We Should Know Better: Top 10 Multifamily Design Mistakes
Learning Objectives

• List the top ten design mistakes that decrease constructability, affordability and overall quality of multifamily housing
• Choose the smarter design choices from a selection of scenarios
• Justify smart design alternatives to your clients and contractors in terms of time, money, energy and health
• Develop a smart design checklist for your team to use on future projects
Yeah, well, you know that's just like, uh, you're opinion, man.
1. OVERCOMPLICATED GEOMETRY
2. DESIGN IRREGULARITIES
3. THERMAL BRIDGING: ROOFS & WALLS
NOTES:

1. ROOF DRAIN SIZE AND NUMBER OF DRAINS SHALL BE IN ACCORDANCE WITH THE LOCAL CODES.

2. ALL BOLTS OR CLAMPS MUST BE IN PLACE TO PROVIDE CONSTANT COMPRESSION ON WATER CUT-OFF MASTIC.

3. THE HOLE IN THE MEMBRANE SHALL NOT EXCEED THE DIAMETER OF THE DRAIN PIPE, BUT SHALL BE 1/2" (13mm) FROM THE ATTACHMENT POINTS OF THE DRAIN CLAMPING RING.

4. FIELD SPLICES MUST BE LOCATED AT LEAST 6" (152mm) OUTSIDE THE DRAIN SUMP.

5. INSULATION TAPER SHALL NOT BE GREATER THAN 6" (152mm) IN 12" (305mm) HORIZONTAL.

6. PROVIDE MINIMUM R15 AT ROOF DRAINS

ROOF DRAIN DETAIL

NOT TO SCALE
### TABLE 1203.3
INSULATION FOR CONDENSATION CONTROL

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>MINIMUM R-VALUE OF AIR-IMPERMEABLE INSULATION^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>2B and 3B tile roof only</td>
<td>0 (none required)</td>
</tr>
<tr>
<td>1, 2A, 2B, 3A, 3B, 3C</td>
<td>R-5</td>
</tr>
<tr>
<td>4C</td>
<td>R-10</td>
</tr>
<tr>
<td>4A, 4B</td>
<td>R-15</td>
</tr>
<tr>
<td>5</td>
<td>R-20</td>
</tr>
<tr>
<td>6</td>
<td>R-25</td>
</tr>
<tr>
<td>7</td>
<td>R-30</td>
</tr>
<tr>
<td>8</td>
<td>R-35</td>
</tr>
</tbody>
</table>

^a. Contributes to, but does not supersede, thermal resistance requirements for attic and roof assemblies in Section C402.2.1 of the International Energy Conservation Code.
CAST STONE

2 PIECE STAINLESS STEEL CAP FLASHING ASSEMBLY

CONTINUOUS 1/8" X 1" PLASTIC TERMINATION BAR SS FASTENER OVER EXTENDED MONOLITHIC FLASHING

SEALANT, TYP.

FLASHING MEMBRANE FULL HEIGHT

SEE STRUCTURAL DRAWINGS FOR CONCRETE WALL AND REINFORCEMENT DETAILS

FACE BRICK

REGLET AND 26 GA SS CAP FLASHING

BASE FLASHING ADHERED TO VERTICAL SURFACE

HOT RUBBERIZED ASPHALT ROOF MEMBRANE

3'-6" CODE REQUIRED MIN. TYP.

FXFOWLE

BUILDING ENERGY NYC
4. THERMAL BRIDGING: SLABS
BSI-062: Thermal Bridges Redux

Joseph Latiburek
JUNE 2, 2015

It is a beautiful building. Quite stunning actually. It is an embodiment of everything that is right and wrong with architecture. An orgy of glass and concrete. It is a thermodynamic obscenity while it takes your breath away. An 82 story heat exchanger in the heart of Chicago? (Photograph 1a, b, c, d, e, f, g).

Photograph 1a (left): Radiator; Photograph 1b (right): Liquid Gas Heat Exchanger

Photograph 1c (left): Extended Finned Surface - Aluminum; Photograph 1d (middle): Extended Finned Surface - Concrete; Photograph 1e (right): Aqua Tower Balcony's

Photograph 1f (left): Infrared of Aqua Tower - Image courtesy of Dave Robley; Thermographer: Fluke Corp and Michael Stuart; L3 TI/RT; Fluke Corp; Photograph 1g (right): Infrared of Aqua Tower Balcony - Image courtesy of Dave Robley, Thermographer: Fluke Corp and Michael Stuart; L3 TI/RT; Fluke Corp.
Studio Gang is going to gimme a thermal break in new Chicago project
5. POORLY DETAILED AIR BARRIER
**Exterior Wall - Top**

**Notes:**
- A, B. Intent: reduce leakage between unconditioned attic and wall cavities
- Option: apply drywall adhesive to framing BEFORE installing drywall (“screw & glue”)
- C. Options:
  - Sheathing with seams sealed (i.e. plywood or rigid foam board)
  - Fluid-applied/adhesive membrane on sheathing (i.e. Grace / Henry products)
- D. Typically drywall

