Objectives for this presentation . . .

1. Brief History of Advanced Framing
2. Overview
3. Benefits
4. Implementation
The Year – 1854
The Book – The American Cottage Builder

1970s
U.S. Department of Housing and Urban Development
NAHB Research Foundation
Operation Break-through delivered “optimum value engineering framing”
Today this is “Advanced Framing”
Overview

What is Advanced Framing?

Framing system on 2’ centers
Reduce Framing Material Use
Increases Insulation Volume
Improves Energy Performance
Reduces Labor Costs (eventually)

24” Centers Inline Framed
No Headers in non-load bearing walls
Single Studs at Rough Openings
No Cripple studs under windows
Two Stud Corners
Single Insulated Header
Header Hangers
Single Top Plate
Overview
Advanced Framing and The Building Code

Within the IRC the following are permitted:

- 24" On Centre Framing
- Single Top Plates
- 24" On Centre Interior Partitions
- No Headers in Non-Load-Bearing Walls
- Interior and Exterior Wall Covering on 24" On Centre
- Drywall Clips
- Single Headers

Overview
Advanced Framing and The Building Code

Single Top Plate
IRC 2000 AND 2003, IN SECTION R602.3.2 TOP PLATE

EXCEPTION: A SINGLE TOP PLATE MAY BE INSTALLED IN STUD WALLS – WITH PROV

24" On Centre Interior Walls
IRC 2000 AND 2003, IN SECTION R602.5

INTERIOR, NONBEARING WALLS SHALL BE PERMITTED TO BE CONSTRUCTED
WITH 2-INCH-BY-3-INCH (51 MM BY 76 MM) STUDS SPACED 24 INCHES (610 MM) ON CENTER
Overview

Advanced Framing and The Building Code

No Headers in Non-Load-Bearing Walls
IRC 2000 AND 2003, SECTION R602.7.2

NONBEARING WALLS. LOAD-BEARING HEADERS ARE NOT REQUIRED IN
INTERIOR OR EXTERIOR NONBEARING WALLS. – WITH PROVISIONS

Exterior Covering over 24” On Centre Framing
IRC 2000 AND 2003 SECTION R703 EXTERIOR COVERING

STRUCTURAL SHEATHING AND SIDING REQUIREMENTS ARE BASED ON TABLE
R703.4. NOTE THAT FOOTNOTE “A” SPECIFIES THAT THE TABLE IS BASED
ON 16 INCHES ON CENTER AND THAT STUDS-SPACED-24-INCHES-ON-CENTER SIDING
SHALL BE APPLIED TO SHEATHING APPROVED FOR THAT SPACING.

Overview

Advanced Framing and The Building Code

Drywall Installation over 24” On Centre Framing
IRC 2000 AND 2003 TABLE R702.3.5 MINIMUM THICKNESS AND APPLICATION
OF GYPSUM BOARD

ALLOWS THE USE OF 24-INCH-ON-CENTER FRAMING FOR FASTENING GYPSUM
BOARD WITH EITHER FASTENERS OR ADHESIVE 1/2 INCH THICKNESS OR GREATER.

Use of Drywall Clips for Drywall
IRC 2000 AND 2003, FIGURE R602.3(2)

NOTE: A THIRD STUD AND/OR PARTITION INTERSECTION BACKING STUDS SHALL
BE PERMITTED TO BE OMITTED THROUGH THE USE OF WOOD BACK-UP CLEATS, METAL
DRYWALL CLIPS, OR OTHER APPROVED DEVICES THAT WILL SERVE AS
ADEQUATE BACKING FOR THE FACING MATERIALS.
Benefits

Reduced Framing Material Use
Lower Construction Costs
Reduced Number of Framing Members
Reduces Labor Costs and Increases Speed
Increased R-Value
Lower Operating Costs
Improved Energy Performance
Reduces Emissions from Space Conditioning

Case Study – Residential House – Material

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard Framing</th>
<th>Advanced Framing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior Wall</td>
<td>467</td>
<td>238</td>
</tr>
<tr>
<td>Exterior Plate</td>
<td>95</td>
<td>63</td>
</tr>
<tr>
<td>Interior Wall</td>
<td>715</td>
<td>279</td>
</tr>
<tr>
<td>Interior Plate</td>
<td>126</td>
<td>85</td>
</tr>
<tr>
<td>Header</td>
<td>273</td>
<td>148</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1403</strong></td>
<td><strong>665</strong></td>
</tr>
</tbody>
</table>

