MICHIGAN FARMWORKER HOUSING

HEALTHY BUILDING: RECOMMENDED STANDARDS

TAUBMAN COLLEGE
ARCHITECTURE & URBAN PLANNING
UNIVERSITY OF MICHIGAN

U-M PUBLIC DESIGN CORPS

Michigan Department of AGRICULTURE & Rural Development

Summer 2024

Sections

Introduction

01_Environmental Systems
Reversible Heat Pump

Air Source Heat Pump System For Farmworker Housing

Agriculture in Michigan depends on rotations of domestic and migrant farmworkers. Farmworker housing may be in operation from early to late fringe season and must be kept at a comfortable temperature the entire duration of occupancy. Owners and operators of farmworker housing in Michigan are encouraged to invest in an air-source heat pump system, as a cost-effective, yet flexible building mechanical system that improves the comfort and livability of farmworker housing. Air source heat pump systems are capable of “reversing” from heating to cooling with the flip of a switch and offer many benefits over conventional mechanical systems.

Claim up to **30% tax credits** for heat pump project costs

Heat pump reach up to **300% to 400%** energy efficiency

Lower annual energy-related CO_2 emissions by **36% to 64%**

Long service life of around **20-25 years** with **low maintenance**

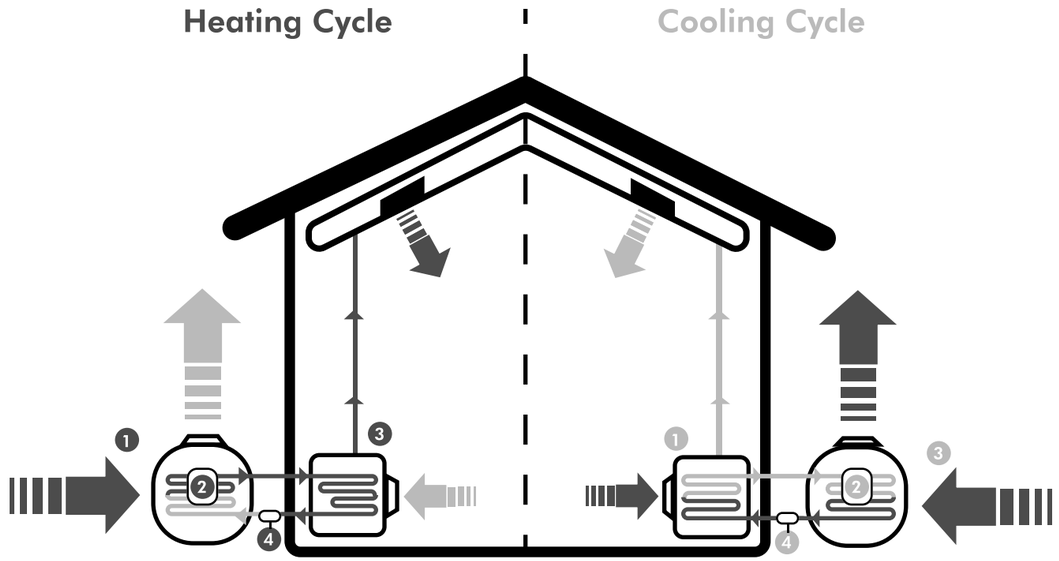
Benefits

- Low running costs can help to reduce building energy bills.
- Heat pumps operate using electricity and produce no emission during operations
- Operate at high efficiency through support from electricity and environment
- Modern heat pump units have life expectancies which are higher than average boiler system

Challenges

- Higher upfront installation cost, which could deter developers whom are averse to higher upfront costs.
- Less efficient in cold weather due to dependence on outdoor temperature conditions.
- Design, planning, and implementation process could be more complicated without professional services, especially within the context of farmworker housing.

