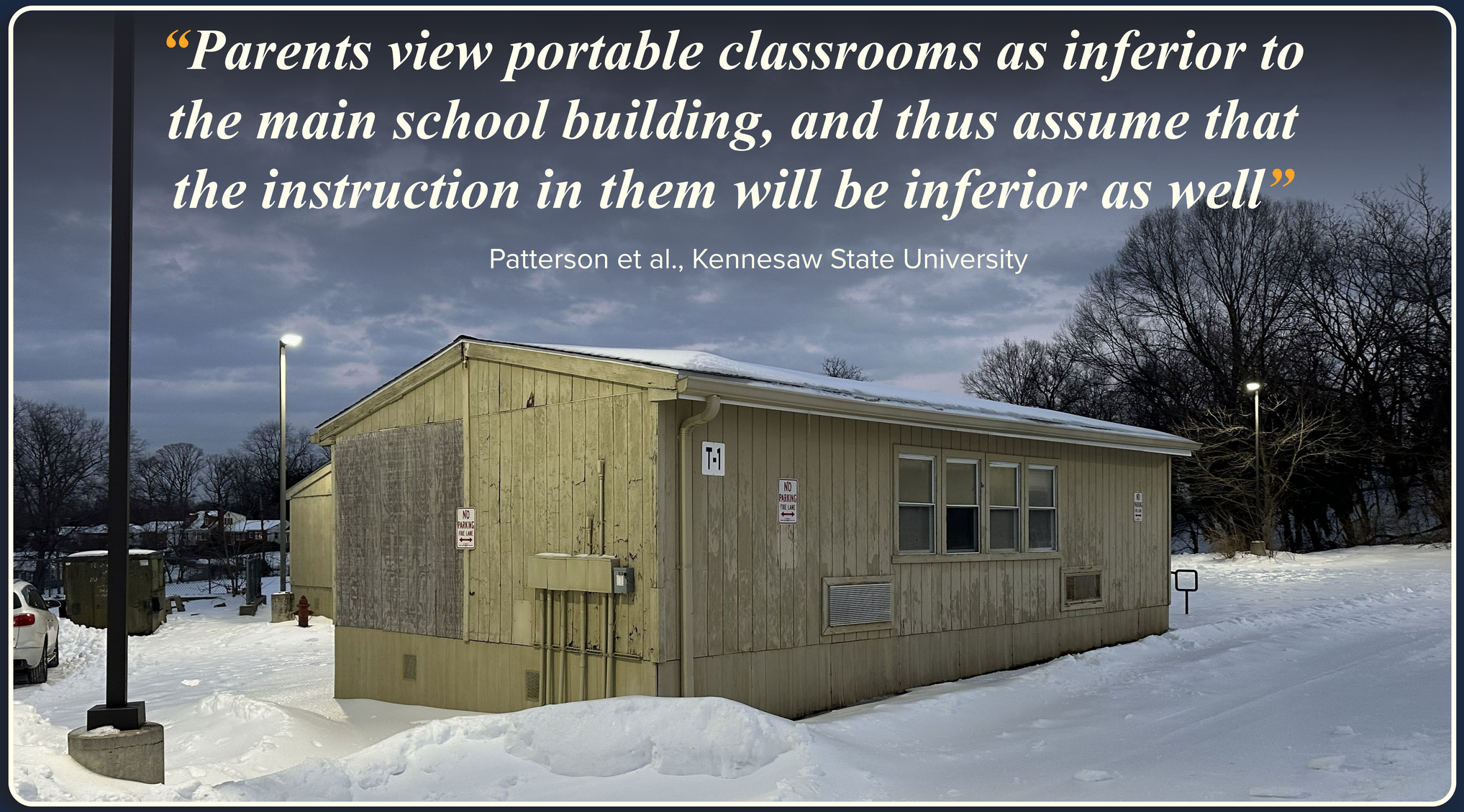
funding gap between current facility conditions and reaching a state of good repair.

(American Society of Civil Engineers, 2025)



02

The Issue



Elementary school portable in Berwyn Heights, MD, 2026 (photo by author)

School Facilities and Student Performance

Literature from institutions such as the US Department of Education, UCLA, Yale University, and Johns Hopkins University affirm that the condition of school infrastructure is integral to the performance of students and teachers.



I.A.Q.

Poor IAQ curbs performance, increases health complaints and absenteeism.

University of California, Berkeley
(Heath and Mendell, 2002)



CLIMATE

Significant reductions in student comprehension occur above certain ranges.

University of Salford (UK)
(Barrett et al, 2015)



ACOUSTICS

Less noise = higher student achievement, more noise = dissatisfaction and stress

UCLA
(Earthman, 2002)



LIGHTING

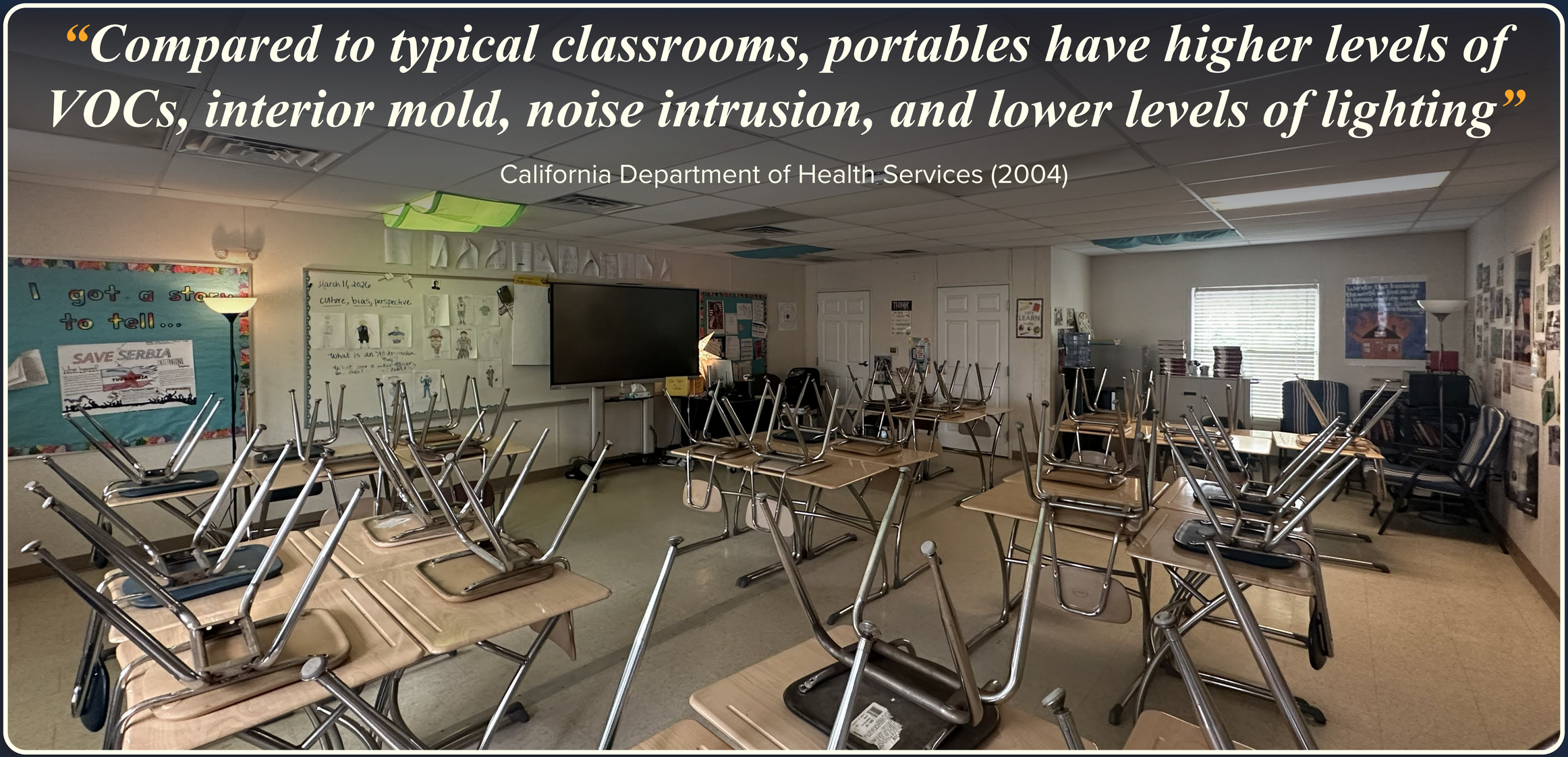
Daylight is important
Full spectrum lighting is ideal for artificial lighting.

Department of Education
(Young, 2002)

Portable Classroom Deficiencies

“Compared to typical classrooms, portables have higher levels of VOCs, interior mold, noise intrusion, and lower levels of lighting”

California Department of Health Services (2004)



Portable Deficiencies

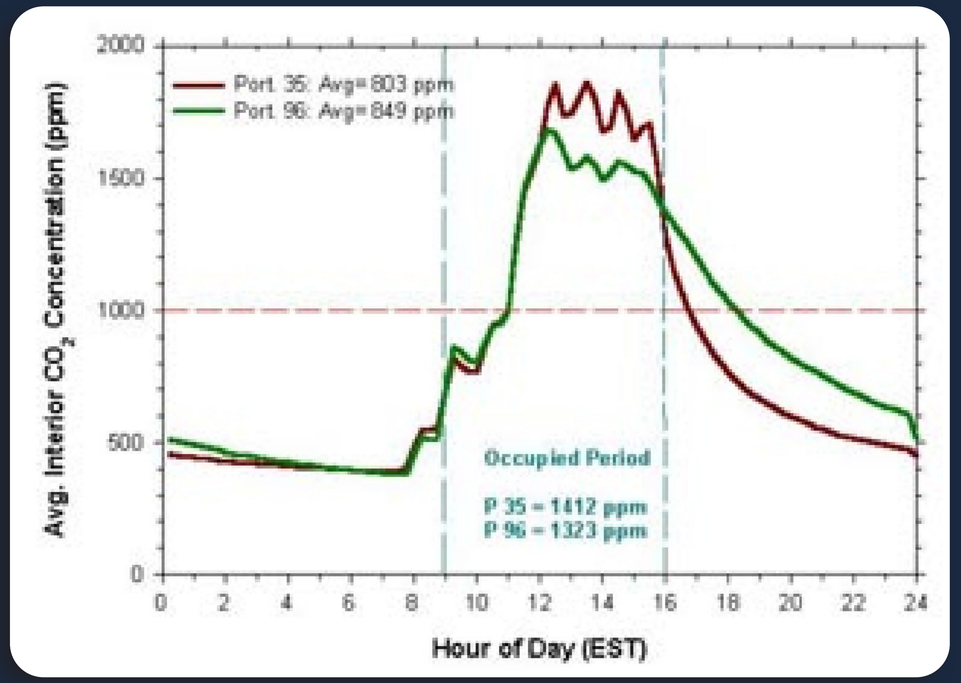


Portable HVAC unit (photo by author)

60%

of teachers in portables turn off their HVAC due to the noise

Calif. Dept. of Health Services (2004)

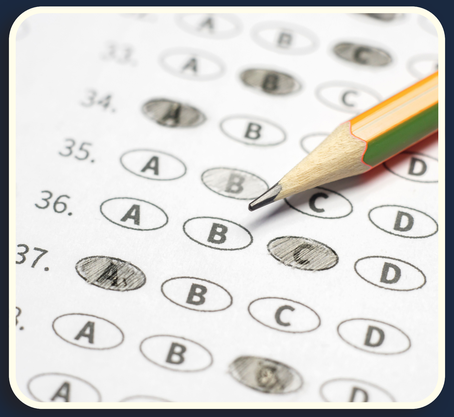


CO2 levels within portables (Callahan et al, 1999)



Students in **regular classrooms** demonstrate **more positive attitudes** towards their schools than those in portable classrooms.

Kennesaw State University
(Chan, 2009)



Intense overreliance on portable classrooms has **significant negative effects** on student achievement in reading and math.

Western University (CAN)
(Riveros and Zhou, 2025)



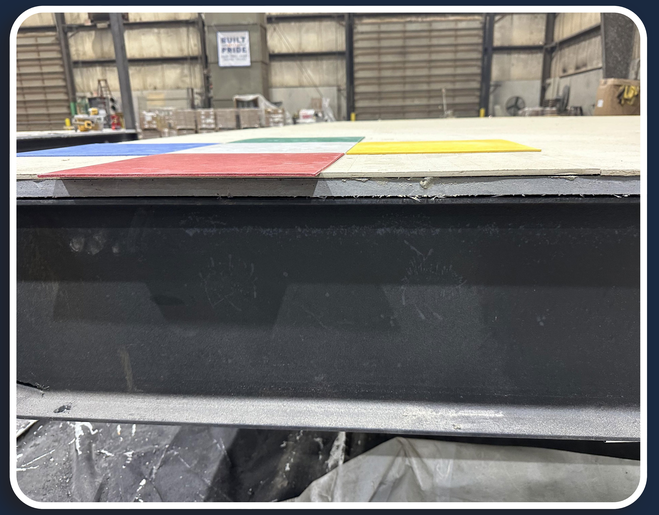
If a secondary school of 1,000 students uses portables as 5% of its building space, it can expect **9-10 more dropouts per year.**

University of Houston
(Branham, 2004)

Whitley East Facility Visit (Leola, PA), Jan 2026













ADAPTABLE

FLEXIBLE

RELIABLE

Thesis Question

How might portable classrooms be reinvented to be more adaptable, flexible, and reliable learning environments?