8’ Studs Board Feet

1634

331

2502

446

273

5186

1312

347

977

298

148

3082
Benefits

Speed of Construction

- Usually Takes 5 Houses to Gain Familiarity
- Fewer Pieces of Lumber to Handle
- Fewer Holes to Drill
- Less Framing to Work Around
- Larger Areas to Work

Benefits

- Fewer Pieces of Lumber to Handle
  - Less to Load
  - Less to Unload
  - Less to Move
  - Less to Fasten
- Primarily Helps Framers
Benefits

Fewer Holes to Drill
Less Framing to Work Around
Larger Areas to Work

HVAC Installer!
Electrician!
Plumber!
Drywaller!

The Truth about R-VALUE
Wood is More Conductive than Insulation

Less Framing Means Higher Overall R-Value!
Benefits

Case Study – Residential House 1 – Energy

2,800 ft²
Slab on grade
2-story, detached single family house
R-13 Walls (2x4 Construction)
R-38 Ceiling
90% AFUE Furnace
14 SEER Air Conditioner
BSC Building America target enclosure airtightness
(0.25 CFM/ft²)
Benefits

Case Study – Residential House 1

<table>
<thead>
<tr>
<th></th>
<th>Annual Energy Savings (%)</th>
<th>One Time Construction Material Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior 2x4 Framing at 16&quot; OC</td>
<td>0.0%</td>
<td>$0</td>
</tr>
<tr>
<td>Exterior 2x6 Framing at 16&quot; OC</td>
<td>9.2%</td>
<td>$1,177</td>
</tr>
<tr>
<td>Exterior 2x6 Framing at 24&quot; OC w/2 Stud Corner</td>
<td>1.7%</td>
<td>$143</td>
</tr>
<tr>
<td>Exterior Single Top Plate</td>
<td>0.9%</td>
<td>$54</td>
</tr>
<tr>
<td>Exterior Opening Framing (Sills, Kings, Jacks)</td>
<td>0.2%</td>
<td>$89</td>
</tr>
<tr>
<td>Exterior Single Headers with Insulation</td>
<td>0.9%</td>
<td>-$27</td>
</tr>
<tr>
<td>Interior Stud Spacing at 16&quot; OC</td>
<td>0.0%</td>
<td>$0</td>
</tr>
<tr>
<td>Interior Stud Spacing at 24&quot; OC</td>
<td>0.0%</td>
<td>-$238</td>
</tr>
<tr>
<td>Interior Single Top Plate</td>
<td>0.0%</td>
<td>-$83</td>
</tr>
<tr>
<td>Interior Opening Framing</td>
<td>0.0%</td>
<td>-$31</td>
</tr>
<tr>
<td>Floor Joist Spacing at 16&quot; OC</td>
<td>0.0%</td>
<td>$0</td>
</tr>
<tr>
<td>Floor Joist Spacing at 24&quot; OC</td>
<td>0.2%</td>
<td>$0</td>
</tr>
<tr>
<td>Roof Rafter Spacing at 16&quot; OC</td>
<td>0.0%</td>
<td>$0</td>
</tr>
<tr>
<td>Roof Rafter Spacing at 24&quot; OC</td>
<td>0.0%</td>
<td>$0</td>
</tr>
<tr>
<td>Total Energy Savings</td>
<td>13.0%</td>
<td></td>
</tr>
</tbody>
</table>

Implementation

BSC Houses Built with Advanced Framing

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Number of Homes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>679</td>
</tr>
<tr>
<td>3</td>
<td>417</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Grand Total</td>
<td>1113</td>
</tr>
</tbody>
</table>
Implementation

Typical Implementation Steps

Optimally the architect and designer would start fresh and design with Advanced Framing

1. 2 x 6 frame at 24" centers
2. Single king studs
3. Single jack studs
4. Removal of non-load bearing headers
5. Stack framing (align all joists, studs and rafters)
6. Single top plates (where possible)
7. Exterior insulation for a more than 25% increase in R-value