System Diagram



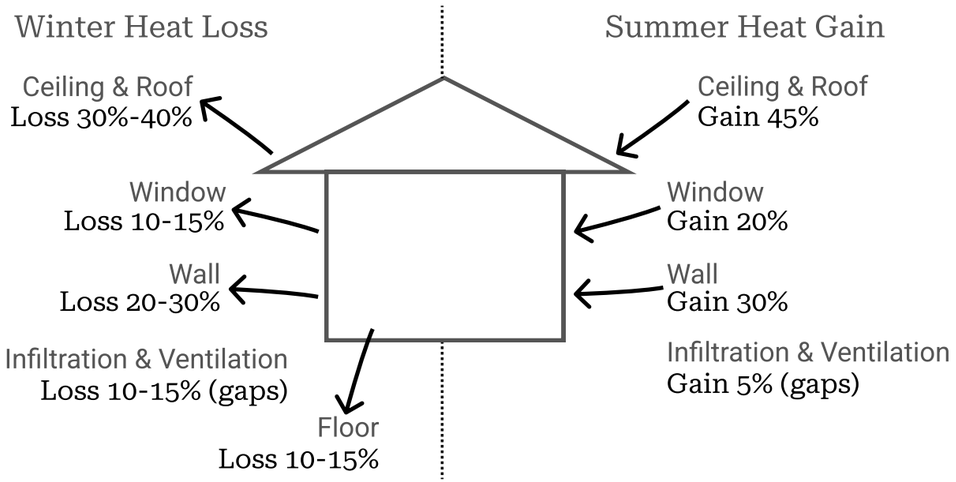
1. Heat from outdoor air is absorbed by liquid refrigerant, which evaporates in a low-temperature gas.
2. Compressor raises temperature and pressure of refrigerant gas
3. The high-temperature, high-pressure refrigerant gas releases heat to indoor air and condenses into a high-temperature refrigerant liquid.
4. The liquid refrigerant is passed through an expansion valve, relieving pressure and temperature as the cool refrigerant is cycled into the outdoor coil unit

1. The heat from warm air indoors is absorbed by a cool refrigerant coil, which evaporates into a low-temperature gas, and the cool air is ducted back throughout the building
2. Compressor raises temperature and pressure of refrigerant gas
3. Hot, high pressure refrigerant gas is passed through the outdoor coil, passing heat to outdoor air and condensing into a high temperature refrigerant liquid
4. The liquid refrigerant is passed through an expansion valve, relieving pressure and temperature as the cool refrigerant is cycled indoors

Insulation

Why Insulate?

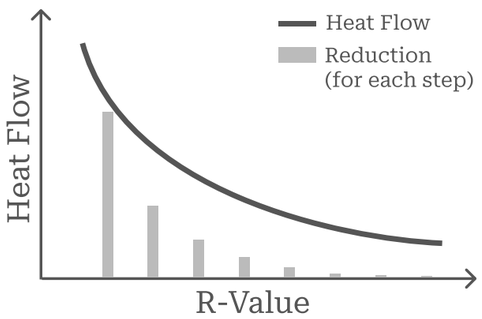
Without Insulation...



Approximate Winter Heat Loss and Summer Heat Gain

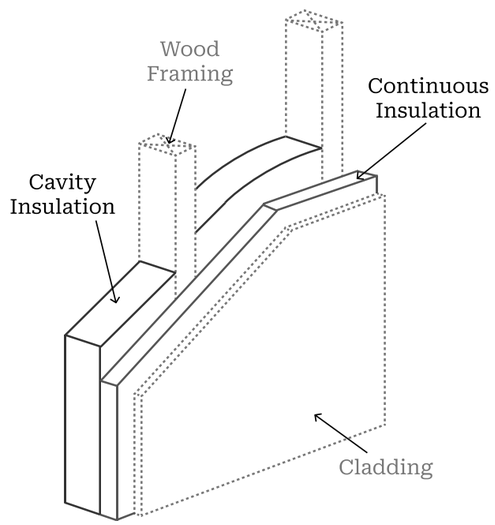
While using air conditioning/heating to sustain temperature spends energy dollars.

The "Diminishing Returns" of Adding More Insulation



Rule: Adding any insulation to uninsulated homes can save more energy than adding more insulation to already-insulated homes.

