

## MULTIFAMILY CONSTRUCTION ADVISORY COMMITTEE OF ILLINOIS

1440 Renaissance Drive, Suite 340, Park Ridge, Illinois 60068 phone : 847-297-6704 fax : 847-297-8373

# Fire Safe Construction

A Cost Comparison Study of Five Different Construction Materials in MultiFamily Housing

The Multifamily Construction Advisory Committee of Illinois encourages the construction of quality housing that is fire safe, soundresistant and durable.

Committee members include:

Brick Distributors of Illinois

Illinois Cement Shippers

Masonry Advisory Council

MIdwest Calumet / Flexicore Corp.

For additional information or resources contact:

Brick Industy Association

National Concrete Masonry Association

Portland Cement Association

Precast / Prestressed Concrete Institute To: All Building Officials, Mayors & Village Presidents, Fire Chiefs, Homebuilders, Apartment Building Developers, University Administrators

Re: Developing a construction cost model to accurately evaluate the relative construction cost of a multi-family building constructed using five different construction materials. The concept of multi-family would include traditional apartment type buildings, condominium style buildings, student housing, elderly housing, and others.

### INTRODUCTION:

With the phasing out of the three predominate model codes, BOCA National Building Code, Southern Building Code, and Uniform Building Code, and implementation of the new International Building Code and associated family of codes, there has been a shift in the approach to fire safety in the built environment. This shift has been characterized as a shift away from the use of passive construction techniques, such as com-

partmentalization and the use of fireproof construction materials, in favor of an increased reliance on active fire control techniques such as sprinkler systems, allowing for construction to occur using materials that are more susceptible to fire damage.

In conjunction with this shift there are also reservations with the current ASTM (American Society for Testing and Materials) methodology for testing fire assemblies ASTM El19, Standard Test Methods for Fire Tests of Building Construction and Materials. This test allows for the removal and replacement of the fire tested specimen prior to the initiation of the hose stream test. This test combination is intended to model the effects of the application of a fire suppression stream immediately after the intense heat from a compartment fire. The effect of this provision is that the specimen is a virgin test specimen when the fire suppression stream is applied, theoretically allowing certain materials to artificially perform at a higher level than would be expected in the field.









# Fire Safe Construction

#### A Cost Comparison Study of Five Different Construction Materials in MultiFamily Housing









In addition, it has long been the opinion of legislators, code-officials, and design professionals that non-combustible concrete construction solutions are more costly than other alternatives such as gypsum fire walls with sprinklers.

Due to the perception of elevated cost, and the aforementioned code and testing issues, the acceptance of a balanced design approach incorporating both passive and active protection systems has met with resistance. Passive design incorporates the compartmentalization of the fire, limiting fire spread and protecting both the building occupants and the responding firefighters. This system is in place at all times and is not subject to failure due to the loss of utility service. An example of this is the incorporation of fireproof materials in the construction of floors and walls used for fire control. The active portion of the design uses a combination of detection systems to warn occupants, and sprinklers to control fire spread until the fire department arrives.

Currently, there is no reliable published documentation available to refute the perception regarding the increased building cost associated with this approach. Based on this lack of information, the design of a comparative study was undertaken to accurately document the increased cost associated with the use of balanced design in a common multi-family residential building. It is our pleasure to present the outcomes of this study.

#### **METHODOLOGY:**

To accurately evaluate the relative construction cost between each of the five building systems, it was determined that a multi-family residential structure should be schematically designed meeting all of the requirements of the International Building Code 2003 edition. Once designed, the building would be reviewed for code compliance, and cost estimates would be prepared for the building using each of the different building systems.

The design team assembled included:

ARCHITECT & ENGINEER: Haas Architects Engineers CODE OFFICIAL: Tim E. Knisely COST ESTIMATION: Poole Anderson Construction

#### BUILDING MODEL:

The building model chosen for the project was a 4 story multi-family residential structure encompassing approximately 25,000 gross square feet of building area per floor. Based on the proposed target building types, it was decided that to better evaluate the relative construction costs, two different floor layouts would be used. The first model is a building comprised exclusively of single bedroom dwelling units. The second model is assembled using a mix of one and two bedroom dwelling units. Schematic floor plans, elevations and detailed wall sections for each of the building models are provided. All buildings had brick exterior, and were sprinkled.

