PHNW 2016 CONFERENCE
SCALING PASSIVE HOUSE

Creating Lasting Value through Sustainable Real Estate

The Arnold Development Group LLC
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• Changes in Demographics and Housing Preferences
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• A New Model for Urban Housing
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• Cost Benefit
History of Residential Typologies in the United States from 1900-2015
Tenement
Belnord Hotel - Apartments for the affluent.
Changes in Demographics and Housing Preferences

Sustainable Development Opportunity

### DISTRIBUTION OF HOUSEHOLDS WITH AND WITHOUT CHILDREN, AND SINGLE-PERSON HOUSEHOLDS, 1960, 2000, AND 2030

<table>
<thead>
<tr>
<th>Household Type</th>
<th>1960</th>
<th>2000</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Households with Children</td>
<td>48%</td>
<td>33%</td>
<td>27%</td>
</tr>
<tr>
<td>Households without Children</td>
<td>52%</td>
<td>67%</td>
<td>73%</td>
</tr>
<tr>
<td>Single-Person Households</td>
<td>13%</td>
<td>26%</td>
<td>28%</td>
</tr>
</tbody>
</table>

### SUMMARY OF HOUSING PREFERENCE SURVEYS

<table>
<thead>
<tr>
<th>Housing Type</th>
<th>Detailed Share</th>
<th>Total Type Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attached</td>
<td>38%</td>
<td></td>
</tr>
<tr>
<td>Apartment</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Townhouse</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Condominium/Cooperative</td>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>Detached</td>
<td>62%</td>
<td></td>
</tr>
<tr>
<td>Small Lot</td>
<td>37%</td>
<td></td>
</tr>
<tr>
<td>Large Lot</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>Total “new urbanity” preference (attached + small lot detached)</td>
<td>75%</td>
<td></td>
</tr>
</tbody>
</table>

### PROJECTED HOUSING DEMAND COMPARED TO CURRENT SUPPLY

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Attached, all types</td>
<td>39,093</td>
<td>38%</td>
<td>55,242</td>
<td>16,149</td>
<td>60,521</td>
<td>5,279</td>
<td>21,429</td>
<td>52,678</td>
</tr>
<tr>
<td>Small lot</td>
<td>25,337</td>
<td>37%</td>
<td>53,789</td>
<td>28,542</td>
<td>58,920</td>
<td>5,140</td>
<td>33,592</td>
<td>62,922</td>
</tr>
<tr>
<td>Large lot</td>
<td>63,773</td>
<td>25%</td>
<td>36,344</td>
<td>(27,430)</td>
<td>39,817</td>
<td>3,473</td>
<td>(23,957)</td>
<td>63,290</td>
</tr>
<tr>
<td>Detached total</td>
<td>89,110</td>
<td>62%</td>
<td>90,132</td>
<td>1,022</td>
<td>98,745</td>
<td>8,613</td>
<td>9,635</td>
<td>108,365</td>
</tr>
<tr>
<td>Total</td>
<td>128,203</td>
<td>145,374</td>
<td>17,171</td>
<td>159,267</td>
<td>13,892</td>
<td>31,064</td>
<td>44,256</td>
<td>189,321</td>
</tr>
</tbody>
</table>

In 2030, only 27% of U.S. Households will have Children

75% of U.S. Households prefer to live where they could walk to more destinations.

44.5 million new attached and small lot detached units will need to be built between now and 2020 to meet the demand.
Examples of Successful Walkable Urban Neighborhoods

SANTANA ROW, SAN JOSE

RIVER MARKET, KANSAS CITY

LODO, DENVER

PEARL DISTRICT, PORTLAND
About the Arnold Development Group

Investment Philosophy

People + Profit + Planet

Certified

the change we seek™
Primary Challenges

Climate Change

“Climate change is the challenge of our time.”

Henry Paulson
Former Treasury Secretary

Buildings account for 40-70% of carbon emissions. We need to change the way we build.

2 or 4 degree rise in temperature?

How we respond to this challenge will largely determine the kind of world we leave our children and grandchildren.
Primary Challenges

Income Inequality

Stagnant wages are eroding the middle class.

