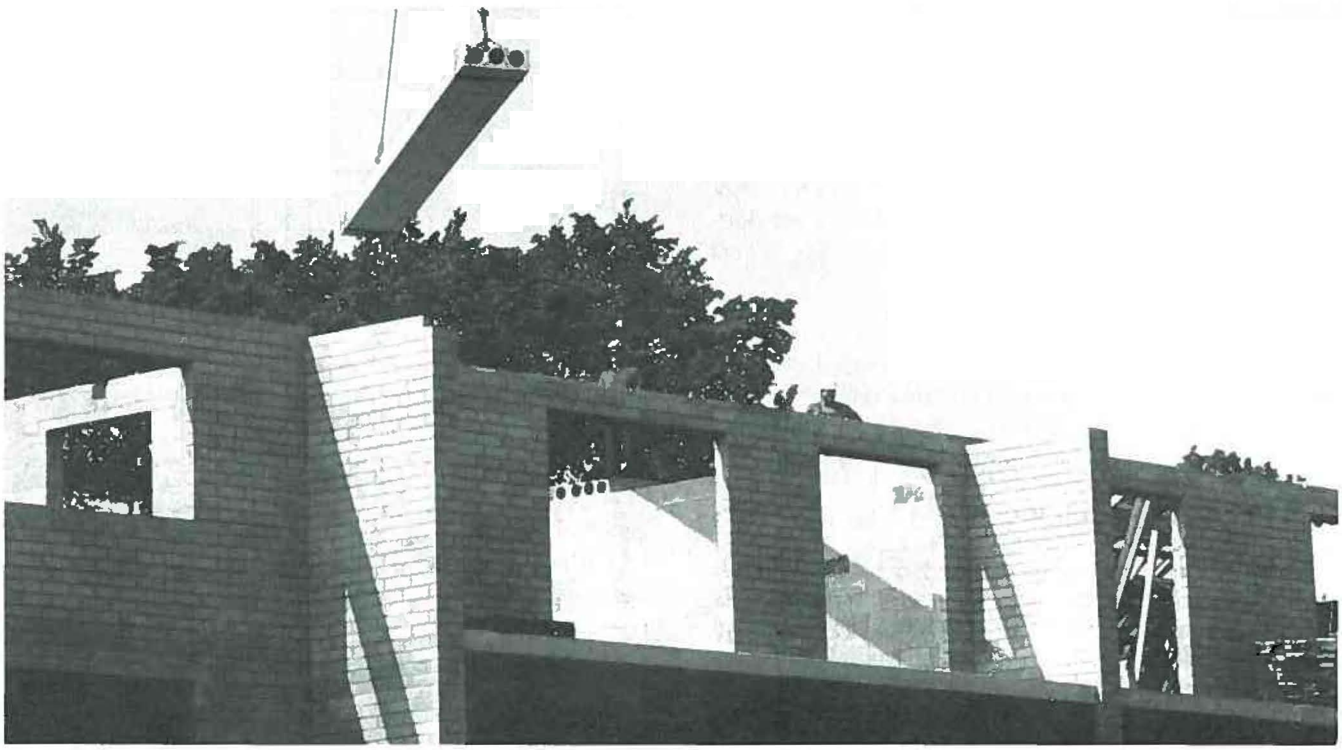
fire protection planning report

BUILDING CONSTRUCTION INFORMATION FROM THE CONCRETE AND MASONRY INDUSTRIES

NO. 15 OF A SERIES

A Comparison of Insurance and Construction Costs for Low-Rise Multifamily Dwellings



Brick, block, and hollow-core building materials are utilized in this noncombustible multifamily structure. Only concrete or masonry constructed walls, floors, and roof will guarantee the owner the lowest-base fire insurance rates.

INTRODUCTION

It has long been a common belief that constructing low-rise multifamily dwellings with concrete and masonry is overly expensive when compared to wood. Evidence is now available to put this misconception to rest.

With the passage of the 1986 Tax Reform Law, the incentives of owning income property for tax-sheltering purposes have been greatly reduced. Prospective owners must now take a much harder look at the income-producing potential of a property. Durability of construction, lowering of long-term expenses, and increasing income all become important factors in increasing profit margins. Concrete and masonry construction can provide the means for meeting these demands.

Some of the economic advantages of concrete and masonry over wood frame are listed below:

a. Lower insurance premiums
b. Lower maintenance costs due to durability of construction
c. Lower energy costs

d. Higher rent potential due to greater tenant appeal of acoustically superior, fire-resistive, noncombustible construction
e. Better resale value

PURPOSE

The purpose of this report is to make prospective building owners, building officials, developers, landlords, and tenants aware of the advantages of concrete and masonry low-rise multifamily dwellings. The report will focus on the economic benefits of constructing with concrete and masonry building materials and, through a life-cycle cost analysis, will show that it is actually less expensive to own a concrete and masonry building than one constructed of wood frame.

Although energy and maintenance savings are also realized in constructing with concrete and masonry, only construction, sprinkler, mortgage, and insurance cost considerations will be addressed in this text.