**Responsibilities:**
- Framing: B, C
- Drywall: A, D

**Exterior Wall - Penetrations, Bottom and Top Plate**

**Notes:**
- A, C. Intent: reduce leakage between floor and wall cavities
- B. Intent: reduce leakage between wall cavity and apartment
- C. Option: self-leveling subfloor (i.e. gyproc)
- E. H. Intent: reduce leakage between floor and wall cavities
- E. Continuous seal of the rim/joint to sheathing, if a TJI joist seal at top and bottom
- F. G. Includes ducts, pipes, wires, etc.
- H. Option: apply drywall adhesive to framing BEFORE installing drywall

**Responsibilities:**
- Framing: A, C, D, E
- Drywall: B, H
- Mech/Elec/Plumb: F, G

**Plumbing Penetrations**

**Notes:**
- A. Seal all penetrations BEFORE installing cabinetry and access panels
- A. Intent: reduce leakage between wall cavities and apartment
- Typical plumbing penetrations include:
  - Sink faucet supplies & drain
  - Toilet supply
  - Showerhead stub-out
  - Heating supply/return
  - Gas supply
  - Sprinklers

**Responsibilities:**
- Drywall: A

**Electrical Boxes**

**Notes:**
- A, B, C. Intent: reduce leakage between framing cavities and apartment
- A, B, C. Includes boxes in floors, walls and ceilings
- A, C. Options:
  - Caulk
  - Foam
  - Mastic (over entire box)
  - Putty pack

**Responsibilities:**
- Drywall: B
- Electrical: A, C
6. NO LIGHTING CONTROLS
C405.2 Lighting controls (Mandatory). Lighting systems shall be provided with controls as specified in Sections C405.2.1, C405.2.2, C405.2.3, C405.2.4 and C405.2.5.

Exceptions: Lighting controls are not required for the following:

1. Areas designated as security or emergency exits are required to be continuously lighted.
2. Interior exit stairways, interior exit ramp and gangways.
3. Emergency egress lighting that is normally lighted.

C405.2.1 Occupant sensor controls. Occupant sensor controls shall be installed to control lights in the following space types:

1. Classrooms/lecture/training rooms.
2. Conference/meeting/multipurpose rooms.
3. Copy/print rooms.
4. Lounges.
5. Employee hunch and break rooms.
6. Private offices.
7. Restrooms.
8. Storage rooms.
10. Locker rooms.
11. Other spaces 300 square feet (28 m²) are enclosed by floor-to-ceiling heights.
12. Warehouses.

1205.3 Artificial light. Artificial light shall be provided that is adequate to provide an average illumination of 10 footcandles (107 lux) over the area of the room at a height of 30 inches (762 mm) above the floor level.

7.8 Illumination of Means of Egress.
7.8.1 General.
7.8.1.1* Illumination of means of egress shall be provided in the means of egress in accordance with Section 7.8 for every building in which required in Chapters 11 through 43. For the purposes of this requirement, exit access shall include only stairs, aisles, corridors, ramps, escalators, and passageways having direct access to an exit. For the purposes of this requirement, discharge shall include only designated stairways, aisles, ramps, escalators, walkways, and passageways of public ways.

7.8.1.2 Illumination of means of egress shall be provided to the means of egress be available for use, unless otherwise specified in 7.8.1.2.1.

7.8.1.2.1 Artificial lighting shall be employed at all times and for such periods of time as are necessary to illumination to the minimum criteria values herein:

7.8.1.2.2* Unless prohibited by Chapters 11 through 43, automatic lighting control devices shall be permitted to temporarily turn off the illumination within the means of egress provided that each lighting control device complies with all of the following:

1. In new installations, the lighting control device is listed and labeled to comply with U.S. Federal Fire Safety Standards.
2. The lighting control device is equipped to automatically energize the controlled lights upon loss of normal power and is evaluated for this purpose.
3. Illumination timers are provided and are set for a minimum 15-minute duration.
4. The lighting control device is activated by any occupant movement in the area served by the lighting units.

In existing installations, the lighting control device is activated by the operation of the building fire alarm system. The lighting control device does not turn off any lighting for activation of photoluminescent egress marking systems.

7.8.1.2.3* Energy-saving sensors, switches, timers, or controllers shall be approved and shall not compromise the continuity of illumination of the means of egress required by 7.8.1.2.

7.8.1.3 The floors and other walking surfaces within an exit and within the portions of the exit access and exit discharge shall be illuminated as follows:

1. During conditions of stair use, the minimum illumination for new stairways shall be at least 10 ft-candle (108 lux), measured at the walking surfaces.
2. The minimum illumination for floors and other walking surfaces, other than new stairways during conditions of stair use, shall be to values of at least 1 ft-candle (10.8 lux), measured at the floor.
3. In assembly occupancies, the illumination of the walking surfaces of exit access shall be at least 0.2 ft-candle (2.2 lux) during periods of performances or projections involving direct light.
4. The minimum illumination requirements shall not apply where operations or processes require low lighting levels.

SECTION 1008 MEANS OF EGRESS ILLUMINATION
1008.1 Means of egress illumination. Illumination shall be provided in the means of egress in accordance with Section 1008.2. Under emergency power, means of egress illumination shall comply with Section 1008.3.