Types of Installations

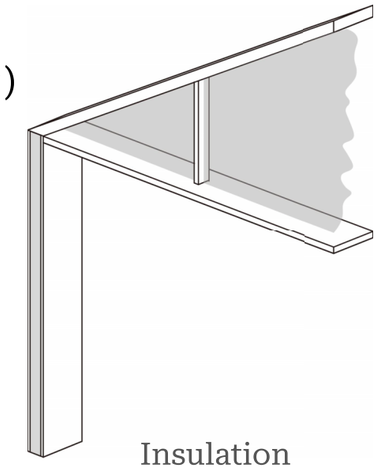


Insulation Strategies

Material Recommendation (Cavity)

Blown-in Cellulose:
- R13: Typically **$1.5** per square foot
- R49: Typically **$6.0** per square foot
- Pros: **Easy to install**, **Pest Resistant**
- Cons: **Packs down easily**, **Molding**

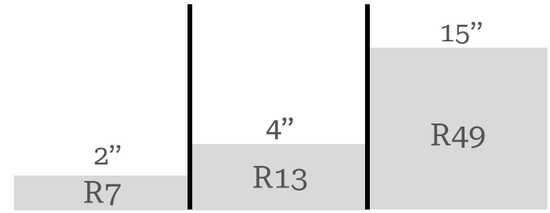
Blown-in Fiberglass:
- R13: Typically **$1.2** per square foot
- R49: Typically **$3.5** per square foot
- Pros: **Non-combustibility**, **Sound-dampening**
- Cons: **Coverage**, **Less effective to air leaks**



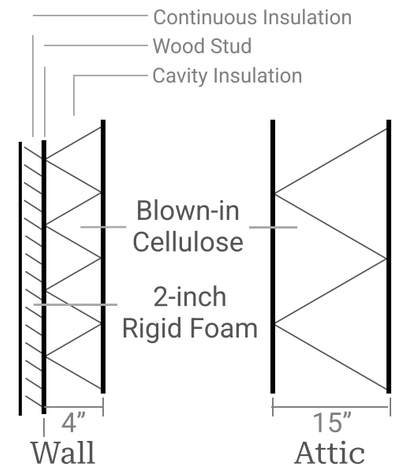
Insulation Placement

Thickness

The effectiveness of insulation improves with increased thickness.



Implementation Sample (Based on 2024 Market Value)



2,000 sqft R13 wall + 2,000 sqft R49 attic

Material Cost:
Cellulose: 2000 × $1.5 + 2000 × $6.0 = **$15,000**
Fiberglass: 2000 × $1.2 + 2000 × $3.5 = **$9,400**

Installation Cost: Typically **$2,000 - $3,000**

Overall Cost: **$11,400 - $18,000**

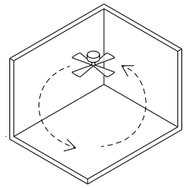
Savings: **$5,500/yr** if fuel is electricity

Payback for investment: **< 4 years**

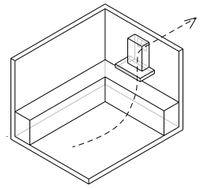
Ventilation

ACTIVE SYSTEMS:VENTILATION

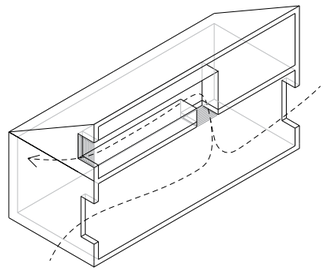
Active environmental systems use of electricity to regulate building temperature. A major active system is air ventilation, which can cool interior temperatures and circulate air in buildings. This is important for maintaining air temperature and air quality.



Ceiling Fans:
Offer cooling through air circulation. Great option when outside air quality is bad (eg: during wild fires)



Hood/Ceiling Vents:
Ventilates air out and helps air quality and prevent mold growth. Great for damp spaces like kitchens/bath-rooms.



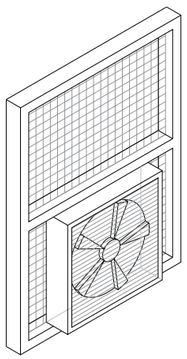
Whole House Fan:
Pulls cool outside air from windows and pushes hot inside air out through the attic. Whole house fans typically use less energy than air conditioners, and helps keep temperatures down.

The options listed above mostly deal with permanant systems that control air quality and temperature through air circulation. The following options cover varying A/C options.

Box Fans:
+Offers cooling through air circulation
+Cheap and available
+Portable

-May damage window screens
-Doesn't actually cool air

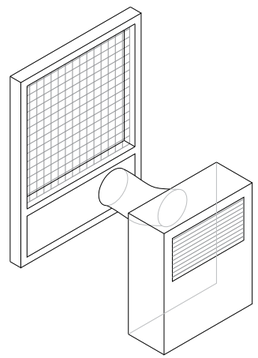
Air filters:
Box fans aren't designed for air filters in mind, however, there are DIY options and filters sold for window box fan set-ups.