03

The Opportunity

Prefabrication and Modularity

“The greatest advantage to prefabrication is predictability”

Mark & Peter Anderson, Anderson Anderson Architects

50%

reduction in time compared to conventional construction

Univ. of Coimbra (PRT)
(Tavares et al. 2021)

1/4

amount carbon produced for vs. conventional school construction

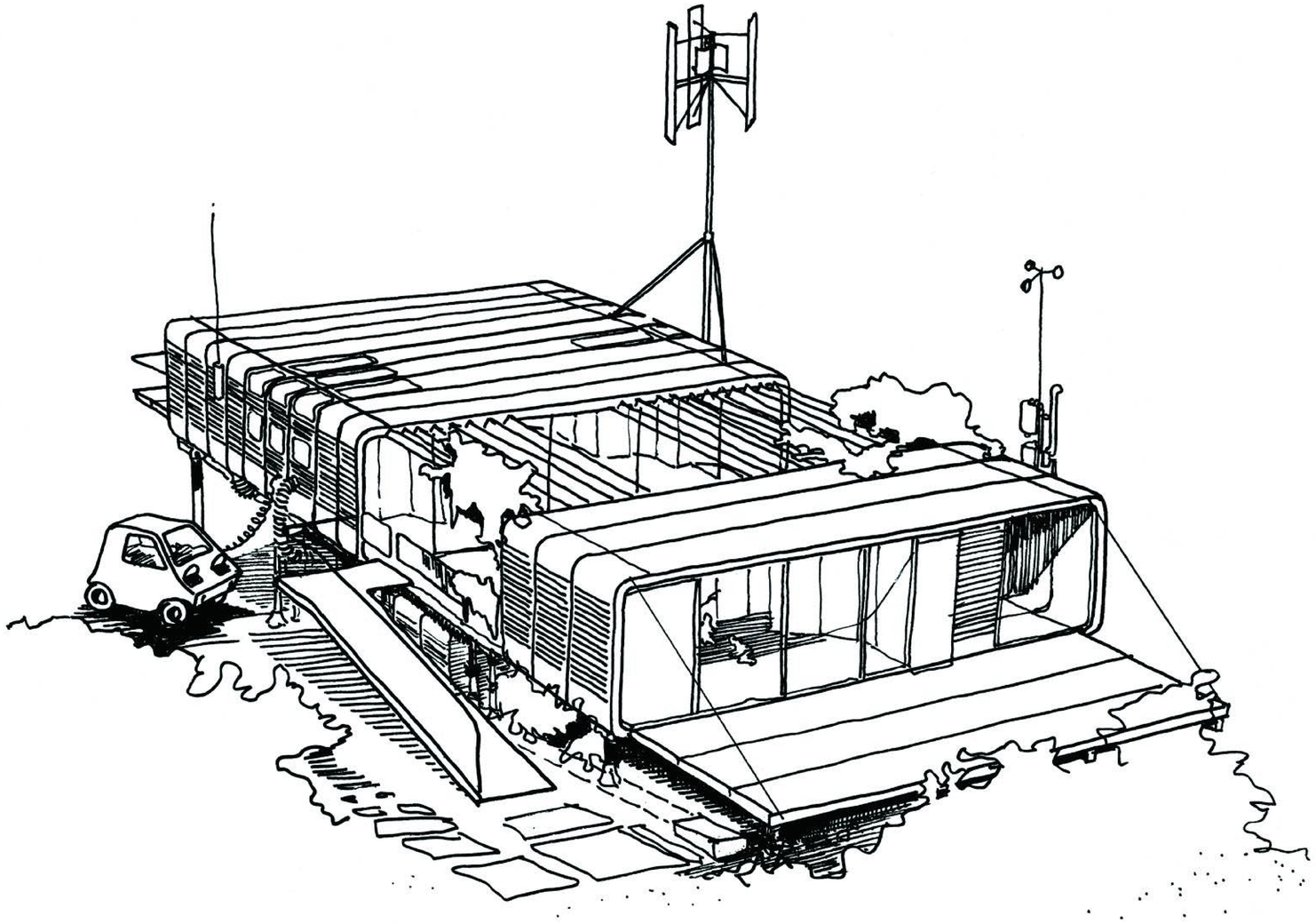
Hanyang University (ROK)
(Nguyen et al., 2023)

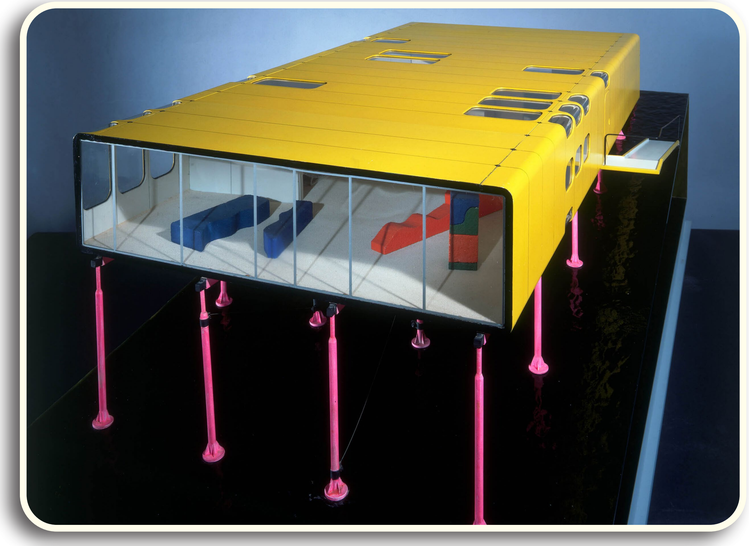
1/5

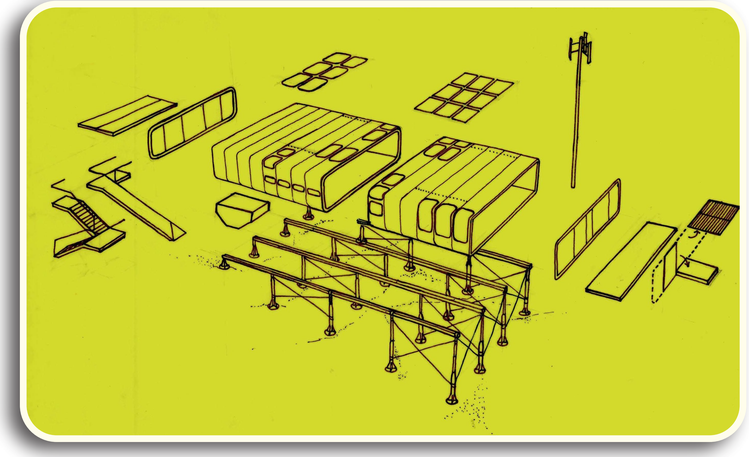
amount of construction waste vs. conventional housing construction

Kongju National Univ. (ROK)
(Boafo et al, 2016)

Zip Up House | Richard Rodgers, 1969 | Unbuilt





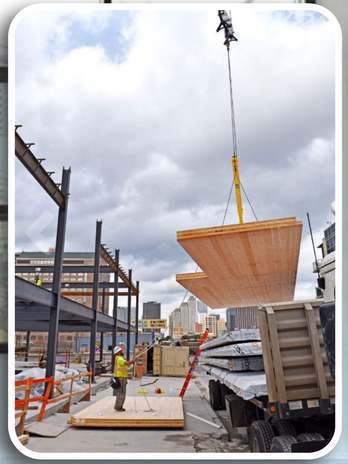


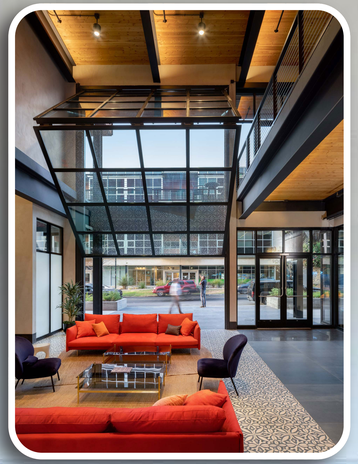
Photos by RSHP

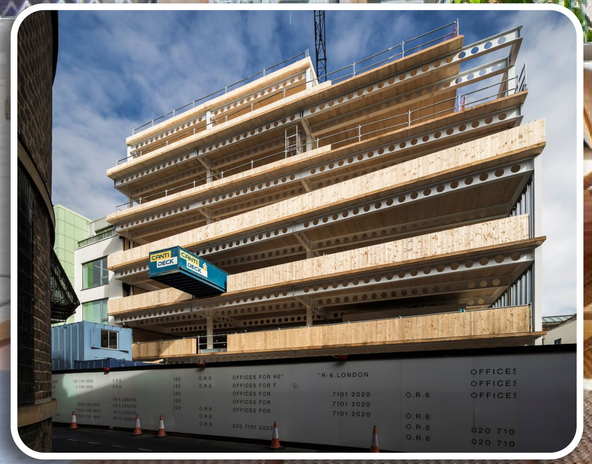


901 E 6th St | Rios Architects | Austin, TX

Photos by Rios Architects









6 Orsman Rd | Waugh Thistelton Architects | London, UK

Photos by Waugh Thistleton Architects

Natural Light

Natural Light	Skylights
20-26%	19-20%
Improvement in math and reading scores	Improvement in math and reading scores

Heschong, Lisa, Dr Roger Wright, and Stacia Okura. Daylighting and Productivity: Elementary School Studies. January 2000.

WUSTL graduate school architecture studios (photo by Kieran Timberlake)

Fuji Kindergarten | Tezuka Architects | Tokyo, Japan



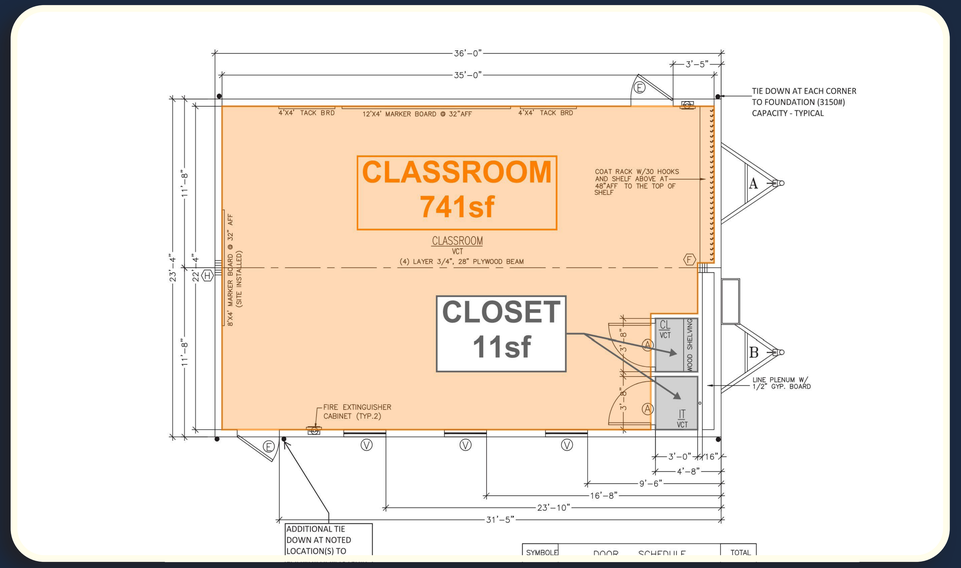
Photos by Tezuka Architects

Munkegaard School | Arne Jacobsen | Gentofte, Denmark





Photos by Arne Jacobsen



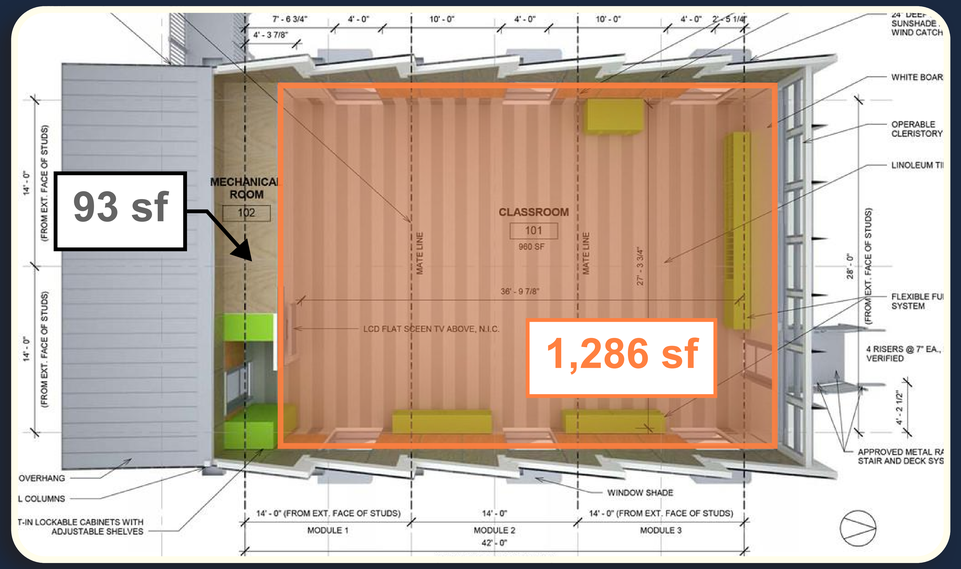
Standard portable floor plan (drawing from Modular Genius)

741 sf / 30 = 24.7sf / person

DOE Guidelines

28-40sf / student

Garrett, Sandy. Planning for Education: Space Guidelines for Planning Educational Facilities. Revised. No. EF005616. Oklahoma State Department of Education, 1998.



Energy positive portable classroom plan (via Anderson Anderson Architects)

1,286 sf / 30 = 42.9sf / person



04

The Kit of Parts

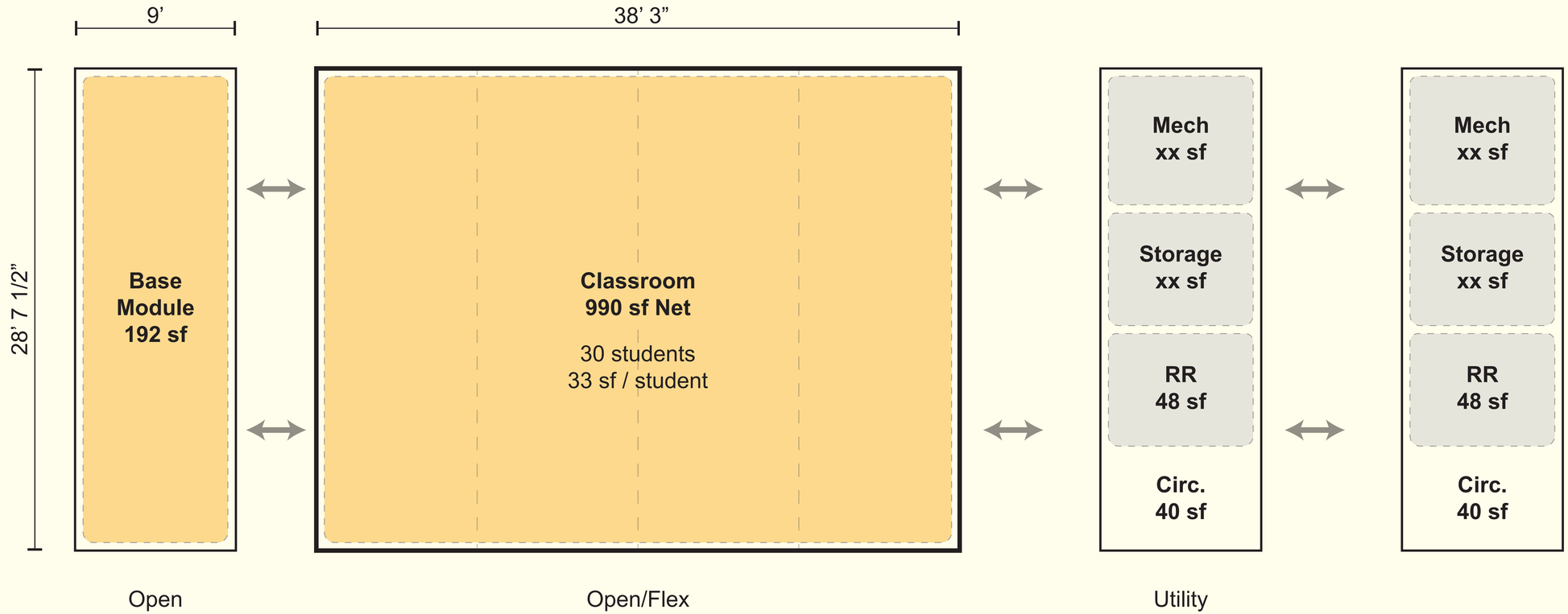
Design Response

~~Portable Classroom~~

Adaptive Modular Classroom (AMC)