Fire Safe Construction

## Cost Comparisons - Chicago, IL

Building System	Cost	Relative Cost
Conventional Wood Framing Single Bedroom Scheme	\$13,636,238.00	100
3 Story Only	\$10,968,692.00	
Conventional Wood Framing Mixed Bedroom Scheme	\$15,600,345.00	100
3 Story Only	\$11,974,259.00	
Light Gauge Steel Framing Single Bedroom Scheme	\$15,133,233.00	106
Light Gauge Steel Framing Mixed Bedroom Scheme	\$15,409,377.00	99
Masonry and Precast Single Bedroom Scheme	\$15,039,182.00	105
Masonry and Precast Mixed Bedroom Scheme	\$15,181,382.00	97
Formed in Place Concrete Floor Alternate (Single)	\$17,451,524.00	122
Formed in Place Concrete Floor Alternate (Mixed)	\$17,670,142.00	113
Precast Construction Single Bedroom Scheme	\$16,919,179.00	119
Precast Construction Mixed Bedroom Scheme	\$17,001,921.00	109
ICF Walls & Precast Planks Single Bedroom Scheme	\$15,711,131.00	110
ICF Walls & Precast Planks Mixed Bedroom Scheme	\$15,837,056.00	102
Formed in Place Concrete Floor Alternate (Single)	\$18,123,474.00	127
Formed in Place Concrete Floor Alternate (Mixed)	\$18,325,690.00	117
Interior CMU Walls Alternate (Single)	\$15,185,037.00	109
Interior CMU Walls Alternate (Mixed)	\$15,613,637.00	106

The least expensive system for the single bedroom scheme is t he conventional wood framing system. The load-bearing masonry system is only 5% more for the single bedroom scheme and is 3% lower for the mixed bedroom scheme.

The relative cost of the most expensive framing system, the insulated concrete form system with cast-in-place concrete floor is 27 percent and 17 percent higher for the single bedroom model and the mixed bedroom model respectively.

The load bearing masonry wall system with precast concrete plank floor system compares favorably with all systems listed.

It is clear from this study that the distinct fire and quality advantages of load bearing masonry and precast concrete plank floors can be realized without any economic trade-offs.



### Chicago - Single Bedroom Scheme



Conventional Wood Fram	e ∎Light Gauge Steel	Masonry Precast Plank	■Masonry Cast-in-Place
Precast	■ICF / Precast	ICF / Cast-in-Place	□ICF / Masonry

Fire Safe Construction

## Cost Comparisons - Rockford, IL

Building System	Cost	Relative Cost
Conventional Wood Framing Single Bedroom Scheme	\$13,608,139.00	100
3 Story Only	\$10,467,399.00	
Conventional Wood Framing Mixed Bedroom Scheme	\$14,871,684.00	100
3 Story Only	\$11,417,909.00	
Light Gauge Steel Framing Single Bedroom Scheme	\$14,488,173.00	106
Light Gauge Steel Framing Mixed Bedroom Scheme	\$14,746,997.00	99
Masonry and Precast Single Bedroom Scheme	\$14,340,689.00	105
Masonry and Precast Mixed Bedroom Scheme	\$14,492,949.00	97
Formed in Place Concrete Floor Alternate (Single)	\$16,443,299.00	121
Formed in Place Concrete Floor Alternate (Mixed)	\$16,667,984.00	112
Precast Construction Single Bedroom Scheme	\$16,225,118.00	119
Precast Construction Mixed Bedroom Scheme	\$15,925,021.00	107
ICF Walls & Precast Planks Single Bedroom Scheme	\$15,002,874.00	110
ICF Walls & Precast Planks Mixed Bedroom Scheme	\$15,138,394.00	102
Formed in Place Concrete Floor Alternate (Single)	\$17,085,823.00	126
Formed in Place Concrete Floor Alternate (Mixed)	\$17,259,125.00	117
Interior CMU Walls Alternate (Single)	\$14,779,312.00	109
Interior CMU Walls Alternate (Mixed)	\$14,914,849.00	100