Portable A/C Unit:
+Fairly affordable and available
+Works for varying window types
+Portable/easy to install

-May damage window screens
-Not as efficient as window units

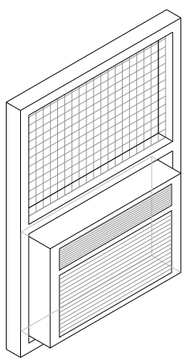
Air filters:
Air filters are often built into the portable units, with filters being washable and replaceable.



Window A/C Units:
+Fairly affordable and available
+More efficient than portable units

-Difficult to install
-Permanent

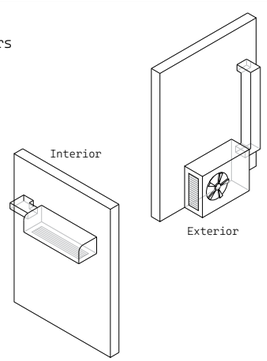
Air filters:
Similar to the portable A/C units, filters are also often built into window A/C units. There are often more filter options for window units however.



Mini-Split:
+Longer lifespan than others
+Cools larger area
+Energy efficient
+Can lower humidity

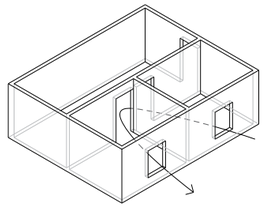
-Expensive up-front cost
-More complicated installation

Air filters:
Like the portable and window A/C units, Mini-Splits often have filters built into their system.

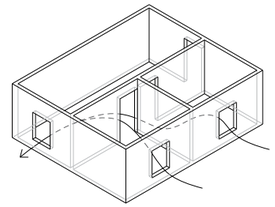


PASSIVE SYSTEMS:VENTILATION

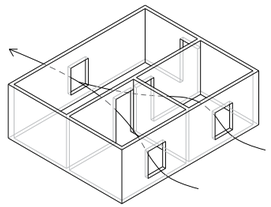
Passive environmental systems are a set of building techniques/features designed to keep buildings cooler in the summer and warmer in the winter, without the use of electricity. Some examples include window shades and insulation. These passive systems reduce the use of electricity which can reduce energy costs while making buildings more comfortable to live in. A major passive system is air ventilation. Proper ventilation of air can cool temperatures throughout a structure with the help of wind, while also improving inside air quality by bringing more outside air in.



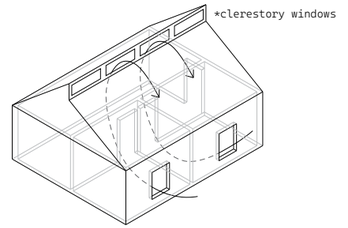
Single-Sided Ventilation:
Building only has openings on one side.
This is the least effective way of passive ventilation.



Angled Cross Ventilation:
Building only has openings on two sides, but not on opposite sides. Ventilation is better than single-sided.

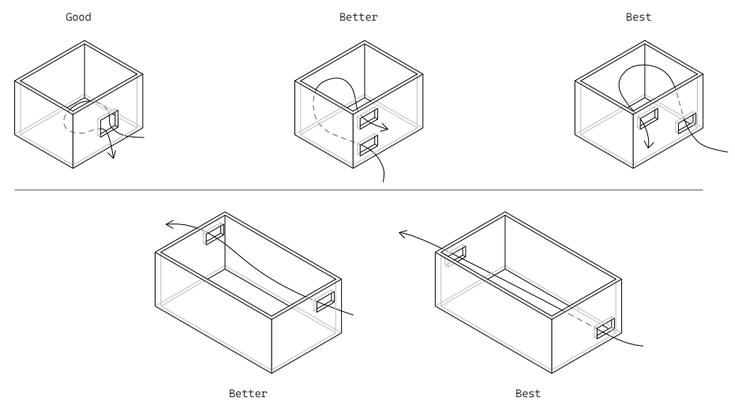


Cross Ventilation:
Building only has openings on opposite sides.
This is one of the most effective ventilation methods, with air exchange being high.



Stack Ventilation:
Building has windows at a high location.
One of the most effective methods, as the height difference allows hot air out and cool air in.