Implementation

Common Issues Found

1) Construction
2) Management
Implementation - Construction

Concern

Tile cracking on floors with 24” o.c. joists

Resolution

This issue is primarily found on main floors
Increase Joist Size
Additional Blocking
Decrease Spans
Decrease Spacing (main floor does not NEED to be stack framed)

Implementation - Construction

Concern

Second floor joist depths for large clear spans
16” o.c. 2x8 lumber increased to engineered lumber for 24” o.c construction

Resolution

Check interference with stair runs with new rise
Additional Blocking
Decrease Clear Spans
Re-orient Joists in an Alternate Direction
Decrease Spacing (may require double top plates on some main floor walls)
Implementation - Construction

Concern
Reduced interior area vs Claimed interior area

Resolution
Claimed floor area does not change
Other Items that may need to change:
  Countertops
  Cabinets
  Bath and Shower areas

Implementation - Construction

Concern
Picture Hanging and Decorating with studs at 24” o.c.

Resolution
Drywall anchors available to support up to 75 lbs.
Additional blocking can be provided in required areas
  Above Fireplaces
  Logical Television Locations
  Behind Cabinets etc.
Implementation - Construction

Concern
Inadequate Drywall Support

Resolution
Generally a perceived issue
Manufacturers have provisions for 1/8" drywall
Increased drywall thickness if necessary

Implementation - Construction

Concern
Hurricane, Tornado and Seismic Requirements

Resolution
Additional Sheathing
Increased Thickness of Sheathing
Variety of Shear Panels available
Consult your Structural Engineer
Implementation - Construction

Concern

Building windows and doors on 24” units

Resolution

Provides an optimal solution
Maximizes savings in material and energy efficiency
Not a necessary step for Advanced Framing
Architects and Designers may prefer other spacings

Implementation - Management

Concern

Code Compliance

Resolution

Within the IRC the following are permitted:
24” On Centre Framing
Single Top Plates
24” On Centre Interior Partitions
No Headers in Non-Load-Bearing Walls
Interior and Exterior Wall Covering on 24” On Centre
Drywall Clips
Single Headers
Implementation - Management

Concern
Customer Knowledge and Information

Resolution
Advanced Framed homes are completely code compliant
Builder may choose to inform the homeowner about the benefits of AF
The homeowner does not need to be informed of the change

Implementation - Management

Concern
Sales and Marketing

Resolution
Training will be necessary to inform the Sales and Marketing staff
Once trained, staff will be able to properly answer home buyer questions and concerns
Sales tools and documentation can be developed to help inform the homebuyer of the benefits of advanced framing.
Implementation - Management

**Concern**

Builder in-house process and direction

**Resolution**

Top-down buy-in from management is the key component

Management direction ensures necessary changes are made

---

Implementation - Management

**Concern**

Does Advanced Framing Save Construction Costs?

**Resolution**

Case study of material use showed $100 per house savings

Building Science Corporation experience with David Weekley Homes nationwide has shown cumulative savings of $1000 per house

Increased Rate of Construction

Waste Reductions

Improved Process

Design simplifications for multiple trades
Implementation - Management

Concern

Does Advanced Framing Save Energy?

Resolution

- Case study of energy use showed 13% space conditioning energy savings.
- Additional exterior insulation improves savings further.
- Additional air sealing details improve savings further.

Concern

Do all of the features need to be used?

Resolution

- Not every step of advanced framing is required.
- Each additional step for exterior walls improves energy savings and construction cost reductions.
- Advanced framed interior partitions save construction costs.
Implementation - Management

Concern
Can Advanced Framing be used at the Community Scale?

Resolution
Building Science Corporation has been involved in the construction of over 1000 homes, both prototype and large scale production homes.

Implementation

Construction Methods

Construction Photographs
Reduce Unnecessary Thermal Bridging

Where 4 is Good

Reduce Unnecessary Thermal Bridging

Where 5 is Better
Reduce Unnecessary Thermal Bridging

10 Has to Be Just GREAT!
Two-Stud Corner with Tie-Downs

* NOTE: TO BE USED WHEN SPlice JOINT IS NOT CENTERED ABOVE STUD

**NAILED FRAMING PLATE PER 1997 UBC**
PG 2301 / SECTION 2320 / 11.2-11.3

2x6 SINGLE TOP PLATE

2x6 24" OC STUD WALL

2x6 FULL WIDTH BLOCKING

Top plate splice
Connector plate
Single top plate
Floor Over Unconditioned Garage