(Limiting who can afford market rate housing.)
Walkable neighborhoods require a critical mass of residents to financially support service retail. **40-70 dwelling units per acre** will achieve this critical mass.
Urban Villages

- Great cities are made up of lots of urban villages.
- Often helped by clearly defined boundaries either natural (Hudson River) or fabricated (Houston Street).
- 1/4 mile radius.
- Wide range of services.
- Served by Transit
Last Generation Development Model

The business model of most merchant builders is to create structures as cheaply as possible and sell them to a REIT, Life Insurance Company or Pension Fund.

The long term consequences are left for the institutional investors and the municipality to contend with.

Problems with Stick Construction:

- Not Flexible - Cannot change use.
- Thin walls allow sound to transfer easily.
- Poorly insulated and energy inefficient.
- OSB absorbs moisture for long periods of time which mold and cause hidden health hazards.
- Require large capital expenditures to maintain buildings over time.

While stick-built construction offers a low cost alternative to concrete construction, over time the structure becomes susceptible to mold.
About the Arnold Development Group

Long Term Investment Philosophy

- Build high performance real assets that outperform the current model financially, socially and environmentally.
- Combine best practices in building science, transportation, and urban food production to increase competitive

CORE COMPONENTS TO ADG DEVELOPMENTS

Super Insulated Envelopes
Reducing energy costs by 70%

Urban Gardens
Producing food and strengthening communities.

Livable Density
Making density attractive, secure and desirable.

Concrete Structures
Making long lasting and adaptable buildings.
The Future We Want

Jonathan Arnold and Bill Becker co-founded the project then partnered with the United Nations.

A 5-year initiative to fill the “vision vacuum” in the sustainability space.

A replicable model for envisioning sustainable communities around the world.

“We need everyone — Government Ministers and policymakers, business and civil society leaders, and young people — to work together to create a future worth choosing, a future we want.”

- Secretary General Ban Ki-Moon
Conclusions after working with the United Nations

• We have all the technologies we need to create long lasting economically resilient environments.

• We need profitable models for smart growth developments that can be easily replicated.
Siloed Thinking addresses issues as distinct “Problems” to be solved individually.

Systems Thinking considers the interdependence of objects and their attributes.
The New Development Model

Goal: Reduce HH Expenditures through Sustainable Design

Replicable model to reduce these household expenditures.

Living in transit oriented neighborhoods can reduce transportation costs by 70%.
## The New Development Model