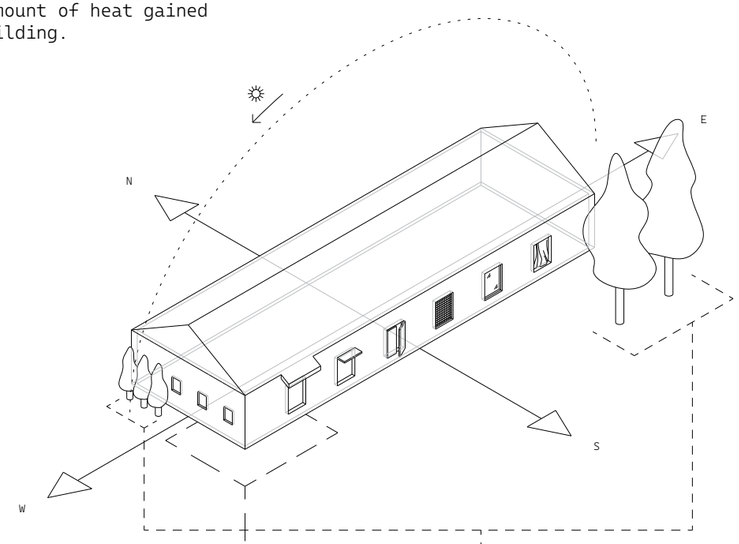
The height placement of windows matters as well. **Windows that are placed at different heights, as well as on different sides of walls are able to circulate more air throughout a space.** This is because the height difference between windows creates a pressure difference, leading to more ventilation. These windows also allow for higher hot air to flow out and lower cool air to come in.



Shading

PASSIVE SYSTEMS:SHADING

Proper shading reduces the amount of sun that gets into the building through window/door openings,which reduces the amount of heat gained inside the building.

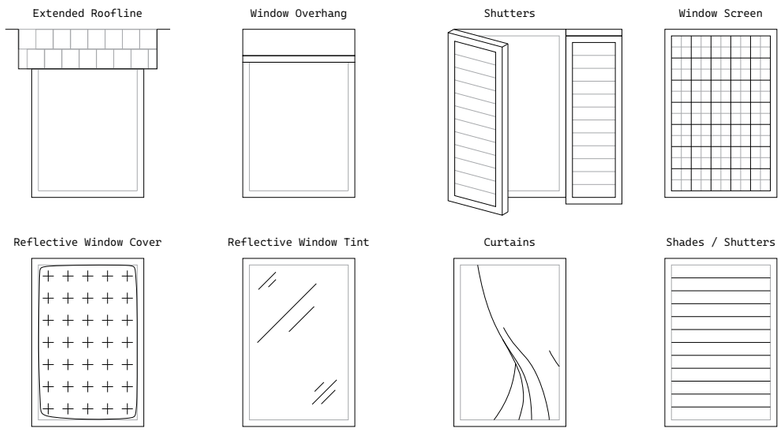


Smaller East/West facing windows on the side of buildings will reduce the amount of light and heat let in by intense morning and late afternoon summer sunlight.

Trees and other vegetation on the sides of the building, in particular the South side,reduce the amount of direct sunlight contacting the building,reducing the amount of heat gained.

There are various kinds of window coverings and shades that can reduce the amount of sunlight let in throughout the day.

However, although they are more exposed to the elements, **exterior shading options are more effective than interior shades** like curtains or window covers. This is because exterior coverings prevent direct sunlight from contacting the window glass/pane. This reduces the amount of direct sunlight that the building interior comes into contact with.