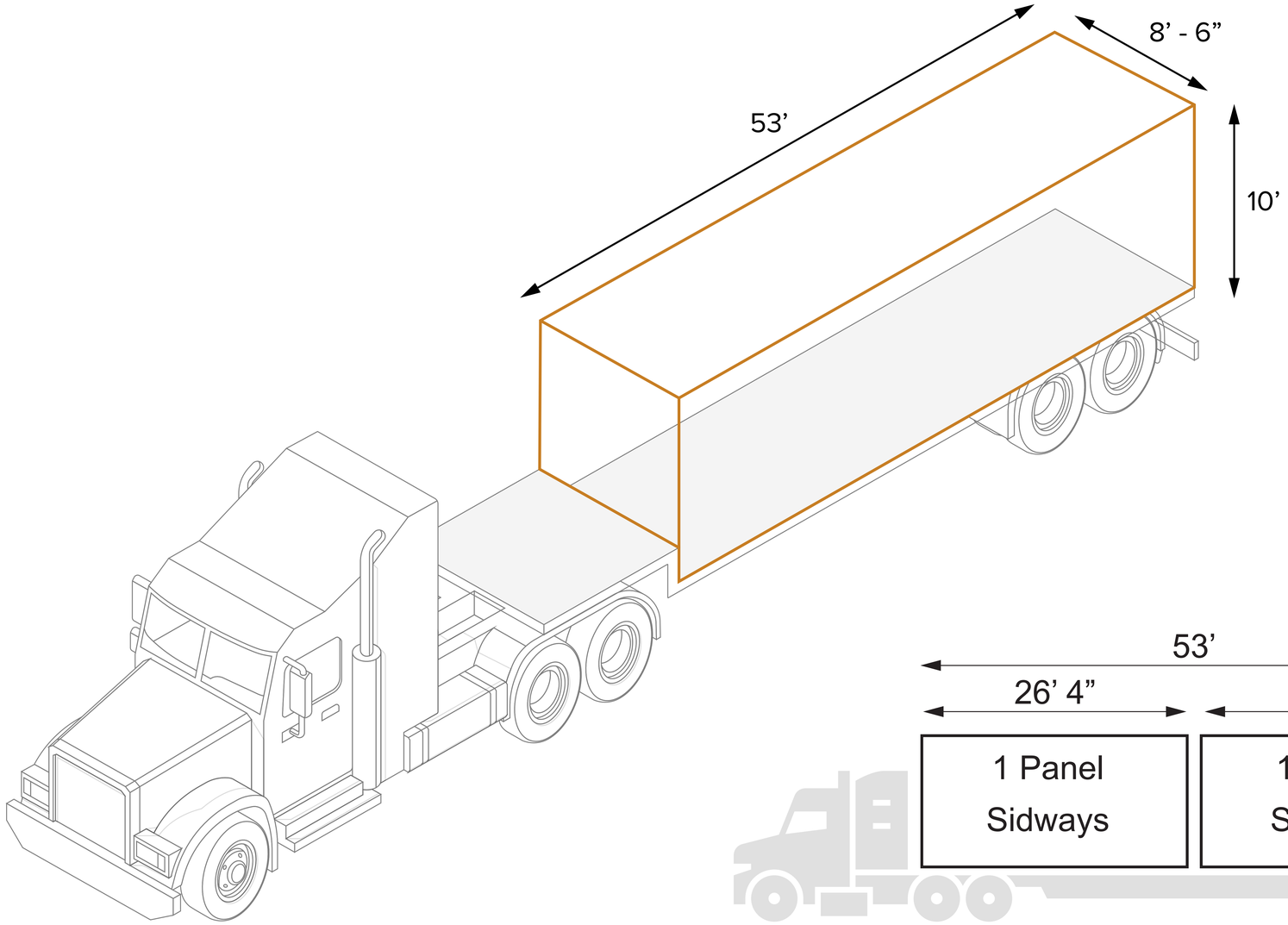
Programming Strategy

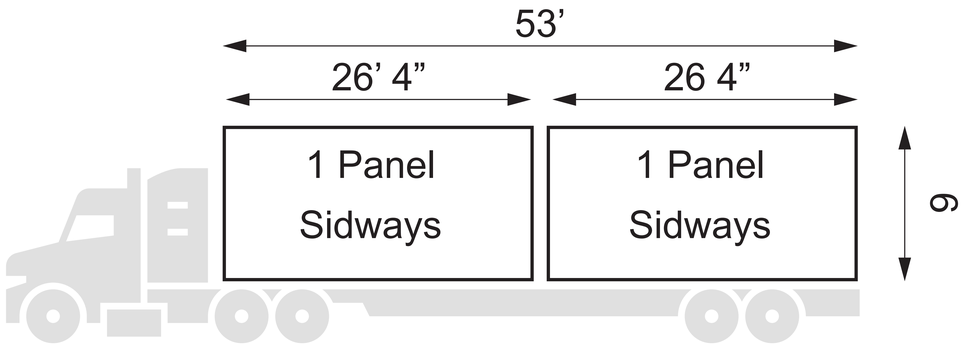
Program Size Calculations
Classroom Size: 30 students
Modular Genius Classroom: 741 sf
Comparable sf per person: 25 sf