DETERMINATION OF CONSTRUCTION COSTS

In Examples 1 and 2, cost comparisons are made between a concrete and masonry building and one constructed of wood frame. Example 1 compares two nonsprinklered buildings and Example 2, two sprinklered buildings.

Construction costs were derived mainly from a University of Michigan study entitled "Comparative Cost of Fire Separations for Multiunit Residential Buildings".[1] The report allows estimation of construction cost differences of low-rise multifamily dwellings based on the building's wall and floor separations, thereby providing a basis for the calculation of construction costs.

Starting with an average of construction cost differences for configurations shown in Figures 1a through 1d, cost adjustments were made to reflect design deviations from the University of Michigan report. Modifications included replacing the wood roof on the concrete and masonry building with an 8-in. hollow-core roof, replacing the truss roof on the wood-frame building with a flat roof, and adding brick masonry as exterior cladding to both buildings. Details of the finished wall-floor separation assemblies are shown in Figs. 2 and 3. Brick masonry was used on exterior walls only.

With all the adjustments made, the resulting construction cost difference was about $3.20 per square foot more for the concrete and masonry building. Price modifications for these changes were obtained from the University of Michigan report as well as Chicago-area precast producers and builders.

DETERMINATION OF SPRINKLER COSTS

Sprinkler installation costs of $1.25 per square foot for the wood-frame building and $1.10 per square foot for the concrete and masonry building are used in Example 2.

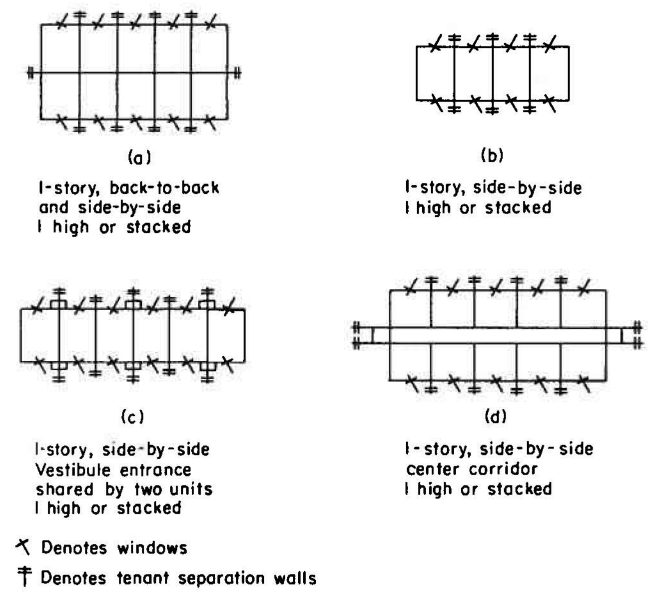


Fig. 1. Common building configurations.

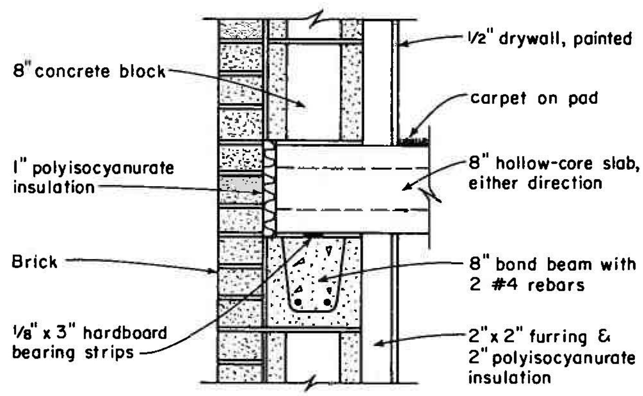


Fig. 2. Hollow-core floor slab and composite wall of fire-resistive structure (Building 2).

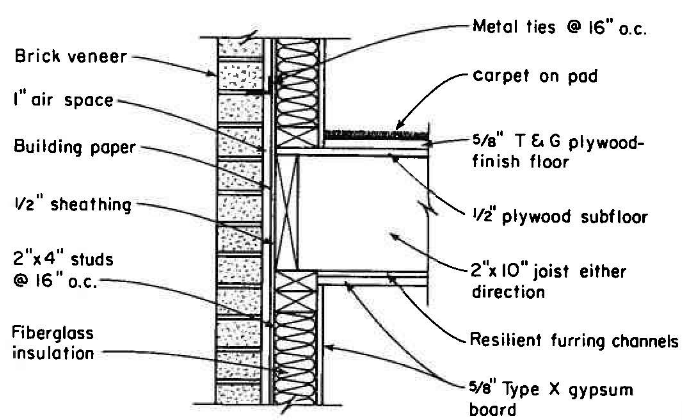


Fig. 3. Wood-joist floor and composite wall of wood-frame structure (Building 1).

These figures are average costs based on estimates provided by four Chicago area sprinkler contractors. Pumps and standpipe systems were not considered.

It is interesting to note that, although much of the higher cost of installing sprinklers in a wood-frame building is due to attic sprinklers, all of the contractors surveyed indicated that the installation cost of sprinklers for a wood-frame building will typically cost at least 15% more than for a concrete and masonry building. If combustible concealed spaces are present, the cost of sprinklers for the wood-frame building could become significantly higher yet, approaching $2.50 per square foot.