02_Site Strategies

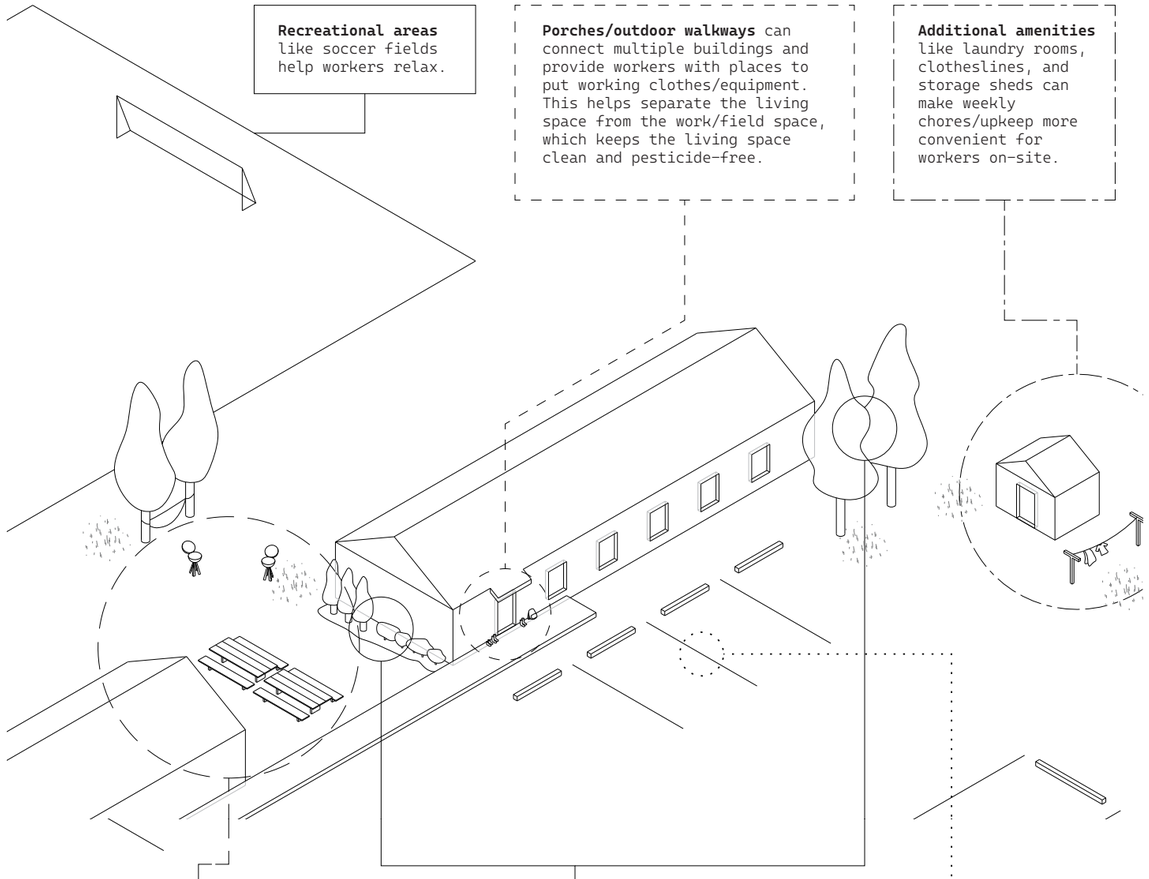
Landscape

Carefully considered outdoor areas and siting strategies can lessen the heat load within dwellings while also improving the quality of life for migrant workers. Investing in the quality of worker living conditions can lead to a more healthy and productive workforce.

Recreational areas like soccer fields help workers relax.

Porches/outdoor walkways can connect multiple buildings and provide workers with places to put working clothes/equipment. This helps separate the living space from the work/field space, which keeps the living space clean and pesticide-free.

Additional amenities like laundry rooms, clotheslines, and storage sheds can make weekly chores/upkeep more convenient for workers on-site.



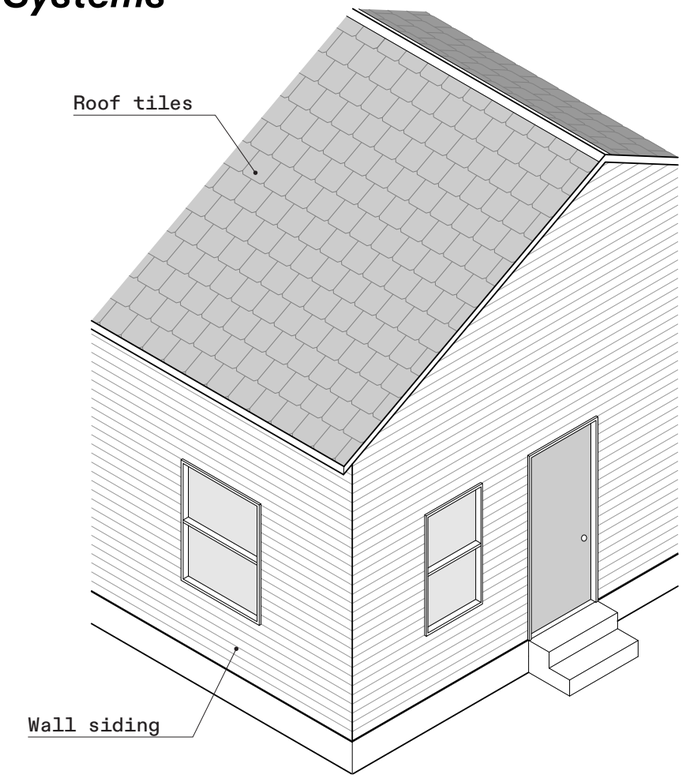
Outdoor cooking and eating areas can reduce the amount of indoor heat and moisture that accumulates from cooking inside. These areas can accomodate multiple users and can reduce the usage of more expensive indoor appliances. These areas can also help foster a sense of community.