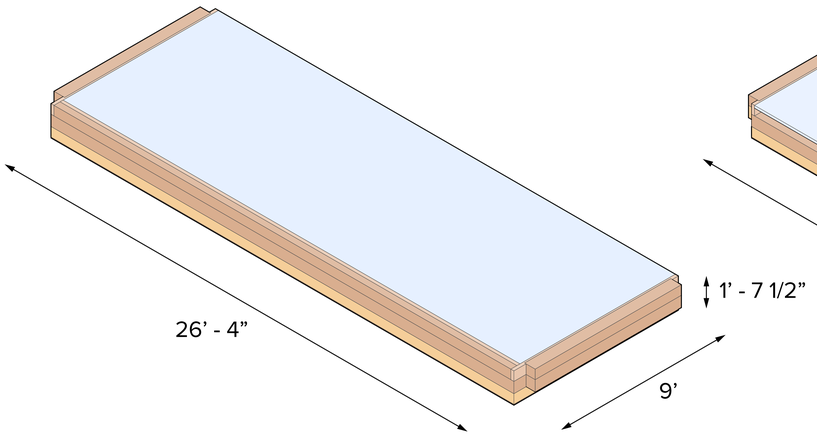
Modular elements and program

Transportation Constraints

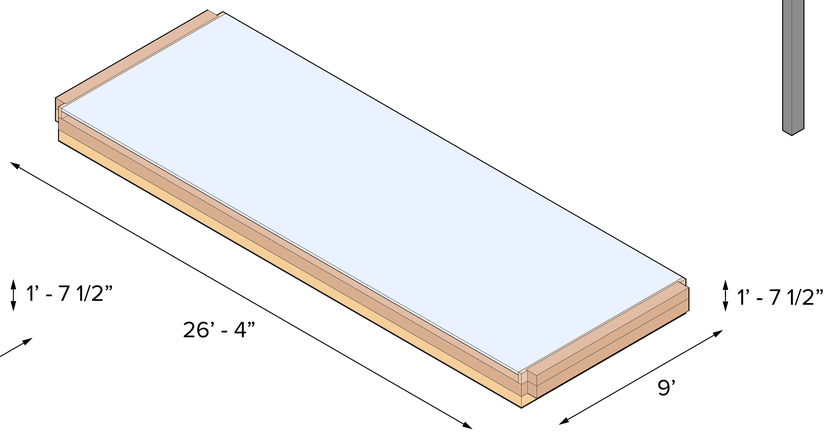




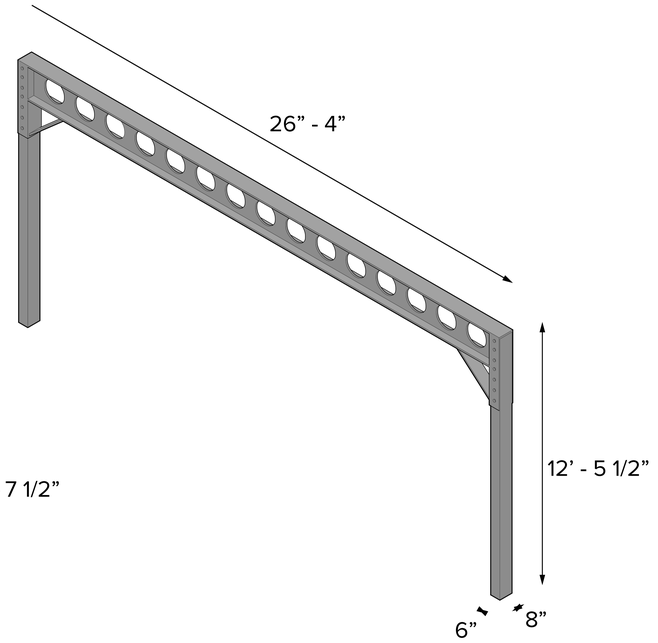
Kit of Parts: Floor Panels



End Panel

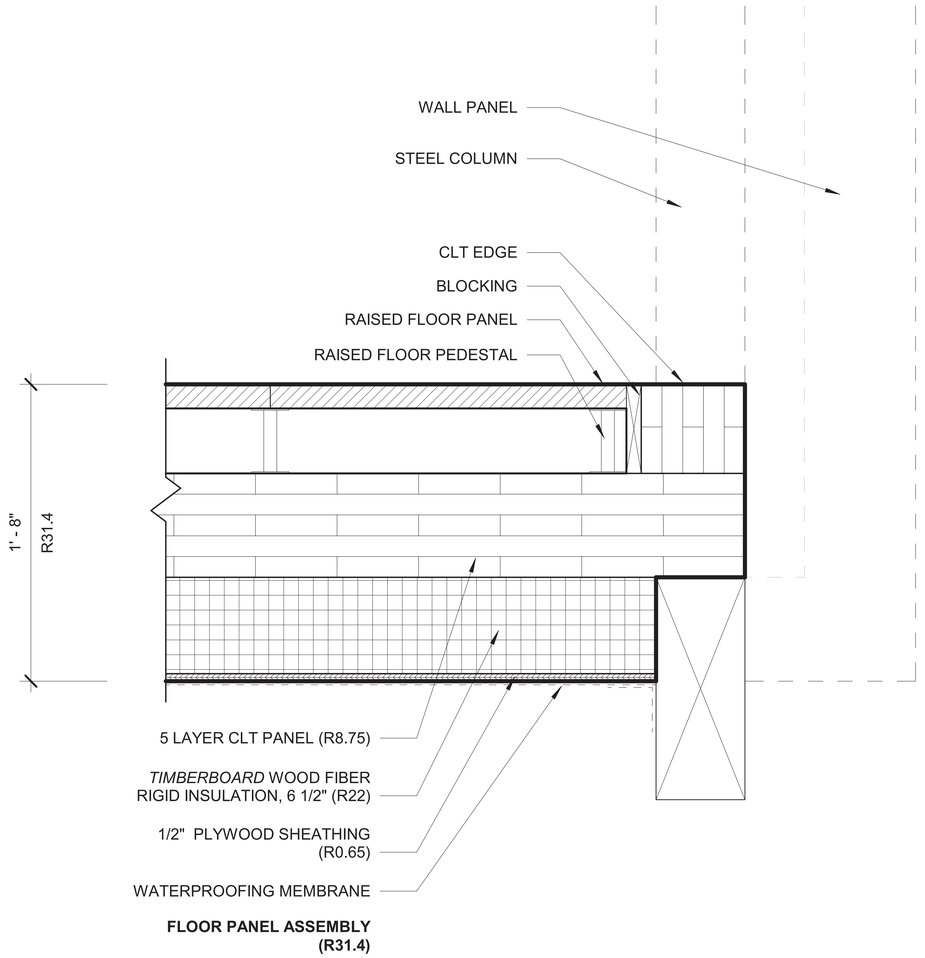


Middle Panel



Steel Structure

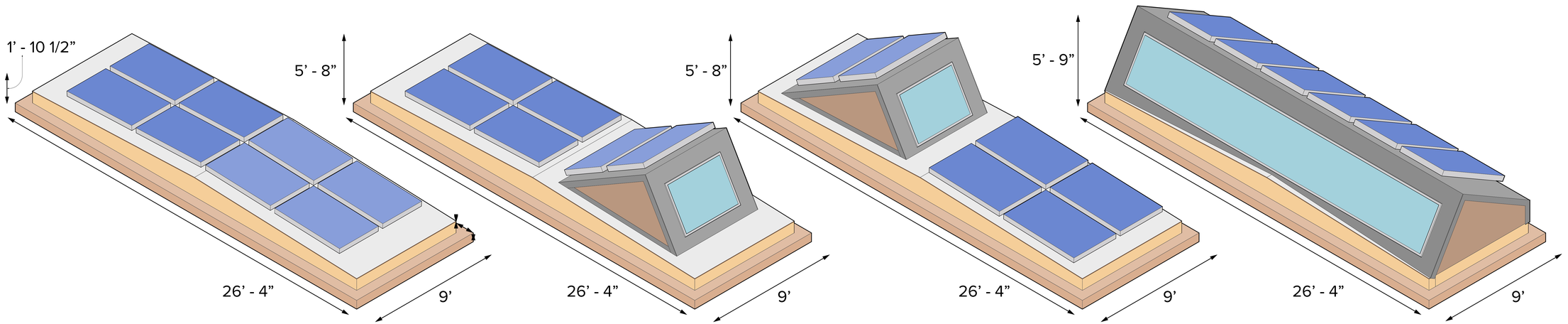
Kit of Parts: Floor Panels



Wall Panel

R31

Kit of Parts: Roof Panels



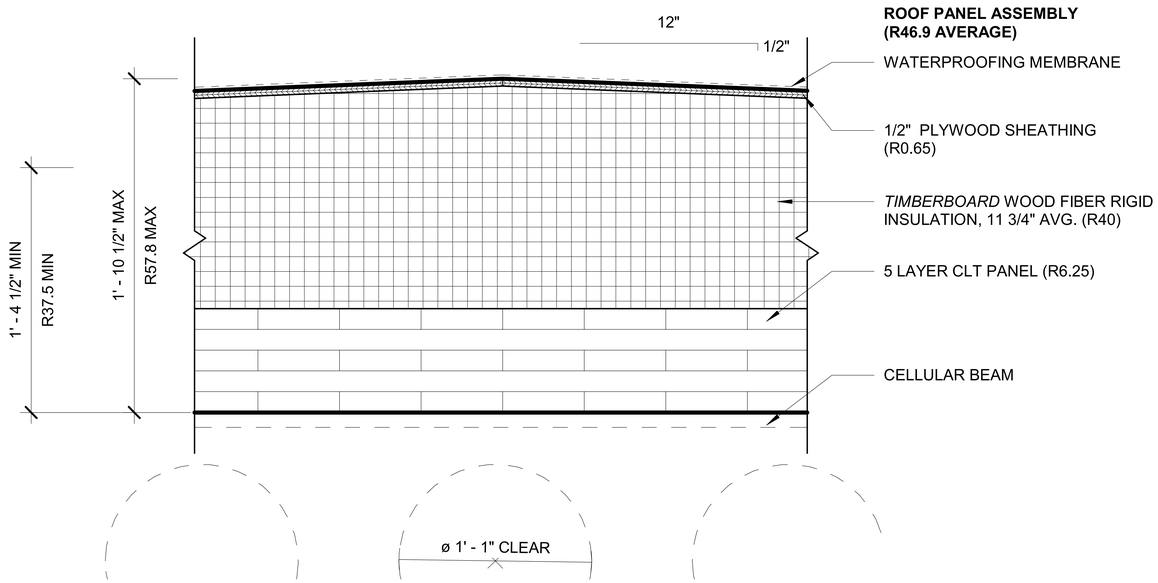
Flat Panel

Side Skylight - Front

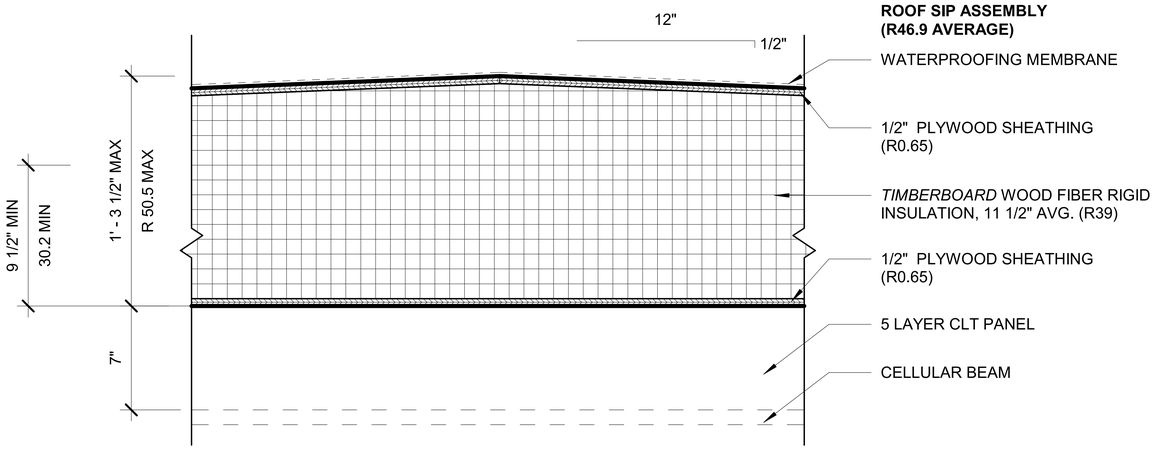
Side Skylight - Back

Sawtooth

Kit of Parts: Roof Panels

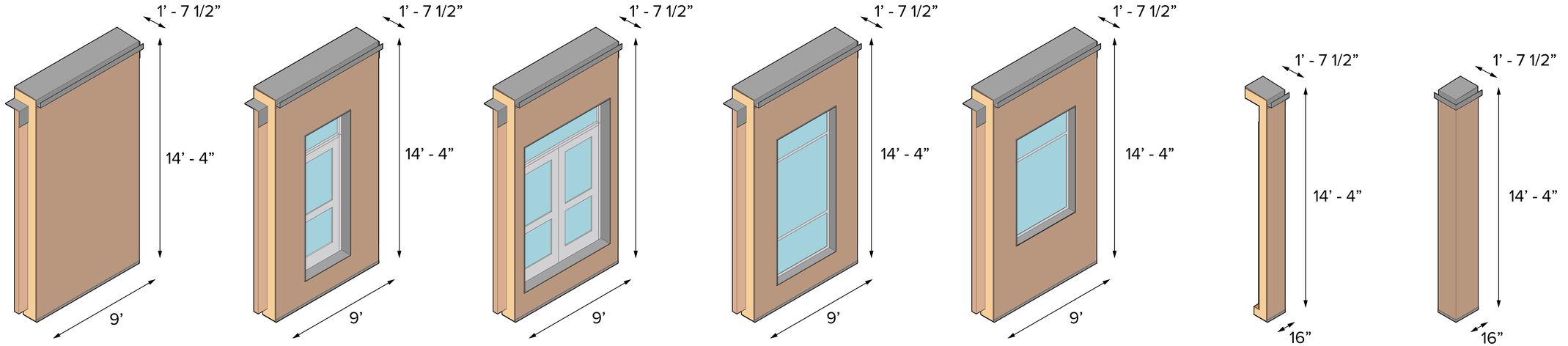


Wall Panel
R38



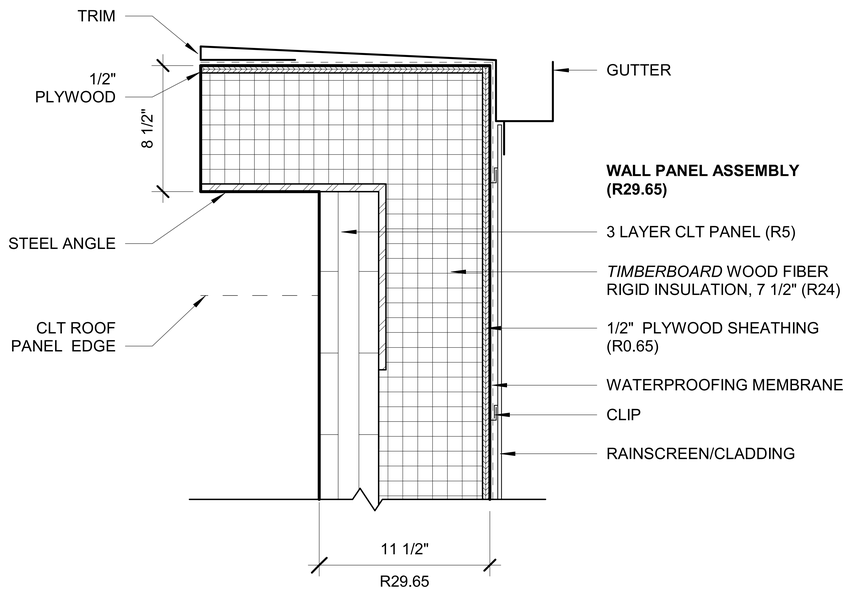
Wall Panel
R30

Kit of Parts: Wall Panels

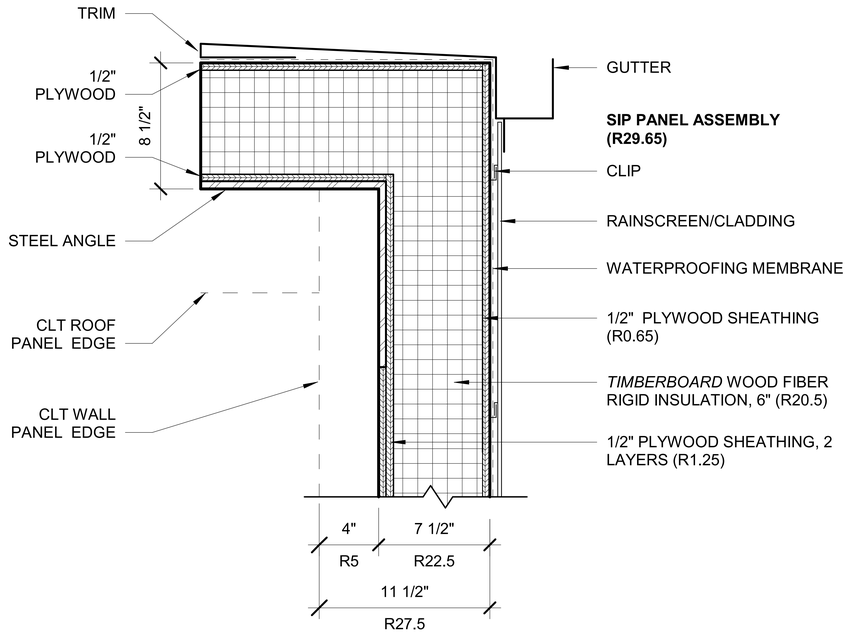


Solid | Single Door | Double Door | Full Height Window | Half Height Window | SIP Infill Panel | SIP Corner Panel