### Workforce Housing

20% of Units Reserved for 50% AMI

Reserving units for workforce housing increases social equity

### Unit Mix

<table>
<thead>
<tr>
<th>Unit Mix</th>
<th># of Units</th>
<th>Ave. Sq. Ft.</th>
<th>Total Sq. Ft.</th>
<th>Current Appraisal</th>
<th>Annual Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit I - Studio</td>
<td>44</td>
<td>550</td>
<td>24,200</td>
<td>930 $</td>
<td>40,920 $</td>
</tr>
<tr>
<td>Unit IA - Studio 50%</td>
<td>14</td>
<td>550</td>
<td>7,700</td>
<td>531 $</td>
<td>7,434 $</td>
</tr>
<tr>
<td>Unit H1 - 1 Bed / 1 Bath</td>
<td>29</td>
<td>644</td>
<td>18,676</td>
<td>1035 $</td>
<td>30,015 $</td>
</tr>
<tr>
<td>Unit H1A - 1 Bed / 1 Bath 50%</td>
<td>7</td>
<td>644</td>
<td>4,508</td>
<td>557 $</td>
<td>3,899 $</td>
</tr>
<tr>
<td>Unit H2 - 1 Bed / 1 Bath</td>
<td>10</td>
<td>700</td>
<td>7,000</td>
<td>1075 $</td>
<td>10,750 $</td>
</tr>
<tr>
<td>Unit H2A - 1 Bed / 1 Bath 50%</td>
<td>3</td>
<td>700</td>
<td>2,100</td>
<td>557 $</td>
<td>1,671 $</td>
</tr>
<tr>
<td>Unit H3 - 1 Bed / 1 Bath</td>
<td>57</td>
<td>850</td>
<td>48,450</td>
<td>1200 $</td>
<td>68,400 $</td>
</tr>
<tr>
<td>Unit H3A - 1 Bed / 1 Bath 50%</td>
<td>11</td>
<td>850</td>
<td>9,350</td>
<td>557 $</td>
<td>6,127 $</td>
</tr>
<tr>
<td>Unit G - 2 Bed / 2 Bath</td>
<td>13</td>
<td>850</td>
<td>11,050</td>
<td>1300 $</td>
<td>16,900 $</td>
</tr>
<tr>
<td>Unit GA - 2 Bed / 2 Bath 50%</td>
<td>3</td>
<td>850</td>
<td>2,550</td>
<td>668 $</td>
<td>2,004 $</td>
</tr>
<tr>
<td>Unit E - 2 Bed / 2 Bath</td>
<td>24</td>
<td>1,050</td>
<td>25,200</td>
<td>1400 $</td>
<td>33,600 $</td>
</tr>
<tr>
<td>Unit EA - 2 Bed / 2 Bath 50%</td>
<td>6</td>
<td>1,050</td>
<td>6,300</td>
<td>668 $</td>
<td>4,008 $</td>
</tr>
<tr>
<td>Unit D - 2 Bed / 2 Bath</td>
<td>29</td>
<td>1,150</td>
<td>33,350</td>
<td>1510 $</td>
<td>43,790 $</td>
</tr>
<tr>
<td>Unit DA - 2 Bed / 2 Bath 50%</td>
<td>7</td>
<td>1,150</td>
<td>8,050</td>
<td>668 $</td>
<td>4,676 $</td>
</tr>
<tr>
<td>Unit B - 2 Bed / 2 Bath</td>
<td>14</td>
<td>1,300</td>
<td>18,200</td>
<td>1650 $</td>
<td>23,100 $</td>
</tr>
<tr>
<td>Unit BA - 2 Bed / 2 Bath 50%</td>
<td>4</td>
<td>1,300</td>
<td>5,200</td>
<td>668 $</td>
<td>2,672 $</td>
</tr>
<tr>
<td><strong>Total / Average</strong></td>
<td>275</td>
<td>843</td>
<td>231,884</td>
<td>1,091 $</td>
<td>299,966 $</td>
</tr>
</tbody>
</table>

### Monthly Income

- **$1,269** per month (Market Rate)
- **$654** per month (Workforce Housing)
Current Development Model uses poorly insulated walls and oversized mechanical systems to compensate for the thermal losses.

Passive House Model calls for super insulated building envelopes and require 70-90% less energy to heat and cool the building.

Passive House Buildings have 70-90% lower utility bills.

5” Walls

$119.00 per month

16” Walls

$26.47 per month
Environmental Benefits

Kansas City High Rise

- Building Size: 277,512 SF
- Site Energy: 40,703,695 kBtu/yr

Second and Delaware (Passive House)

- Building Size: 290,754 SF
- Site Energy: 4,519,743 kBtu/yr
Additional Environmental Benefits

Natural Gas Combined Heat and Power

CHP CAPTURES ENERGY THAT WOULD NORMALLY BE LOST in power generation and uses it to provide heating and cooling, making CHP **75-80 PERCENT EFFICIENT** at using fuels.

**82 GW**
The current installed capacity of CHP – about 8 percent of U.S. generating capacity.

**40 GW**
The national goal for added CHP capacity, signed in August 2012 Executive Order by President Obama

**Meeting this goal would:**

- Save American manufacturers and companies $10 billion each year
- Spur $40 to $60 billion in new capital investments in plants and facilities
- Save 1 percent of all energy use in the U.S. (one quadrillion Btu of energy)
- Reduce emissions by the equivalent of taking 25 million cars off the road
Environmental Benefits

Energy Consumption Comparison

<table>
<thead>
<tr>
<th>Conditioned Space (sf)</th>
<th>2015 High-Rise</th>
<th>Second and Delaware Apartments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>277,512</td>
<td>290,754</td>
</tr>
<tr>
<td>Total Energy Consumption kBtu/yr</td>
<td>40,703,695</td>
<td>4,519,743</td>
</tr>
<tr>
<td>Source Energy (kBtu/yr)</td>
<td>145,370,339</td>
<td>11,292,706</td>
</tr>
</tbody>
</table>