Trees/vegetation on the south and east/west sides of buildings can reduce the amount of solar heat a building gains throughout the day. Planting trees/plant species that are low maintenance and suitable for Michigan's climate can help minimize upkeep efforts and costs.

Designated parking spaces a convenient distance away from the residence give workers a clear place to park while separating pedestrian and vehicular areas.

03_Materials and Fixtures

Cladding Systems



SIDING CHOICES

VINYL

+ Least upfront cost
+ Rot resistant, low maintenance

– Prone to warping and fading
– Not environmentally friendly material

FIBER-CEMENT

+ Excellent fire resistance
+ Lasts 30-50 years

– Higher upfront cost
– Requires specialized labor

WOOD

+ Sustainable and biodegradable
+ Natural insulation properties

– Higher upfront cost
– Requires regular maintenance

METAL

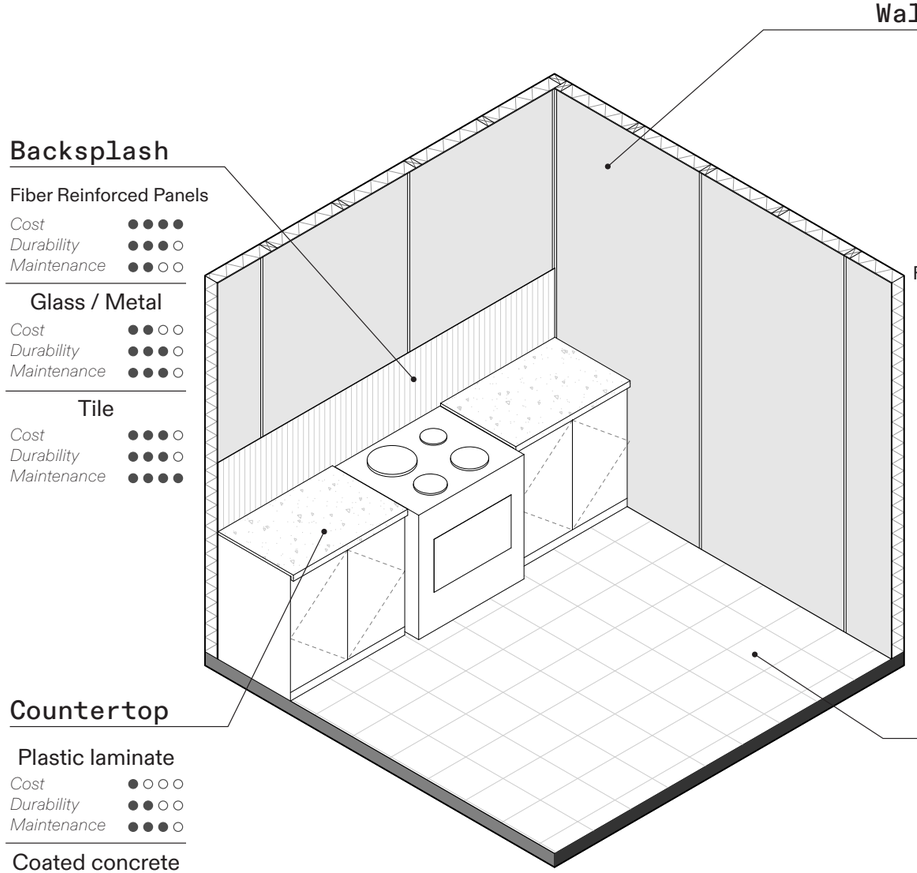
+ Highly durable and weatherproof
+ Low maintenace
+ Can be recycled

