Can a housing system be designed to cope with the rapid housing demand of an oil boom in rural North Dakota and be maintained or removed when the boom subsides?
typology

Temporary housing development

claim

Without proper development and planning, an oil boom community is at risk of an economic failure.
A community experiencing or anticipating an oil boom can be severely burdened if they are not prepared.

A rural town must take appropriate action to plan and develop adequate housing for migrant workers flooding into its community in order to protect its existing housing market and economy.

A community’s population may be multiplied during an oil boom and with an influx in citizens comes an increase in housing demand.

A thoroughly composed development strategy is necessary to protect the community during a period of transition.
An architecture that can meet the rapid housing demand of migrant workers and either accommodate their families for prolonged residency or be disassembled and relocated for future use, will greatly enhance the sustainability of a community.
key concepts

Provide a temporary housing development to accommodate oil field employees or other rural workforces and their families.

The project will embody a self-sufficient approach in an effort to relieve rural communities from an overwhelming population increase of migrant workers.

The temporary housing will exist with little or no aid from outside infrastructure, allowing it to be implemented anywhere there is a demand.

Construction methods and materials are explored to produce a housing system which is not only easily and efficiently assembled and disassembled, but also directly reusable for future application.

Sustainable products and systems will allow for the generation of renewable energy and make self-sufficient living possible.
site selection

Upper Midwest

Stanley, North Dakota

North Dakota

Site
The chosen site is located in Stanley, North Dakota, at the epicenter of an oil boom. Located just inside city limits, the site is in close proximity to the railroads tracks, providing an efficient option for transportation of the Boom Abodes. The design of the housing units is driven by climatic influences and sustainable strategies.
Private Spaces

- Housing Units suitable for families
- Housing Units suitable for a workforce

Public Spaces

- Community Parks
- Multi-purpose Community Buildings
- Community Management Offices
- Community Maintenance Building
process
models
final design
family unit plan

- bedroom
- bath
- kitchen
- mechanical
- dining
- living room
- entry
- storage
- bedroom
- car port
interior perspectives

living room

kitchen
EXPLODED ISOMETRIC

- Photovoltaic Panels
- Insulated Roof Panels
- Glu-Lam Beams with Strong-Tie Connections
- Operable Transome Windows
- Perforated Weather Screen
- Insulated Sub-Floor
- Adjustable Foundations
- Sub-Floor Skirting
- Utilidor
- Elevated Vehicle Pad
- Raised Floor System
- Structurally Insulated Panels
- Horizontal Louvers
- Portable Living Unit
Operable exterior solar shades on the south and east facades help regulate solar heat gains and also act as a light shelf bouncing light into the spaces.

Transome windows on the north and west facades of the house bring natural light into the living and kitchen spaces.

Photovoltaic panels and solar thermal panels provide all the electricity and hot water consumed by the residence.

Adjustable footings allow flexibility and adaptation to any terrain.

Structurally insulated panels with aerogel provide an R-value per inch of 40-50.

Operable exterior solar shades on the south and east facades help regulate solar heat gains and also act as a light shelf bouncing light into the spaces.

A raised floor system houses electrical, plumbing and HVAC components.
construction
sequence
portable living unit
portable living unit

section perspective
- units are delivered flat-packed to the site by either truck or rail
- adjustable footings mean the units do not require a level site or foundations and can be deployed almost anywhere

- the skirting around the sub-floor and footings provides additional insulation and prevents snow build-up
raised floor system

- the raised floor system provides space underneath the floor to house electrical, plumbing and HVAC components
- the raised floor is also integrated with a radiant heating system
structurally insulated panels (SIPs)

- structurally insulated panels are supplied in five families: interior, exterior, polycarbonate, sub-floor and roof.
- every panel is universal in size and can be interchanged with any other panel within its family, thus creating flexibility.
- panels are kept to a dimension which requires minimal crane assistance.
- the panels are connected via cam-lock requiring only a wrench.
structurally insulated panels (SIPs)

- the SIPs are insulated with a composite material consisting of compressed wheat straw, an agricultural waste product which could be manufactured locally
- a large variety of exterior panel finishes allows residence to personalize the appearance of their homes

- polycarbonate panels are lightweight, temperature resistant, recycleable, and virtually unbreakable
- panels are filled with aerogel, the lightest know solid
- aerogel is an excellent insulator and is semi-transparent allowing light to filter into the house
- an open cell ceiling allows for flexible lighting fixture placement
- glu-lam beams are connected to the SIPs via Simpson Strong-Tie hangers
- the roof panels are assembled with the aid of a small crane
- transome windows along the north roof facade allow daylight to penetrate into the house
- photovoltaic panels are comprised of solar cells which generate electricity from sunlight, reducing electricity bills and environmental impact.