Kit of Parts: Wall Panels

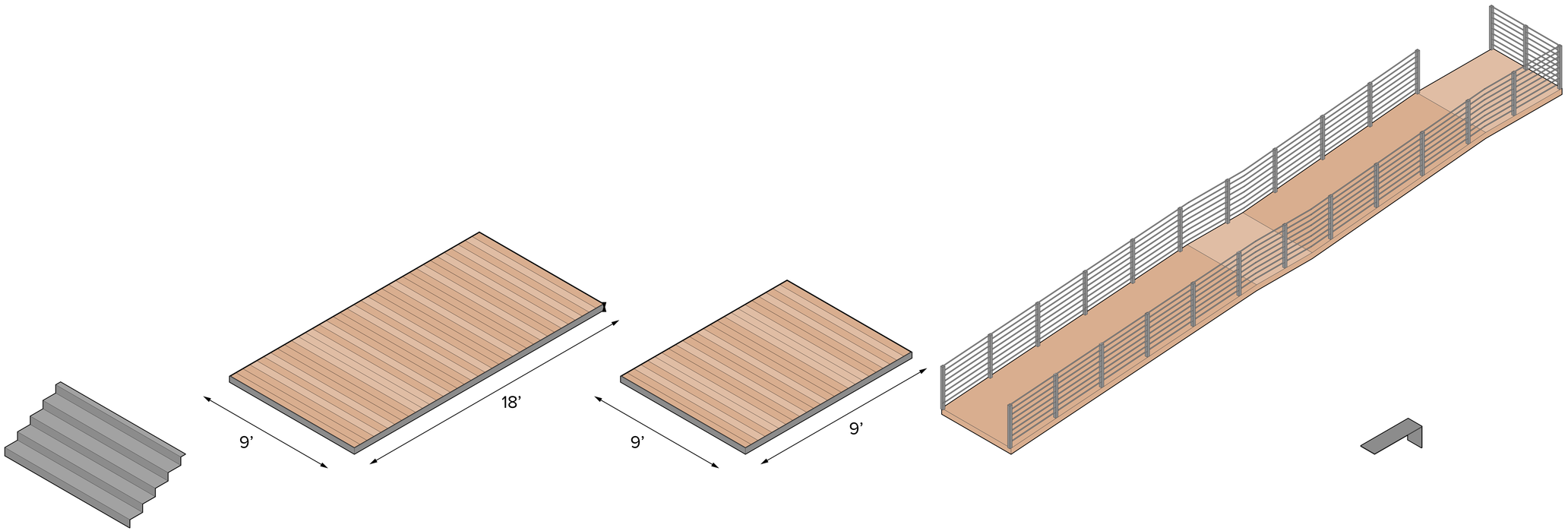


Wall Panel
R30



Wall Panel
R28

Kit of Parts: Accessories



Stairs

Deck Panel

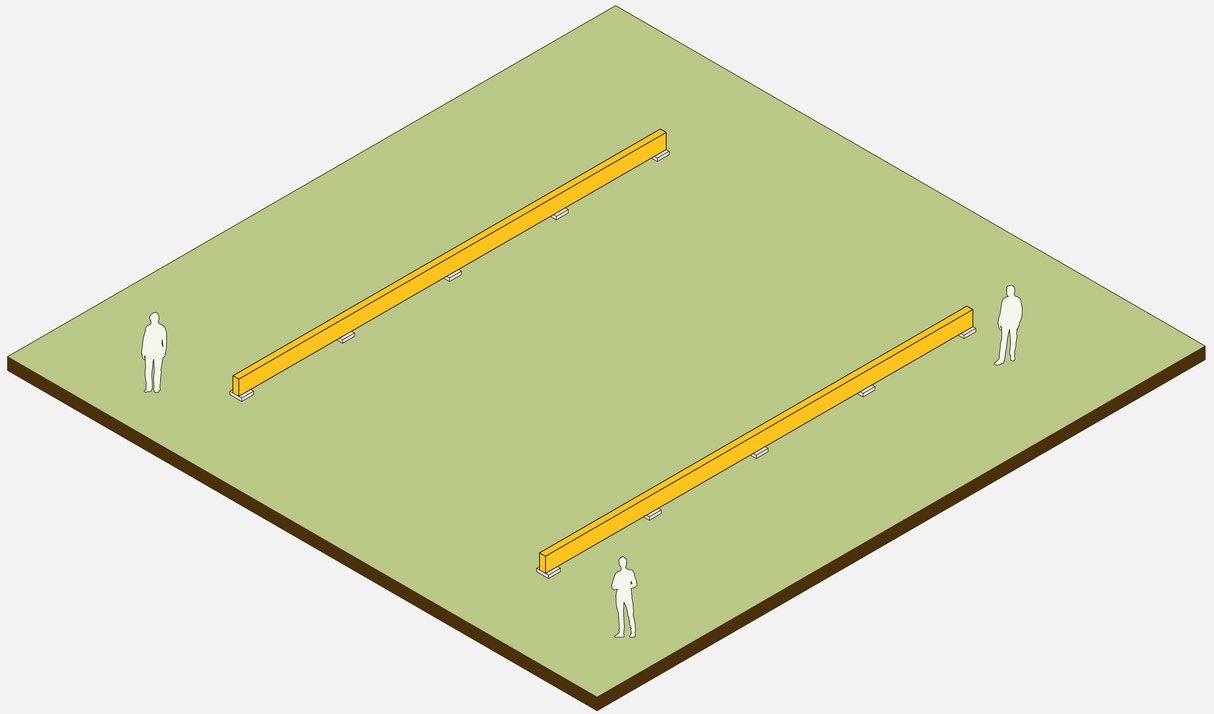
Half Deck Panel

Ramp

Window Shading Device

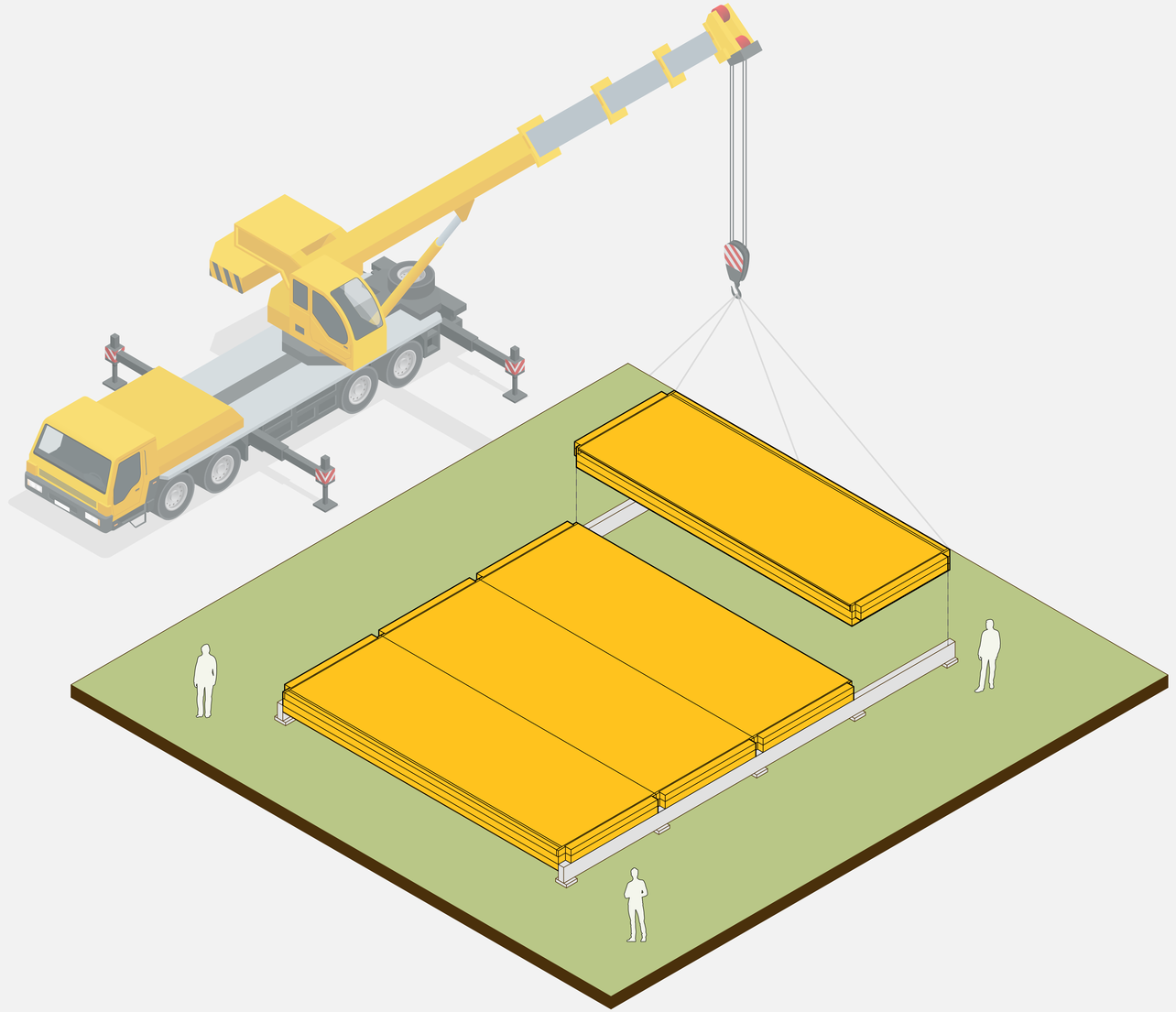
Assembly Sequence

1 Support Beams



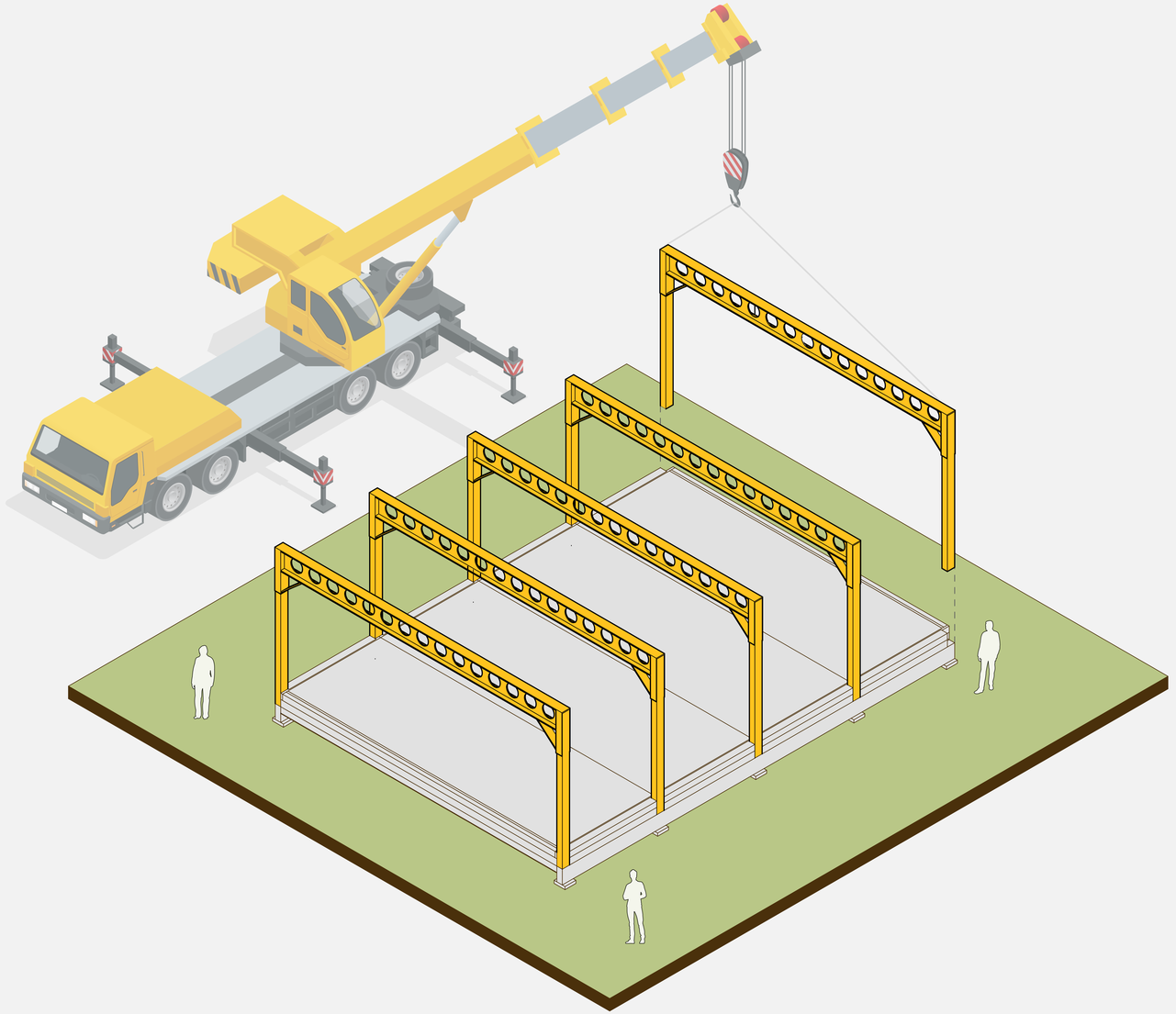
Assembly Sequence

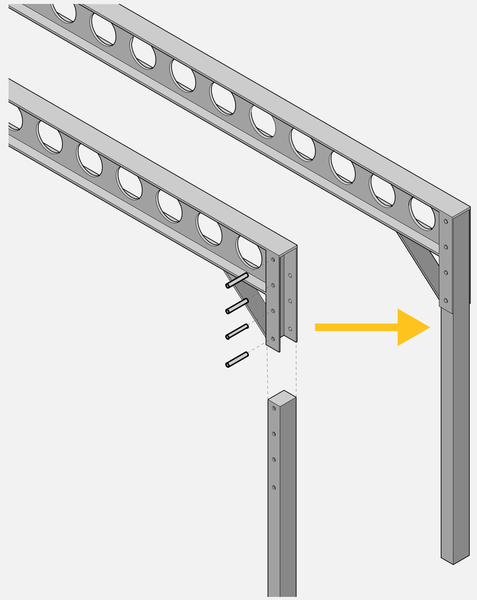
2 Floor Panels



Assembly Sequence

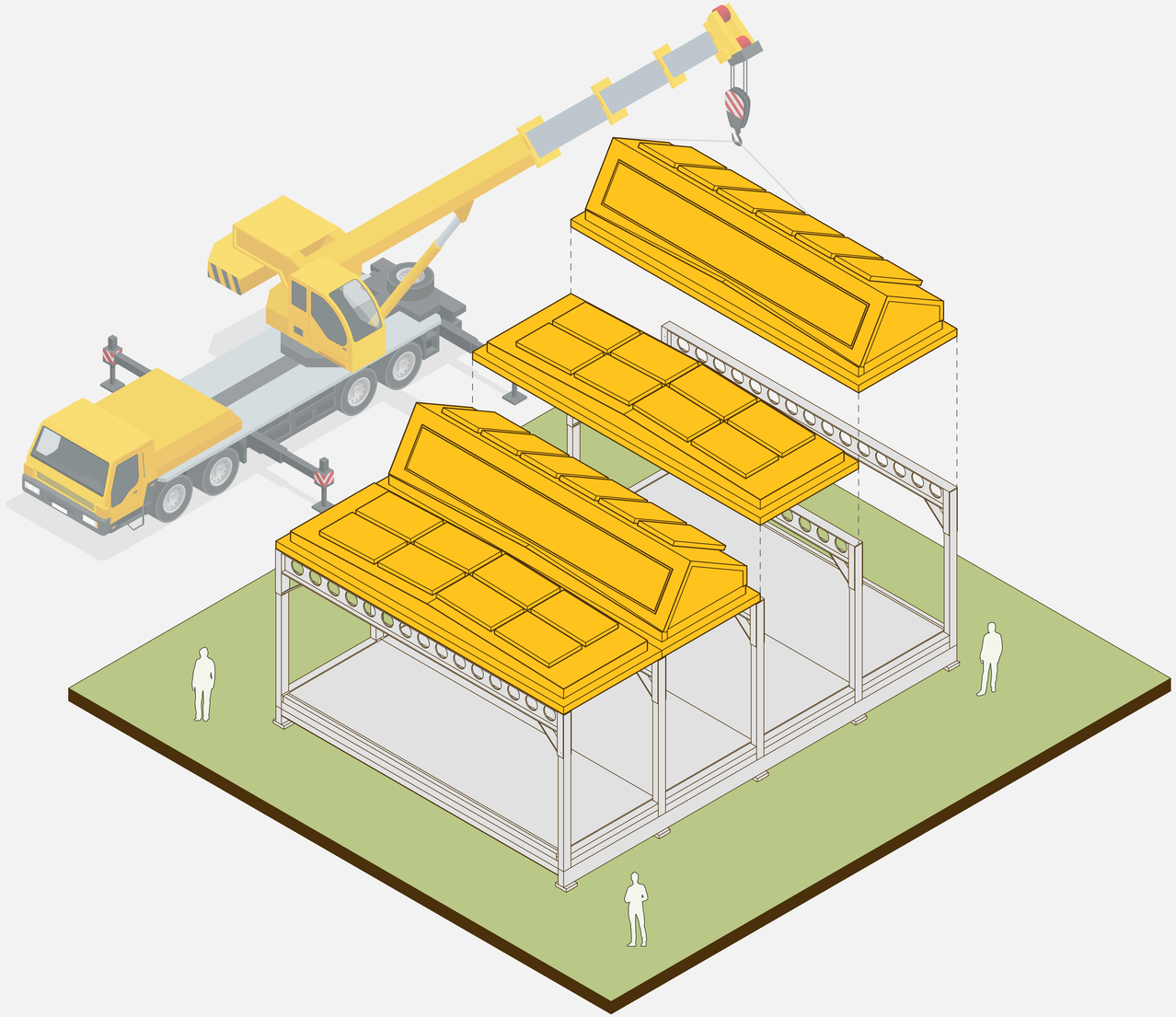
3 Structural Steel





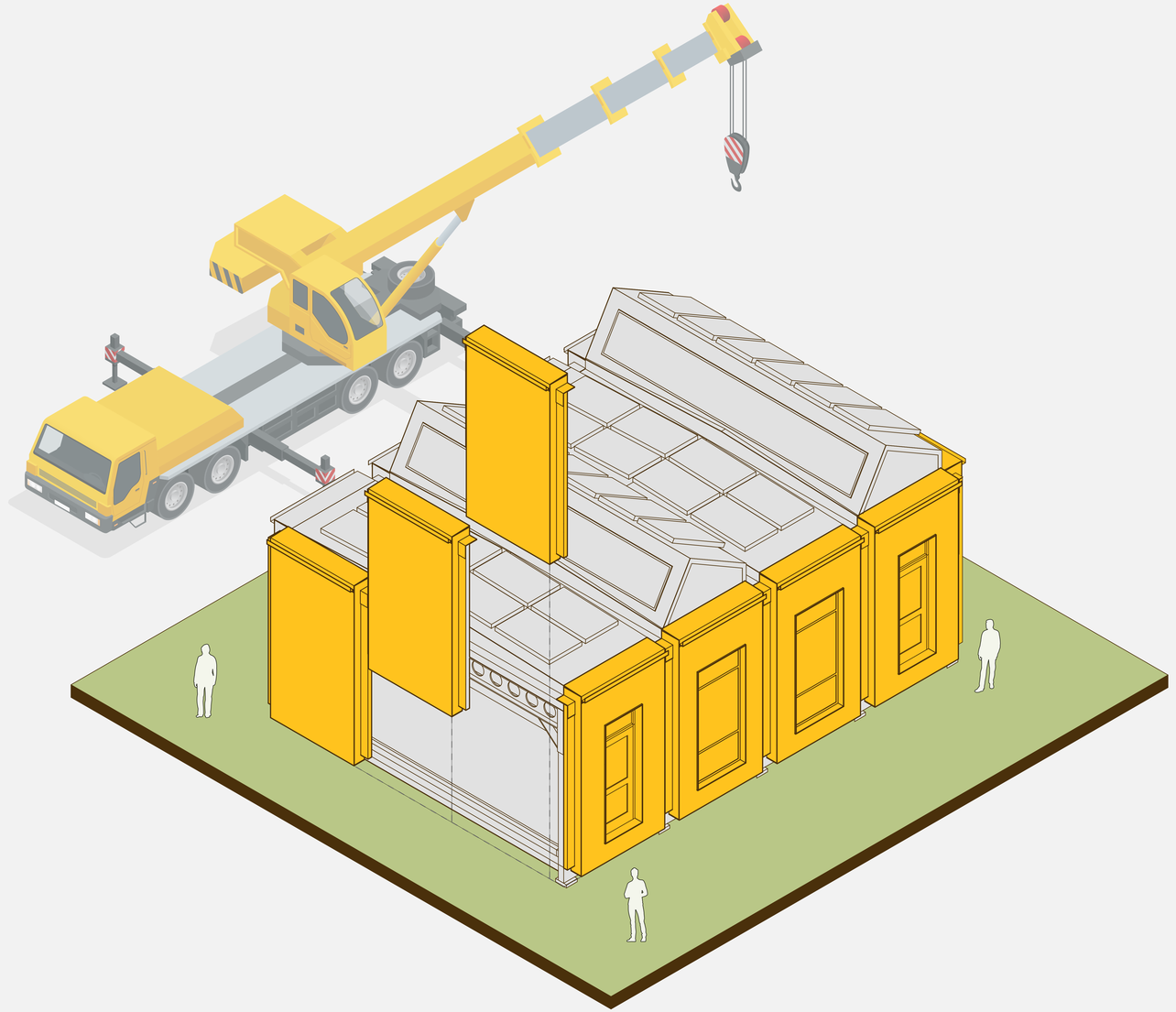
Assembly Sequence

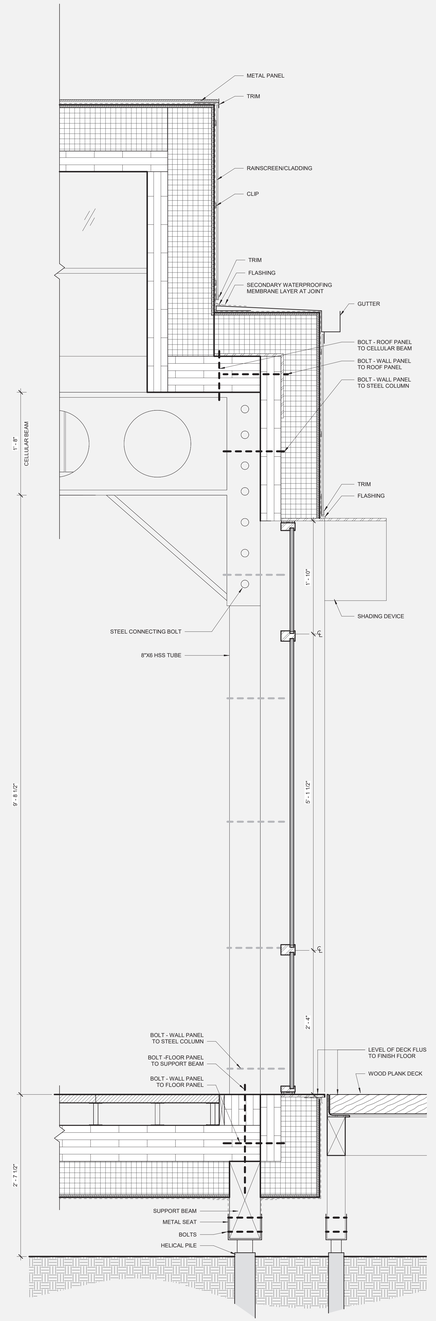
4 Roof Panels



Assembly Sequence

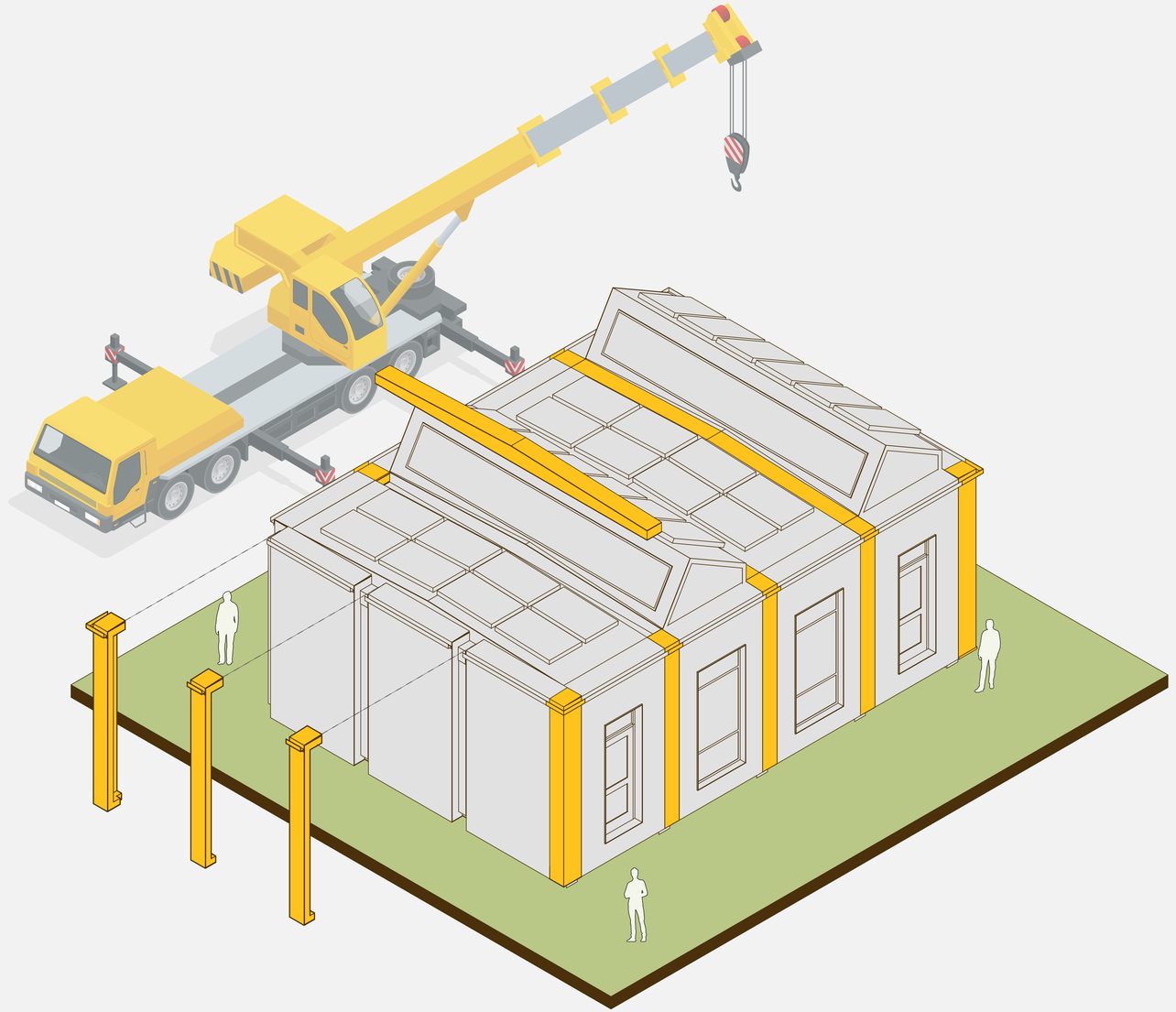