92% Reduction in Energy Consumption
The New Development Model

Second & Delaware

- 276 Unit Multifamily Project
- Transit Oriented
- Passive House Certified
- 20% Workforce Housing
View of Courtyard
View of the Pool
FORMWORK CYCLE

1. Steel & Utilities - Walls and Columns
   • Erect and Place Reinforcing Steel
   • Install Rough-In Electrical Conduits and Plumbing

2. Forming Part 1
   • Form Interior Walls and Columns
   • Form Interior Beams & Elevated Slabs

3. Steel & Utilities - Elevated Slab
   • Erect and Place Reinforcing Steel
   • Install Rough-In Electrical Conduits and Plumbing

4. Forming Part 2
   • Place Thermomass XPS in Wall Cavity
   • Form Exterior Wall – One Side

5. Pour & Finish Concrete
6” Non-Post Tensioned Concrete Slab
QUADRANT 1
Northwest

POUR 1 – 240.21 Cubic Yards

6 STOREY TOWER
(FORM SET -1A)

5 STOREY TOWER
(FORM SET-1B)

POUR 2 – 264.15 Cubic Yards
QUARTER COMPLETE – 1 QUADRANT

QUADRANT 1
Northwest

POUR QTY

POUR 10 – 283.99 CY
POUR 8 – 263.59 CY
POUR 6 – 263.96 CY
POUR 4 – 264.80 CY
POUR 2 – 264.15 CY

6 STOREY TOWER (FORM SET -1A)

5 STOREY TOWER (FORM SET-1B)
ENTIRE COMPLEX – 4 QUADRANTS

QUADRANT 1
Northwest

QUADRANT 3
Northeast

QUADRANT 2
Southwest

QUADRANT 4
Southeast
KLEARWALL WINDOW
1/2" AIRDAM SEALANT
1" RIDGID INSULATION
BREAKMETAL COVER
SILL COVER
SILICON CAULK W/weep holes on bottom
BREAKMETAL SILL COVER
1/2" AIRDAM SEALANT
KLEARWALL WINDOW
TAPERS PLYWOOD SILL EMBEDDED IN FAST FLASH
1/2" AIRDAM CAULK BEAD WITH BACKEROD

1" x 1.5" STEEL ANGLE
18" O.C.

KLEARWALL CLIP WITH
2 SCREWS PER CLIP
2 CLIPS PER SIDE
3/4" PLYWOOD EMBEDDED AND COATED IN FAST FLASH

1/2" AIRDAM SEALANT

1" RIDGID INSULATION

PREFABRICATED BREAKMETAL COVER

KLEARWALL TILT AND TURN WINDOW ON 1/2" SHIMS
## Structure Cost Per Square Foot:

<table>
<thead>
<tr>
<th>Item</th>
<th>ADG Model</th>
<th>Stick Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>$4,256,000</td>
<td>$7.74</td>
</tr>
<tr>
<td>Concrete</td>
<td>$14,289,502</td>
<td>$25.98</td>
</tr>
<tr>
<td>Masonry</td>
<td>$899,800</td>
<td>$1.64</td>
</tr>
<tr>
<td>Metals</td>
<td>$1,423,506</td>
<td>$2.59</td>
</tr>
<tr>
<td>Rough Carpentry</td>
<td>$377,280</td>
<td>$0.69</td>
</tr>
<tr>
<td>Finish Carpentry</td>
<td>$686,830</td>
<td>$1.25</td>
</tr>
<tr>
<td>Waterproofing</td>
<td>$380,002</td>
<td>$0.69</td>
</tr>
<tr>
<td>Roofing</td>
<td>$1,352,451</td>
<td>$2.46</td>
</tr>
<tr>
<td>Sheetmetal</td>
<td>$54,277</td>
<td>$0.10</td>
</tr>
<tr>
<td>Doors</td>
<td>$587,361</td>
<td>$1.07</td>
</tr>
<tr>
<td>Windows</td>
<td>$1,743,247</td>
<td>$3.17</td>
</tr>
<tr>
<td>Glass</td>
<td>$893,875</td>
<td>$0.03</td>
</tr>
<tr>
<td>Lath and Plaster</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Drywall</td>
<td>$3,290,604</td>
<td>$5.98</td>
</tr>
<tr>
<td>Tile Work</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Wood Flooring</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Painting and Decorating</td>
<td>$813,231</td>
<td>$1.48</td>
</tr>
<tr>
<td>Specialties</td>
<td>$108,388</td>
<td>$0.20</td>
</tr>
<tr>
<td>Special Equipment</td>
<td>$15,000</td>
<td>$0.03</td>
</tr>
<tr>
<td>Cabinets</td>
<td>$893,875</td>
<td>$1.63</td>
</tr>
<tr>
<td>Appliances</td>
<td>$963,841</td>
<td>$1.75</td>
</tr>
<tr>
<td>Blinds and Shades, Artwork</td>
<td>$136,836</td>
<td>$0.25</td>
</tr>
<tr>
<td>Carpets</td>
<td>$229,790</td>
<td>$0.42</td>
</tr>
<tr>
<td>Special Construction</td>
<td>$1,721,503</td>
<td>$3.13</td>
</tr>
<tr>
<td>Elevators</td>
<td>$536,560</td>
<td>$0.98</td>
</tr>
<tr>
<td>Plumbing and Hot Water</td>
<td>$2,732,365</td>
<td>$4.97</td>
</tr>
<tr>
<td>Heat and Ventilation</td>
<td>$2,602,679</td>
<td>$4.73</td>
</tr>
<tr>
<td>Electrical</td>
<td>$4,209,080</td>
<td>$7.65</td>
</tr>
<tr>
<td><strong>Subtotal (Structures)</strong></td>
<td><strong>$40,048,008</strong></td>
<td><strong>$80.55</strong></td>
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</tbody>
</table>
### Total Life-cycle Cost