1008.2 Illumination required. The means of egress serving a room or space shall be illuminated at all times that the room or space is occupied.

Exceptions:

1. Occupancies in Group U.
2. Aisle accessways in Group A.
3. Dwelling units and sleeping units in Groups R-1, R-2 and R-3.
4. Sleeping units of Group I occupancies.

1008.2.1 Illumination level under normal power. The means of egress illumination level shall be not less than 1 footcandle (11 lux) at the walking surface.

Sources: 2015 IBC/IFCC, NFPA 101
Figure LE-4.
Light-Reduction Controls Method by
Source: energycodes.gov

Dimming

- a) Control of all lamps/luminaires

Alternating Luminaires

- b) Dual switching of alternate rows of luminaries

Alternating Lamps

- c) Switching middle lamp luminaires independently
7. IMPROPERLY SIZED HVAC
8. ANTIQUATED VENTILATION
Hidden Dangers in the Air We Breathe

For decades, no one worried much about the secondhand smoke or radon present. Then scientists at Lawrence Berkeley National Laboratory (Berkeley Lab) began to identify the health consequences of poor indoor air quality, which can lead to accidents or infectious diseases in the United States, and the home is cooking.

The Berkeley Lab scientists are now working on solutions to the problems, including better standards for the hazardous indoor pollutants. They have described some of their findings in an article titled, "Pollutant Exposures from Natural Gas Cooking Burners: A Simulation-Based Assessment for Southern California," in Environmental Health Perspectives in 2013.

Research

Pollutant Exposures from Natural Gas Cooking Burners: A Simulation-Based Assessment for Southern California

Jennifer M. Logue, Neil R. Klepeis, Agnes R. Lobescheid, and Brett C. Singer

First Published: 5 November 2013  Cited by: 4

Abstract

Background: Residential natural gas cooking burners (NGCBs) can emit substantial quantities of pollutants, and they are typically used without venting range hoods.

Objective: We quantified pollutant concentrations and occupant exposures resulting from NGCB use in California homes.

Methods: A mass-balance model was applied to estimate time-dependent pollutant concentrations throughout homes in Southern California and the exposure concentrations experienced by individual occupants. We estimated nitrogen dioxide (NO₂), carbon monoxide (CO), and formaldehyde (HCHO) concentrations for 1 week each in summer and winter for a representative sample of Southern California homes. The model simulated pollutant emissions from NGCBs as well as NO₂ and CO entry from outdoors, dilution throughout the home, and removal by ventilation and deposition. Residence characteristics and outdoor concentrations of NO₂ and CO were obtained from available databases. We inferred ventilation rates, occupancy patterns, and burner use from household characteristics. We also explored proximity to the burner(s) and the benefits of using venting range hoods. Replicate model executions using independently generated sets of stochastic variable values yielded estimated pollutant concentration distributions with geometric means varying by < 10%.

https://ehp.niehs.nih.gov/doi/10.1289/ehp.1306673

https://well.blogs.nytimes.com/2013/07/22/the-kitchen-as-a-pollution-hazard/
9. INEFFICIENT DHW DISTRIBUTION
Building Section - "3-Pipe" Design

Balancing valves, self-actuating valves are preferred.
Balancing valves, self-actuating valves are preferred.

Building Section - "Box" Design
Table 8  Hot-Water Demand and Use Guidelines for Apartment Buildings  
(Gallons per Person at 120°F Delivered to Fixtures)

<table>
<thead>
<tr>
<th>Guideline</th>
<th>5</th>
<th>15</th>
<th>30</th>
<th>60</th>
<th>120</th>
<th>180</th>
<th>Maximum Daily</th>
<th>Average Daily</th>
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<tbody>
<tr>
<td>Low</td>
<td>0.4</td>
<td>1.0</td>
<td>1.7</td>
<td>2.8</td>
<td>4.5</td>
<td>6.1</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Medium</td>
<td>0.7</td>
<td>1.7</td>
<td>2.9</td>
<td>4.8</td>
<td>8.0</td>
<td>11.0</td>
<td>49</td>
<td>30</td>
</tr>
<tr>
<td>High</td>
<td>1.2</td>
<td>3.0</td>
<td>5.1</td>
<td>8.5</td>
<td>14.5</td>
<td>19.0</td>
<td>90</td>
<td>54</td>
</tr>
</tbody>
</table>

Fig. 15  Apartment Building Cumulative Hot-Water Use Versus Time (from Table 8)
Plank core holes to be large enough to allow for full thickness of insulation to pass through the plank.
10. POOR COMMUNICATION
MOVING FORWARD
MINDSET
SKILLSET
TOOLSET
What are my priorities?
Am I being clear with my design intent?
Have I done this before? Do I know it will work?
What are the long/short-term cost factors?
Am I over-complicating this?
Where are the opportunities for failure?
How is this actually going to get built?
Have I thought about this in three dimensions?
What did we do right last time?
What did we do wrong last time?
SUMMARY
THANK YOU!!!

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