5 Wall Panels





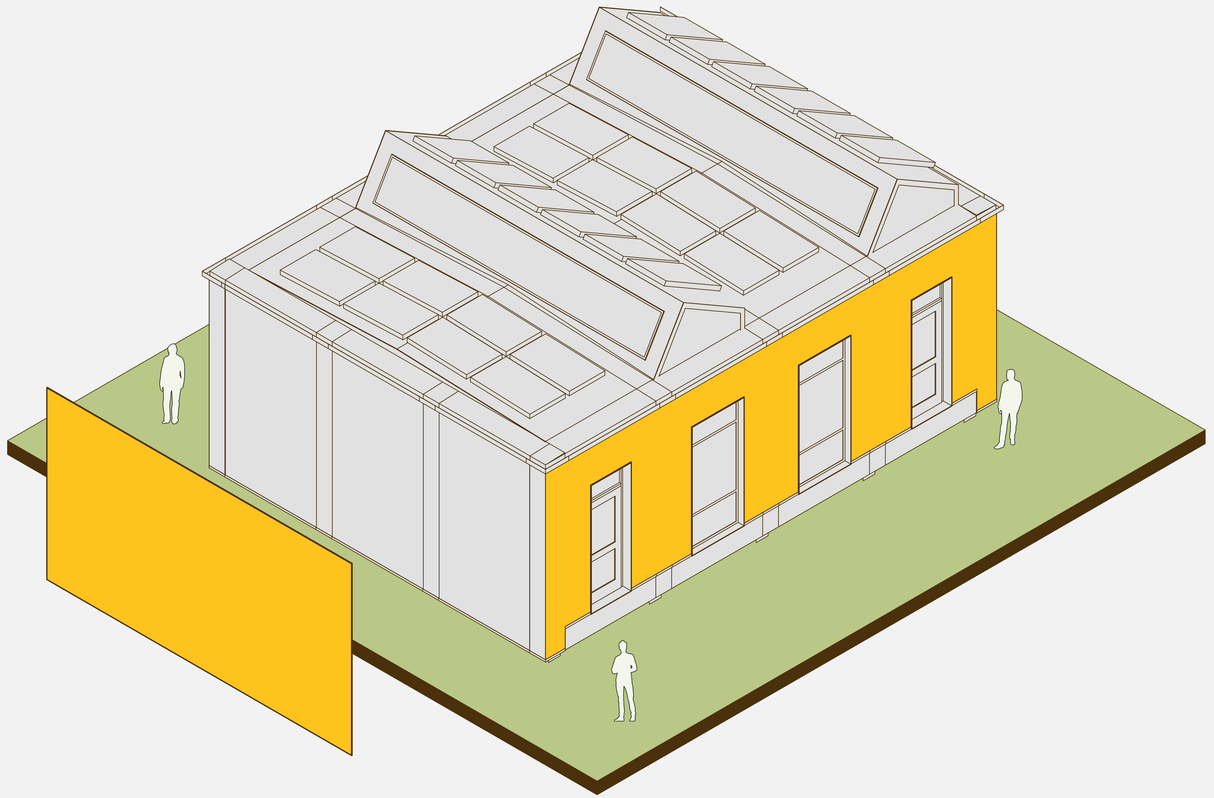
Assembly Sequence

6 SIPs & Waterproofing



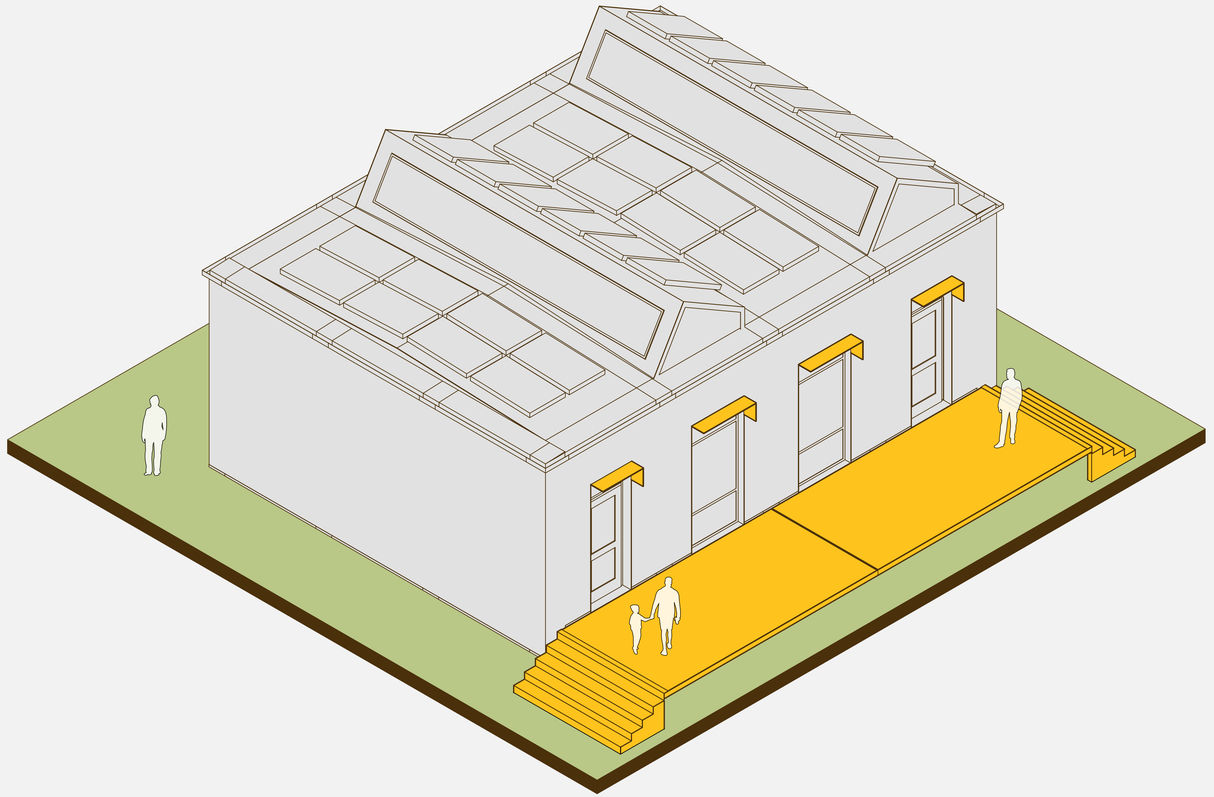
Assembly Sequence

7 Rainscreen / Cladding



Assembly Sequence

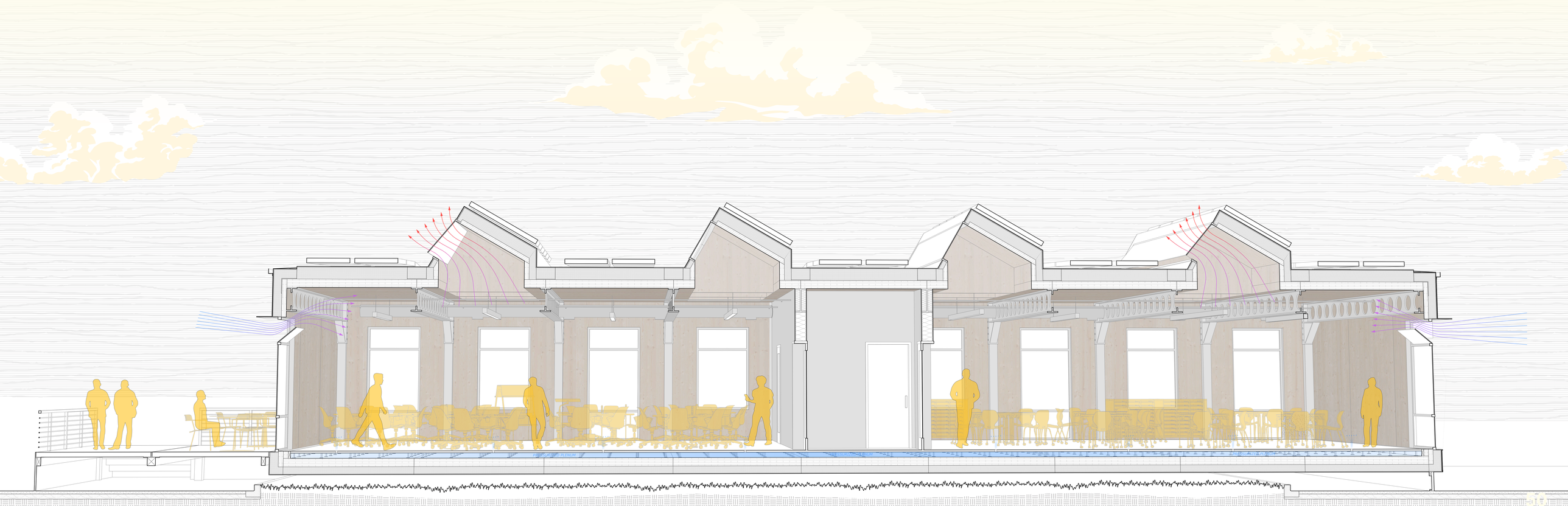
8 Accessories



A Single Unit AMC



A Double Unit AMC



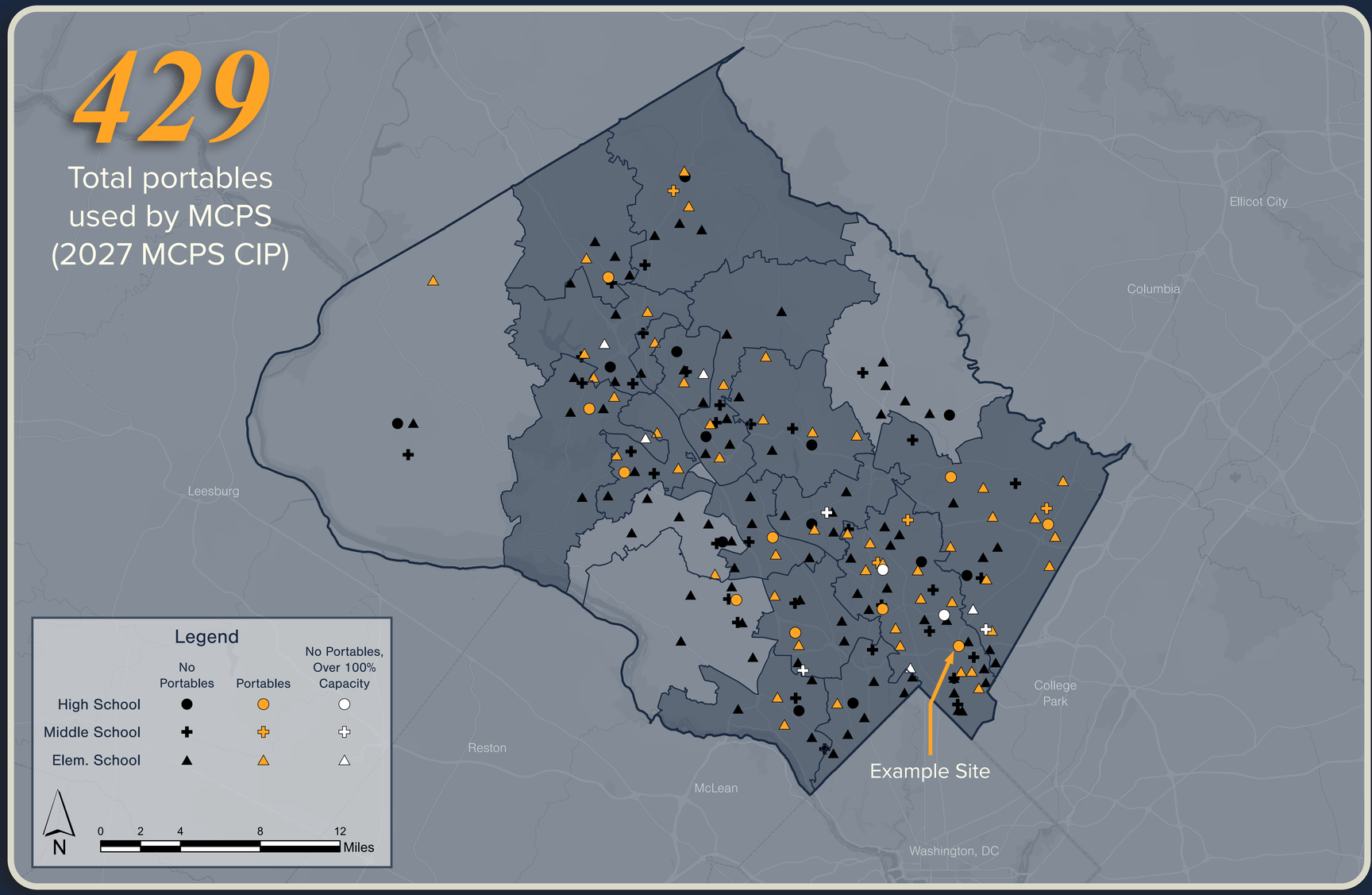
03

The Site



Photo by G. Edward Johnson, Wikimedia Commons

Site Selection



MCPS Clusters + School Overcrowding overlay

“Given their current age, MCPS should be renovating, renewing, or replacing 6-7 elementary schools ($221-345m/year) and 2+ secondary schools ($135-210m/year) every year for the next 20 years”