<table>
<thead>
<tr>
<th></th>
<th>ADG Model</th>
<th>Stick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land and Structures Cost</td>
<td>80.55 $</td>
<td>84.68 $</td>
</tr>
<tr>
<td>First Cost Savings</td>
<td>4.12</td>
<td>-</td>
</tr>
<tr>
<td>Operating Expenses Savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Painting at Turnover (50%)</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>General Maintenance (50%)</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Utilities (76% Less)</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>Insurance (15% Less)</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Vacancy (1% less)</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.53</td>
<td></td>
</tr>
<tr>
<td>Value at 5% Cap Rate</td>
<td>10.59</td>
<td>-</td>
</tr>
<tr>
<td>20% of NPV of Years 50-100</td>
<td>1.170</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total Life-cycle Cost</strong></td>
<td><strong>$68.79</strong></td>
<td><strong>$84.68</strong></td>
</tr>
</tbody>
</table>

New Model is 19% Lower in Life-cycle cost
The New Development Model

**Lean Construction & IPD**

Between 50% and 90% of on-site labor does not produce value.

Lean Construction and Integrated Project Delivery (IPD) lowers waste by 10%-40%

**Best Practices Key to Keeping Costs in Line:**

- Last Planner System
- Target Value Design
- Lean Construction
- Best in class team

**Diagram:**

1. Target Value
2. Team Selected
3. Cost Validated
4. Subs Direct Designers
5. Continuous Improvement
ADG Model Summary

- Efficient flexible structures
- Efficient Land Use
- 92% Energy Savings
- 5% Lower First Cost
- 19% Lower life-cycle costs
Lessons Learned

• Lean / IPD = Cost Savings
• Patient Capital (HUD 221(d)4)
• Engage City Leaders
• Don’t Quit, Perservere
• Team with Experts
Opportunity

• Demand: 40 million units
• Stay in Homes: (13 million)
• Remaining: 27 million units
• 100,000 Second and Delaware Buildings
• Globally - 60 million people move to cities each year.
Second and Delaware
275 unit Passive-house Certified development in Kansas City, MO.

Funded with HUD 221(d)4 loan guarantee, Low Income Housing Tax Credits and Equity.

**Cost:** $50 million

**Affordable Units:** 55

**Start Construction:** September - 2015

South Side Station
1,400 residential units, 400,000 sf commercial space in Dallas, TX.

Funding to be determined.

**Cost:** $378 million

**Affordable Units:** 55

**Start Construction:** Jan - 2016
Thank you.

For more information visit:
ArnoldDevelopmentGroup.com

or send an email to:
jarnold@ArnoldDevelopmentGroup.com