– Higher cost upfront
– High surface temperature in summer

Interior Finishes

Score Guidelines:
Cost (*) *price of upgrade and labor (higher score = more affordable)*
Durability *lifespan and damage resistance*
Maintenance *ability to clean and ease of care*

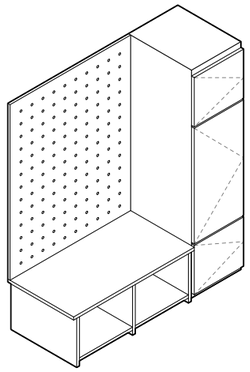
**based on 2024 market price*



FINISHES SUGGESTION

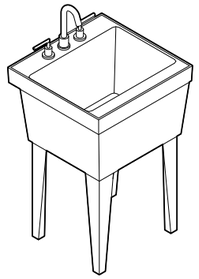
Learn more at www.michigan.gov/mdard/environment/migrantlaborhousing

Personal Space Recommendations



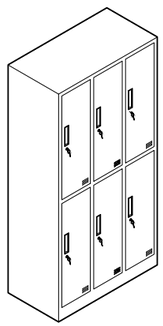
Mudroom

A mudroom with benches, hooks, and storage bins to keep field gears separate from living area. The flooring in the mudroom is designed to withstand heavy traffic and is made from easy-to-clean materials like tile, stone, or vinyl.



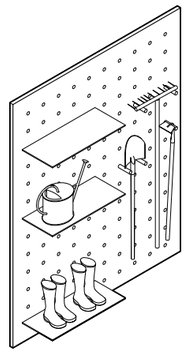
Sanitation station at Entryway

Handwashing and sanitation stations near the entry to maintain cleanliness. These stations should be equipped with soap, water, hand sanitizers, and paper towels or air dryers. Clear signage should be provided to guide individuals to these stations, emphasizing the importance of hand hygiene.



Personal lockers

Chests, trunks, bed with storage for personal valuables, offering ample space and often feature locks and decorative designs while maximizing space efficiency in small living areas.



Shelving units

Keep work clothes, which may have been exposed to pesticides, separate from the living areas; ensure that farmworkers maintain a healthier living environment.

04_Resources
Energy Rebate Program

PROGRAM BACKGROUND

The Inflation Reduction Act (IRA), signed into law on Aug. 16, 2022, provisions a combined $8.8 billion dollars of Home Efficiency Rebates (IRA Section 50121) and Home Electrification Rebates (IRA Section 50122) to be administered through state energy offices. The Michigan Department of Environment, Great Lakes, and Energy (EGLE) is preparing to open the combined Home Energy Rebate Program to households in October 2024* to distribute $211.1 million in energy rebates to single- and multi-family households across the state. While the rebate program design and requirements have yet to be finalized, details shared at a series of town halls throughout 2024 as well as guidelines within the IRA itself lay out broadly the parameters of the program.

MICHIGAN'S $211M FUNDING ALLOCATION

HOME EFFICIENCY REBATES: $105.9M

- Whole-house energy saving retrofits
- Additional low-income (< 80% AMI) incentives
- For 20% modeled or 15% measured energy savings

ELECTRIFICATION AND APPLIANCE REBATES: $105.3M

- Rebates for qualified electrification projects
- Additional low-income (< 80% AMI) incentives

QUALIFIED PRODUCTS AND MAX. REBATE:

Heat pump, space heating/cooling	$8,000
Heat pump, hot water	$1,750
Heat pump, clothes dryer	$840
Electric kitchen oven/cooktop	$840
Insulation, air sealing, and ventilation	$1,600
Electric wiring	$2,500

TAX REBATE PROCESS: HOW IT WORKS

Target Owners

- Housing built prior to 1980
- Leverage utility data
- Need heating/cooling and insulation upgrades
- Work with Regional Inspectors

Home Assessment and Data Analysis

- Building Performance Assessment
- Visual/infrared inspection of equipment
- Airtightness testing

Rebate Eligibility Identified

- Combine with other state and federal rebates

Scope Agreement Signed

- Project Budget Finalized

Energy Upgrades

- Performed by certified contractor
- Free disposal of old equipment

Performance Verification

- Warranty paperwork filed
- Streamlined maintenance

***Program launch date tentative. Please refer to EGLE for latest information.**

https://www.michigan.gov/egle/about/organization/materials-management/energy/rfps-loans/home-energy-rebate-programs

Conclusion

Credits