Interior space
- Sealant, adhesive or gasket
- Blocking or solid joist positioned over wall to act as draftstop
- Sealant or adhesive around four edges
- Taped or sealed joints
- Rigid insulation
- Gypsum board

Unconditioned Garage

Interior space
- Sealant, adhesive or gasket
- Seal electrical penetrations
- Electrical wire
Shed Roof at Exterior Wall

- Sheathing Tape
- Adhesive membrane strip (top edge taped to sheathing with sheathing tape)
- Flashing
- Shear adhesive or gasket
- Adhesive
- Electrical wire
- Ledger nailed over top of rigid insulation
- Sealant, adhesive or gasket
- Rigid insulation, seams taped/sealed prior to installation of shed roof framing
- Sealant at corner of bottom plate and subfloor or gasket under bottom plate
- Lead electrical penetration
- Sealant

Air Barrier Continuity At Fireplace

- Taped or sealed joints
- Rigid insulation
- Tape
- Sheathing liner taped to frame opening both sides and top
- Closure framing materials after sheathing liner and fireplace installation
- Prefabricated fireplace
- Sheathing liner taped to frame opening both sides and top
- Tape
- Thin profile structural sheathing as end/bounce liner
Air Sealing Electrical

Properly Insulating

- Insulation is compressed creating voids when inset stapling is used
- Kraft or foil facing
- Face stapling is recommended where faced batt insulation is installed
- Notch out in bottom of stud
- Alternate Wiring with Batt Insulation Detail
Truss Uplift and Floating Corners

Bead of adhesive

Continuous bead of drywall adhesive required here

Bead of adhesive

 Clips may also be used

Continuous bead of drywall adhesive required here

Bolted anchor at non-bearing walls

Floating drywall at wall corners

Drywall clips
Truss Uplift and Floating Corners

Framing Vented Hip Roof

- Hip rafters (2 x 10) doubled and smaller than jack rafters
- Ridge rafter (2 x 10) smaller than common rafters
- Common rafters (2 x 12)
- Jack rafters (2 x 10)
- Valley rafters doubled and smaller than jack rafters

Building for Energy Efficiency: Part II
Framing Vented Hip Roof

Shear Panels with Exterior Insulating Sheathing
Shear Panel

Shear Strapping with Exterior Insulating Sheathing
Shear Strapping with Exterior Insulating Sheathing