MCPS FY27 Capital Budget and FY27-32 CIP

5

total number of school projects in
MCPS 6 year pipeline
(2027 MCPS CIP)

Montgomery Blair High School (Silver Spring)



View from NE, imagery via Apple Maps

Built 1998

Largest HS in MD (~3,200 students)

2 Magnet Programs

110.5% Capacity

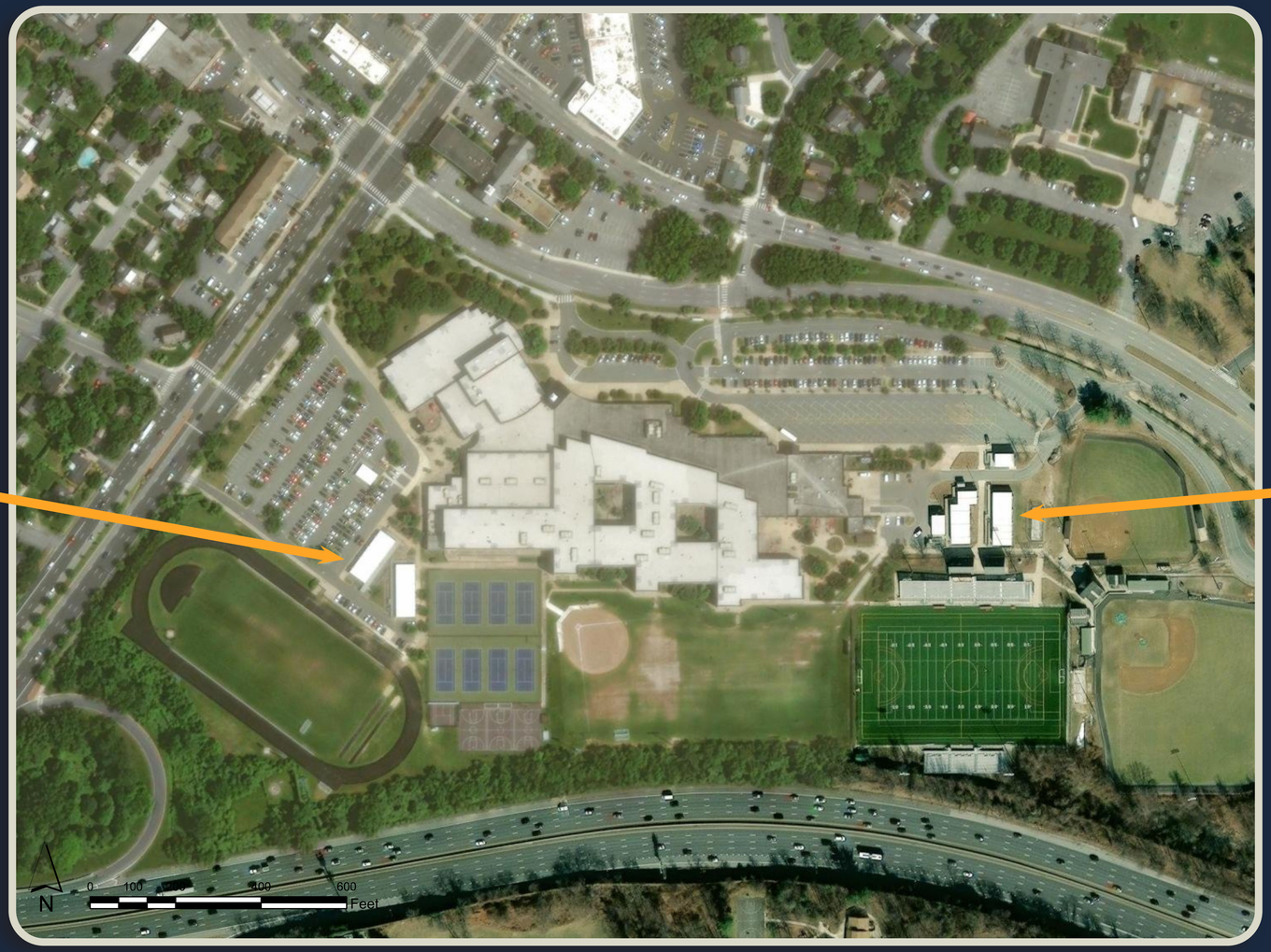
FCI Score: 55% (Needs Repair)

C.U.P.F.

Montgomery Blair High School (Silver Spring)



West Campus Portables



Existing Site Plan



East Campus Portables

Site Design

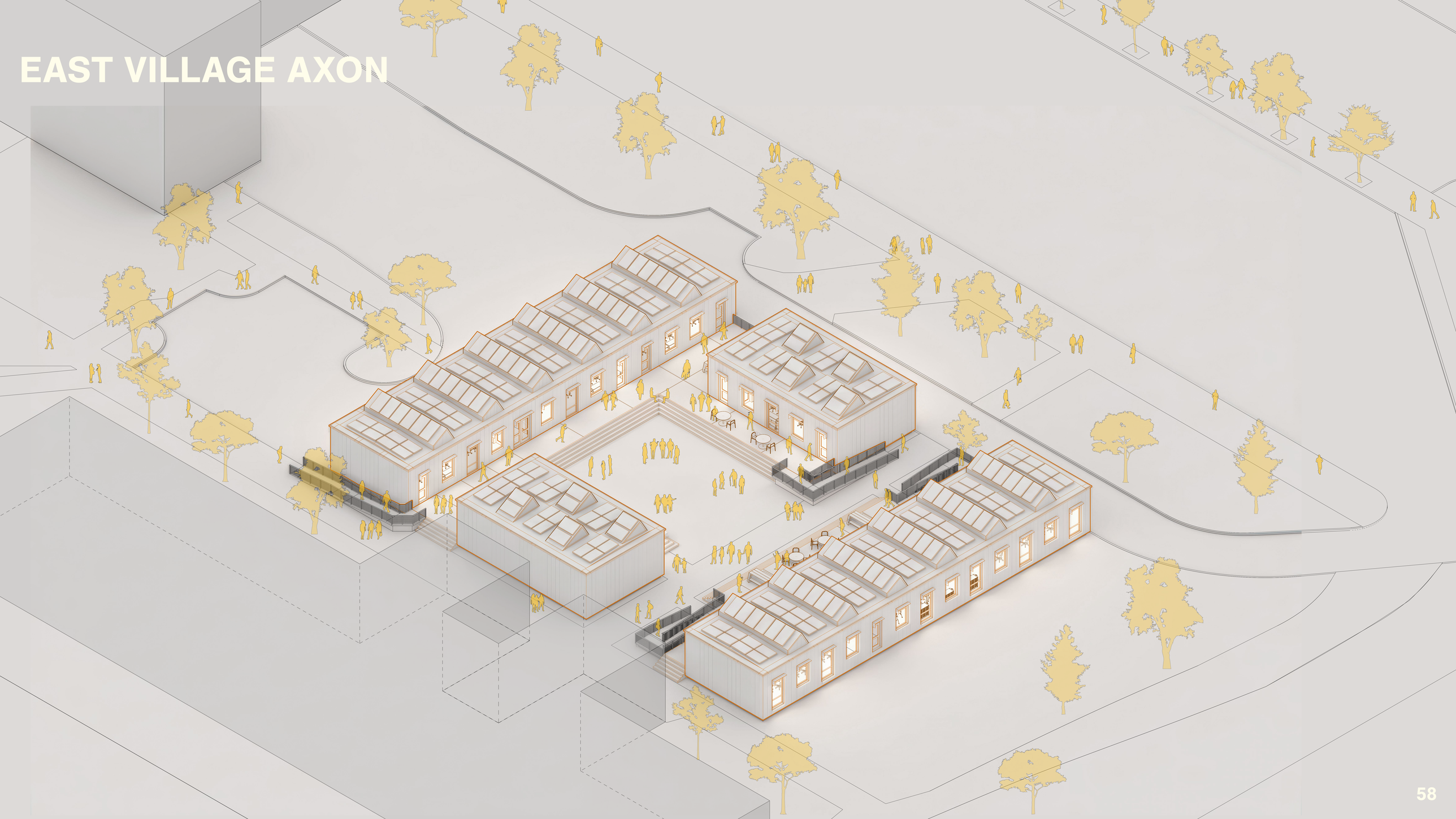


Proposed Site Plan

EAST VILLAGE PLAN



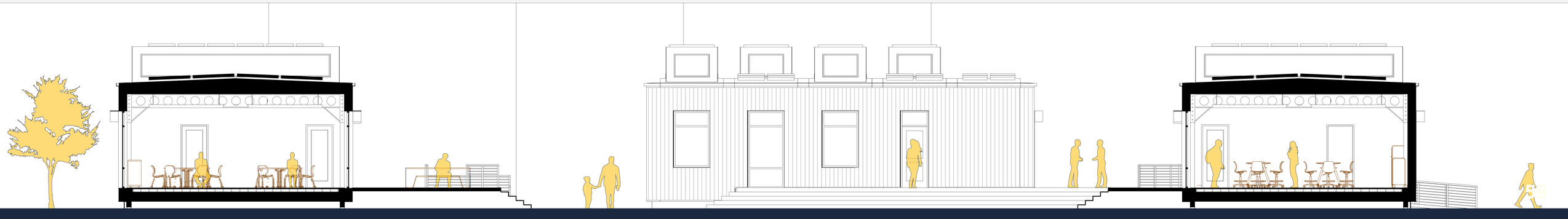
EAST VILLAGE AXON



SECTION C



SECTION D



EAST VILLAGE “FORUM”