- horizontal louvers on the east and south walls shade the translucent walls from direct sunlight, reducing unwanted heat gains.

- a weather screen placed on the west facade of the house sheds rain and snow before it can contact the wall preventing moisture intrusion.
passive ventilation
passive daylighting
noon sun in summer

noon sun in winter
ROOF COLLECTION AREA: 1,344sf

SOLAR COLLECTION: 230W Solar Photovoltaic Module
Polycrystalline silicon cells
BP3210T

1,344sf collection area divided by 17.5sf/panel
= 60 panels
x 230W/panel
= 13,800W (13.8 kW)

Average production for 5 hours per day
13.8kW x 5hrs x 365 days
= 25,185 kWh/yr.

Annual electricity usage: Household average per month = 1,150 kWh
1,150kWh x 12mo. = 13,800 kWh/yr.

PRODUCTION: 25,185 kWh/yr. = 182% of consumption

Excess AC power generated is sold back to the grid and used by the utility company. The house will use electricity from the city grid during non-solar harvesting times.
Average precipitation: 18”/ year
Collection roof area: 1,600 sf

Water collection: \( SF \times \text{inches/year} \times \frac{0.5618}{\text{in. to gal.}} = \text{gallons/year} \)

\[ 1,600 \text{ sf} \times 18”/\text{yr.} \times 0.5618 = 16,180 \text{ gallons/year} \]

Divided by 52 weeks
\[ = 311 \text{ gallons/week available} \]

5 months draught (<1in. rainfall)
\[ \times 4 \text{ weeks/month} = 20 \text{ weeks} \]
\[ \times 311 \text{ gallon/week budget} = 6220 \text{ gallon supply for draught} \]

Consumption: 29.5 gallons/day average per person
\[ \times 4 \text{ people per household} = 118 \text{ gallons/day} \]

\[ 118 \text{ gallons/day} \times 365 \text{ days} = 43,070 \text{ gallons/year consumed} \]

16,180 gallons/year collection = 37% of consumed water
rainwater harvesting system

RAINWATER

DEBRIS FILTER
CISTERN
PRESSURE PUMP
PRESSURE TANK
PARTICLE FILTERS
CARBON BLOCK
ULTRAVIOLET LIGHT FILTERS
PRESSURE PUMP
HOLDING TANK
SOLAR THERMAL
HOT WATER
DOMESTIC USE

WATER MAIN
(MUNICIPAL)

GREYWATER

WASTEWATER TREATMENT SYSTEM
20' and 40' Shipping Container Biofilters
SC-20 treats 5,300 gpd
= approximately 40 people
(10 homes)
SC-40 treats 10,600 gpd
= approximately 80 people
(20 homes)

BLACKWATER
SEWER

GREYWATER

WC

BLACKWATER
**pex plumbing** - pex tubing is flexible allowing the freedom to run pipes anywhere in the house

**utilidor** - an above ground plumbing system that carries and insulates pipes
alternative layouts
workforce unit

section perspective
community layout
- family units
- workforce units
- multi-purpose buildings
- additional structures
- community parks
- community circulation
- family units are oriented on the site to create interior courtyard spaces and to also have direct access to a road
- each group of units is supported by a water treatment module placed within the courtyard
- located at the northeast corner of the site, the workforce units are provided easy access to both entrances, thus minimizing disturbance to the rest of the community from coming and going pickup trucks
- oriented on site to create separation between family and workforce units
- creates job opportunities for community residence

functions
- convenience / grocery store
  - open market
- restaurant / bar / coffee shop
- retail
  - workforce clothing and essentials
- fitness center
- game room
- bingo / dance hall
additional structures

community management offices
- including a day-care facility
- adjacent to community park

maintenance building
- store maintenance vehicles
- additional building components

solar powered tree street lights
- provide safety and security
- bring an artificial nature into the community

bus stop shelters
- also services a bicycle sharing program
parks
- create spaces for a variety of outdoor activities
- the large southern park helps create distance and a noise buffer from the railroad tracks
community circulation

roads - gravel or scoria
- allow for efficient delivery of units

recreation path - gravel, mulch or roll-out paths
community layout
birds-eye perspective
family units
birds-eye perspective
workforce units
questions & comments