Ladder Blocking and Extra Blocking
Non-Load-Bearing and Load-Bearing

Advanced Framing and Spray Foam
Advanced Framing and Cellulose

Advanced Framing and Cellulose
Advanced Framing and The Building Code

- SINGLE TOP PLATE
  - IRC 2000 AND 2003, IN SECTION R602.2.2 TOP PLATE
  - EXCEPTION: A SINGLE TOP PLATE MAY BE INSTALLED IN STUD WALLS, PROVIDED THAT THE PLATE IS ADEQUATELY TIED AT JOINTS, CORNERS, AND INTERSECTING WALLS BY A MINIMUM 2-INCH-BY-4-INCH BY 0.036 INCH-THICK (51 MM BY 102 MM BY 0.914 MM) GALVANIZED STEEL PLATE THAT IS NAILED TO EACH WALL OR SEGMENT OF WALL BY SIX 8D NAILS ON EACH SIDE, PROVIDED THAT THE RAFTERS OR JOISTS ARE CENTERED OVER THE STUD WITH A TOLERANCE OF NO MORE THAN 1 INCH (25 MM). THE TOP PLATE MAY BE OMITTED OVER LINTELS THAT ARE ADEQUATELY TIED TO ADJACENT WALL SECTIONS WITH STEEL PLATES OR EQUIVALENT AS PREVIOUSLY DESCRIBED.
  - IRC 2000 AND 2003, IN FIGURE R802.3.2
  - THE FIGURE LABEL STATES "SINGLE OR DOUBLE TOP PLATE."
  - IRC 2000 AND 2003, IN SECTION R602.0
  - INTERIOR, NONBEARING WALLS SHALL BE PERMITTED TO BE CONSTRUCTED WITH 2-INCH-BY-4-INCH (51 MM BY 102 MM) STUDS SPACED 24 INCHES (609 MM) ON CENTER OR, WHEN NOT PART OF A BRACED WALL LINE, 2-INCH-BY-4-INCH (51 MM BY 102 MM) FLAT STUDS SPACED AT 16 INCHES (406 MM) ON CENTER. INTERIOR, NONBEARING WALLS SHALL BE CAPPED WITH AT LEAST A SINGLE TOP PLATE. INTERIOR, NONBEARING WALLS SHALL BE FIREBLOCKED IN ACCORDANCE WITH SECTION R602.8.
  - IRC TABLE R602.2.1
  - FOR TOP OR SOLE PLATE TO STUD (END NAIL), TWO 16D FASTENERS ARE REQUIRED.
  - NO HEADERS IN NON-LOAD-BEARING WALLS
  - IRC 2000 AND 2003, SECTION R602.7.2
  - NONBEARING WALLS, LOAD-BEARING HEADERS ARE NOT REQUIRED IN INTERIOR OR EXTERIOR NONBEARING WALLS. A SINGLE, FLAT 2-INCH-BY-4-INCH (51 MM BY 102 MM) MEMBER MAY BE USED AS A HEADER IN INTERIOR OR EXTERIOR NONBEARING WALLS FOR OPENINGS UP TO 8 FEET (2438 MM) IN WIDTH IF THE VERTICAL DISTANCE TO THE PARALLEL NAILING SURFACE ABOVE IS NOT MORE THAN 24 INCHES (610 MM). FOR SUCH NONBEARING HEADERS, NO CRIPPLES OR BLOCKING IS REQUIRED ABOVE THE HEADER.
  - IRC 2000 AND 2003 TABLE R702.3.5 MINIMUM THICKNESS AND APPLICATION OF GYPSUM BOARD
  - ALLOWS THE USE OF 24-INCH-ON-CENTER FRAMING FOR FASTENING GYPSUM BOARD WITH EITHER FASTENERS OR ADHESIVE 1/2 INCH THICKNESS OR GREATER.
  - IRC 2000 AND 2003 SECTION R602.10.2 SEISMIC DESIGN CATEGORY D2
  - IN SEISMIC DESIGN CATEGORY D2, CRIPPLE WALLS SHALL BE BRACED IN ACCORDANCE WITH TABLE R602.10.1.
  - DRYWALL CLIPS
  - IRC 2000 AND 2003, SECTION R602.3 DESIGN AND CONSTRUCTION
  - EXTERIOR WALLS OF WOOD-FRAME CONSTRUCTION SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH THE PROVISIONS OF THIS CHAPTER AND FIGURES R602.3.1 AND R602.3.3 ON IN ACCORDANCE WITH TABLES R602.3.1 THROUGH R602.3.6. (EXCEPT:
  - IRC 2000 AND 2003, FIGURE R602.3.3)
  - NOTE: A THIRD STUD AND/OR PARTITION INTERSECTION BACKING STUD SHALL BE PERMITTED TO BE OMITTED THROUGH THE USE OF WOOD BACK-UP CLEATS, METAL DRYWALL CLIPS, OR OTHER APPROVED DEVICES THAT WILL SERVE AS ADEQUATE BACKING FOR THE FACING MATERIALS.
Advanced Framing and The Building Code

<table>
<thead>
<tr>
<th>STUDY SIZE</th>
<th>BEARING WALLS</th>
<th>NONBEARING WALLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(inches)</td>
<td>Lateral</td>
<td>Maximum spacing when supporting a</td>
</tr>
<tr>
<td></td>
<td>unsupported assembly or a</td>
<td>non-load-bearing assembly or a</td>
</tr>
<tr>
<td></td>
<td>stud or diaphragm (inches)</td>
<td>stud or diaphragm (inches)</td>
</tr>
<tr>
<td>2 x 4</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>3 x 4</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>2 x 5</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>2 x 6</td>
<td>10</td>
<td>24</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 square foot = 0.093 m².

a. Lateral heights are determined between points of lateral support placed perpendicular to the plane of the wall, increases in exceptional heights are permitted where justified by analysis.

b. Studs shall not be used in load-bearing walls.

c. In load-bearing walls assembly supported by a 2 x 6 stud limited to areas up to 15 feet. Where the stud assembly extends more than 15 feet, the wall height shall be increased to 2 x 8; this shall be designed in accordance with acceptable engineering practice.