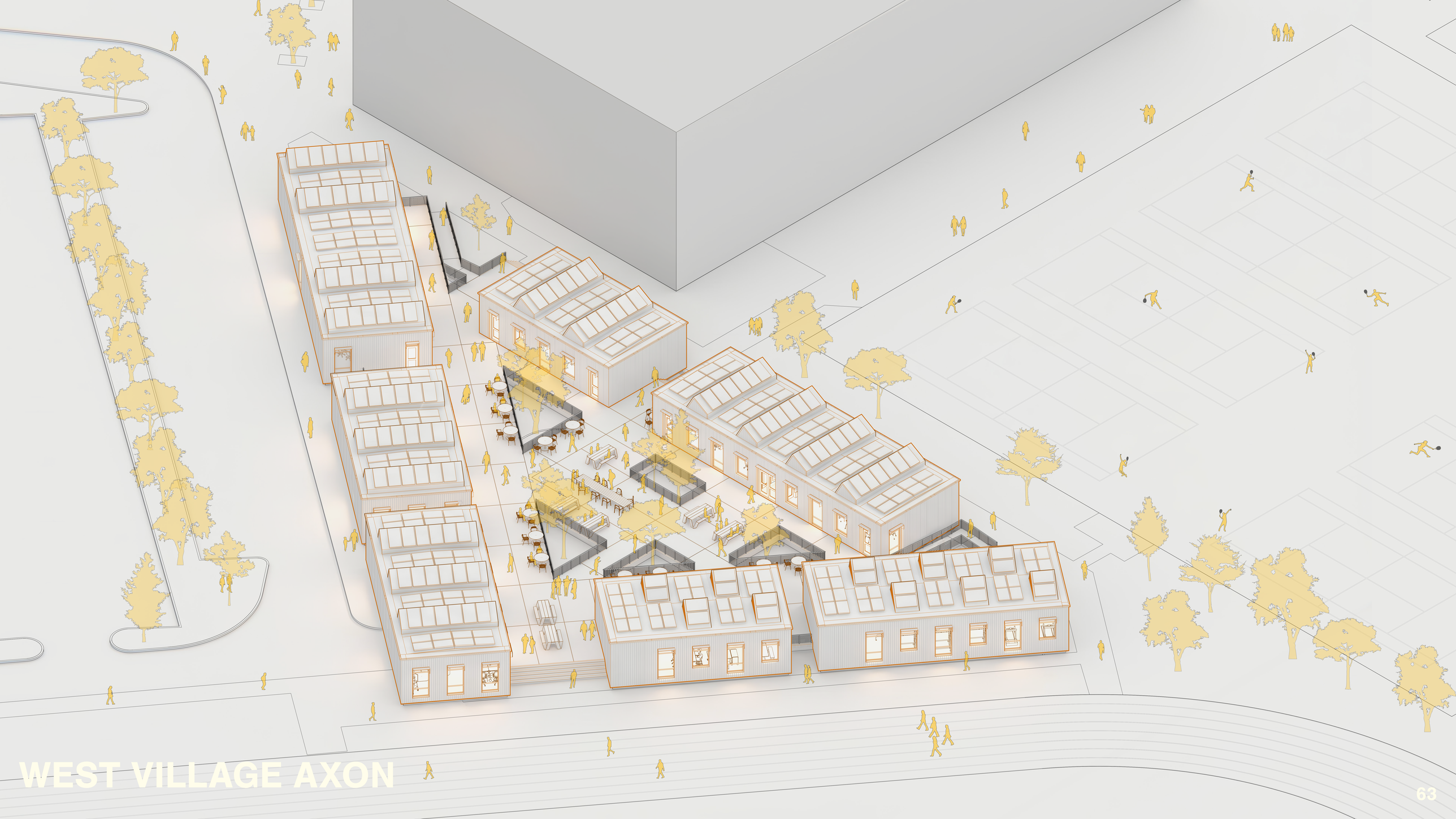


LAB/MAKERSPACE



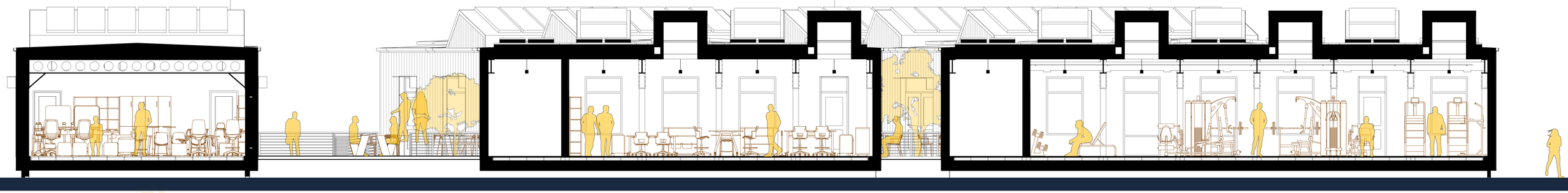
EAST VILLAGE PLAN



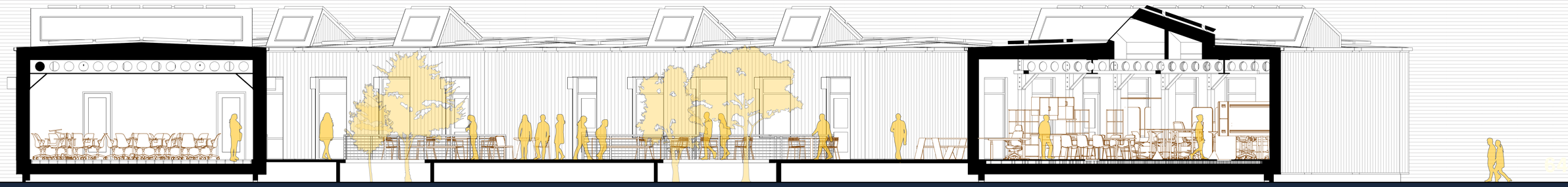


WEST VILLAGE AXON

SECTION A



SECTION B



WEST VILLAGE DECK



ACTIVE LEARNING CLASSROOM



GYM



Presentation Goals

1. **Consequences of Overcrowding**
2. **The Opportunity**
3. **Design Reponse**
4. **Site Selection & Application**

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THANK YOU



04

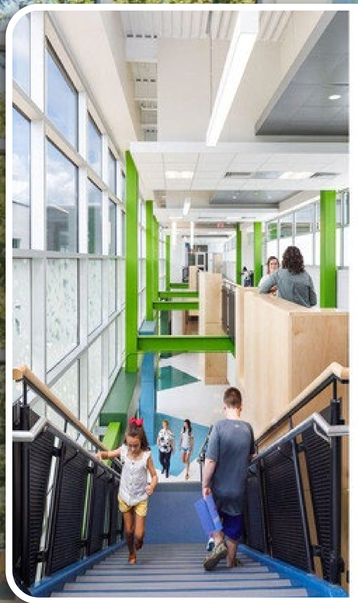
Appendices

Contextual Map

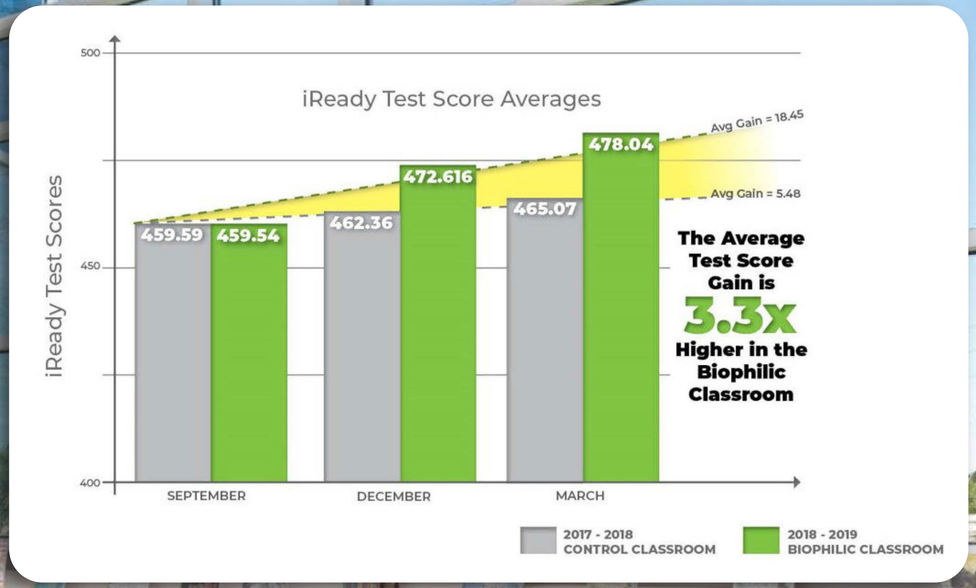


Improve

Learning Enviroment: Biophilia







Bethel-Hanberry Elementary | Craig Gaulden Davis, 2022 | Blythewood, SC

Photos by Kris Decker, Browning and Determan, 2024

Modify

Program: Beyond a “Classroom”

Academic Spaces (less Public access) ⟷ Extracurricular Spaces (More Public Access)

Science Lab



Library



Computer Lab



Fitness



Art/Makerspace



Breakout/Study Space



Active Learning Classroom



Active Learning Classrooms

"Students felt that the (ALC) design 'erased the line' between instructors and students... creating a sense of community and enhancing student engagement."

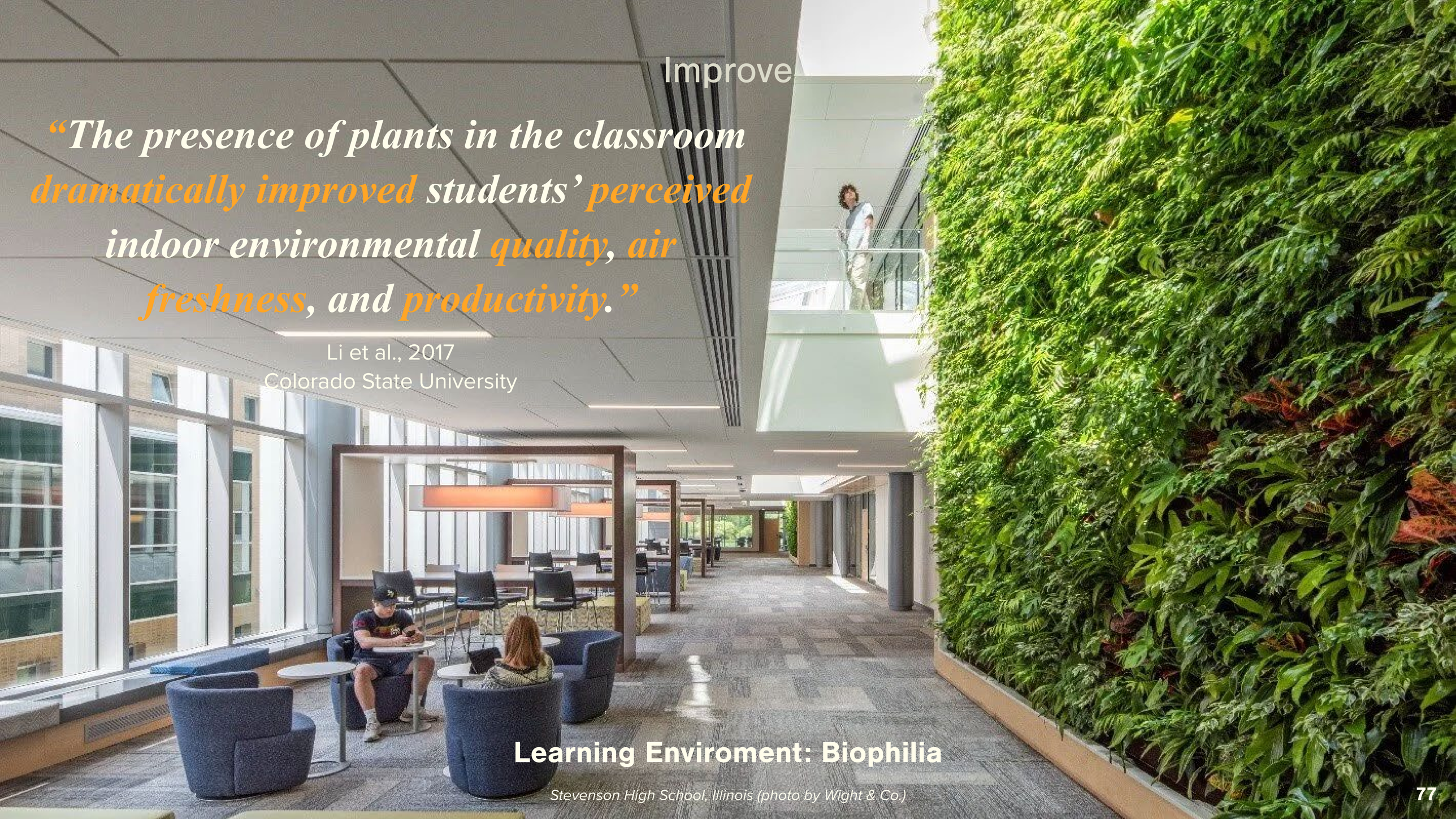
Rands and Gansemer-Topf (2017)



ALC in Edward St John Learning Center, UMD, (photo by Ayers Saint Gross)

"The presence of plants in the classroom dramatically improved students' perceived indoor environmental quality, air freshness, and productivity."

Li et al., 2017
Colorado State University



Learning Enviroment: Biophilia

Stevenson High School, Illinois (photo by Wight & Co.)