## 

□ Conventional Wood Frame □ Light Gauge Steel

Precast

■ICF / Precast

### Rockford - Single Bedroom Scheme

### Rockford - Mixed Bedroom Scheme



Fire Safe Construction

## Cost Comparisons - Merrillville, IN

Building System	Cost	Relative Cost
Conventional Wood Framing Single Bedroom Scheme	\$13,586,442.00	100
3 Story Only	\$10,449,125.00	
Conventional Wood Framing Mixed Bedroom Scheme	\$14,840,136.00	100
3 Story Only	\$11,359,439.00	
Light Gauge Steel Framing Single Bedroom Scheme	\$14,333,953.00	106
Light Gauge Steel Framing Mixed Bedroom Scheme	\$14,643,126.00	99
Masonry and Precast Single Bedroom Scheme	\$14,032,953.00	105
Masonry and Precast Mixed Bedroom Scheme	\$14,492,949.00	97
Formed in Place Concrete Floor Alternate (Single)	\$16,443,299.00	121
Formed in Place Concrete Floor Alternate (Mixed)	\$16,667,984.00	112
Precast Construction Single Bedroom Scheme	\$16,225,118.00	119
Precast Construction Mixed Bedroom Scheme	\$15,925,021.00	107
ICF Walls & Precast Planks Single Bedroom Scheme	\$15,002,874.00	110
ICF Walls & Precast Planks Mixed Bedroom Scheme	\$15,138,394.00	102
Formed in Place Concrete Floor Alternate (Single)	\$17,085,823.00	126
Formed in Place Concrete Floor Alternate (Mixed)	\$17,259,125.00	116
Interior CMU Walls Alternate (Single)	\$14,779,312.00	109
Interior CMU Walls Alternate (Mixed)	\$14,914,849.00	100

## 

### Merrillville - Single Bedroom Scheme





Conventional Wood Frame	Light Gauge Steel	Masonry Precast Plank	□ Masonry Cast-in-Place
Precast	ICF / Precast	ICF / Cast-in-Place	□ICF / Masonry

### Conclusion

Based on the construction cost estimates prepared by Poole Anderson Construction, the cost associated with a compartmentalized construction method utilizing a concrete based material was generally less than 5 percent of the overall construction cost. Comparatively speaking this amount is less than the contingency budget typically recommended for the owner to carry for unanticipated expenditures during the project.





The minimal increase in construction cost can be paid for over the life of the structure. Materials like concrete masonry, precast concrete, and cast-in-place concrete have many other advantages beyond their inherent fire performance including resistance to mold growth, resistance to damage from vandalism, and minimal damage caused buy water and fire in the event of a fire in the building. In many cases, with this type of construction the damage outside of the fire compartment is minimal. This provides for reduced cleanup costs and quicker reoccupation of the structure.

### Containment Example: Dormitory Fire Contained

On October 11, 2001, fire engulfed the Rees Hall Dormitory at Hobart and William Smith Colleges in Geneva, New York. Temperatures soared as high as 1800 degrees Fahrenheit resulting in melted plastic picture frames, light fixtures, smoke detectors, metal hinges and the steel door of the room where the fire began. Within 20 minutes, the raging fire had caused approximately \$100,000 in damages. This small repair bill was attributed to the fact that concrete construction contained the fire and saved the building from being completely destroyed.

Originally constructed in 1969 with concrete masonry and hollow-core floor planks, the building is "durable and fire resistant," says Christopher J. Button, Senior Project Manager, HWS, "and has much lower maintenance and insurance costs." Replacing the entire structure would have cost as much as \$5 million.

Button says he'd always believed any building with a smoke detector and non-combustible materials would withstand similar catastrophes, but after seeing how concrete stood up to the intense fire, he's "a believer in concrete construction."