INSURANCE RATES

Construction costs provide a basis for evaluating insurance limits. However, rating information and general knowledge of insurance principles are necessary to determine annual insurance premiums. This methodology is explained at appropriate stages in the example that follows:

Table 1. Insurance Rates for Low-Rise Multifamily Dwellings in Illinois

	Frame	Fire resistive
Building	1.056	.067
Contents	.378	.085
Extended coverage, building	.173	.053
Extended coverage, contents	.173	.053
Loss of rents*	.655	.042

*Loss of rents calculated at 62% of building rates.

Base rates provided by the Insurance Services Office (ISO), which is the dominant insurance rating bureau in the country, are modified by NATLSCO's proprietary operating costs.

Deductibles are not considered.

Rates reflect a public protection class 4 (1 being the best and 10 the worst), which is an indication of the adequacy of a community's fire department and water supply.

80% coinsurance rates are used. This is a requirement whereby an insured must carry an amount of insurance greater than or equal to 80% of the appraised value of the insured's property (building and contents). Since the rates have already been adjusted to 80%, limits used in the example will reflect 100% values.

Rates are expressed in dollars and are applied per $100 of value.

Rates are applicable in Illinois for buildings of 11 to 30 units.

Rates in Table 1 were extracted from a report prepared by the National Loss Control Service Corporation (NATLSCO).[2] Since rates are independent of building configuration, they are identically applied to each of the configurations shown in Figures 1a through 1d.

Terms in the far left column of Table 1 indicate coverages. "Building" and "Contents" refer to coverages insured under the standard fire portion of a policy. This section basically provides coverage from loss against fire, lightning, and resultant water damage from firefighting efforts.

"Building" denotes the rates that will be applied to building limits. The generated premium is the insurance company's fee for covering damages to the physical structure in the event of an insurable loss.

"Contents" denotes the rates that are to be applied to the amount of the owner's contents on the premises. Typical items covered include refrigerators, stoves, cabinets, and carpeting.

Rates for extended coverages are also indicated as they apply to the building and contents. These coverages include damages from windstorm, hail, aircraft, riot and civil commotion, vehicles, explosion, and smoke. Along with coverage for fire, theft, vandalism, and malicious mischief, these extended coverages basically provide the policyholder with all-risk coverage, excluding flood and earthquake.

"Loss of rents" refers to the rates that will be applied to the 100% annual rental income amount (typically calculated as a percentage of the corresponding building rate). This coverage takes effect when a tenant space becomes untenable due to damages from an insured peril.

Construction categories in the table are ISO terms and are defined below:

Frame: Buildings having exterior walls of wood or other combustible materials, including construction where combustible materials are combined with other materials (such as brick veneer, stone veneer, aluminum siding, or stucco on wood).

Fire Resistive: Buildings having exterior walls, floors, and roof constructed of masonry or fire-resistive materials having a fire-resistance rating of not less than two hours.

EXAMPLE 1
COST COMPARISON ANALYSIS FOR NONSPRINKLERED BUILDINGS

Example 1 illustrates how the insurance industry applies rates to low-rise multifamily dwellings of various construction types.

PART A
Establishing Limits

BUILDING LIMITS

Starting with a typical average value of $40 per square foot [3,4,5] for a wood-frame structure and adding $.63 per square foot for the cost of the brick masonry results in an initial construction cost of $40.63 per square foot. Multiplying this by the total floor area establishes the building value at $1,228,651. Likewise, using the $3.20 per square foot cost difference between the two structures and repeating the procedure results in a cost of $43.83 per square foot or $1,325,419 for the concrete and masonry building.

These figures are rounded to the nearest $100 and used as building limits in Part B.

CONTENTS LIMITS

Contents limits will be assumed the same for both buildings. The contents limit of $50,500 is derived based on a relationship between a typical amount of an owner's contents found in an apartment building, and the building's total floor area.

LOSS-OF-RENTS LIMITS

Loss-of-rents limits used in this example are also equal for both buildings, although it is likely that the concrete and masonry building would command higher rents. The limit is established by taking 100% of the annual rental income, or $216,000 based on an assumed monthly rent of $600 per unit.

EXTENDED COVERAGE LIMITS

Limits for extended coverage are identical to their corresponding building and contents limits.

PART B
Calculating Insurance Premiums

Combining the rating information from Table 1 with the limits just established, annual premiums for Buildings 1 and 2 are determined as shown in Table 2.

Rates are shown in dollars and are applied per $100 of value. Multiplying limits by the rates and dividing by 100 yields the annual premiums. Dividing these totals by the number of units results in per-unit insurance costs of $560 for Building 1 and $58 for Building 2: a savings of $502 more per unit for the concrete and masonry structure.

LIFE-CYCLE INSURANCE COSTS

If one considers the cost impact of insurance premiums over the 30-year depreciated life of a building, the comparison is even more revealing. This is done by using the life-cycle cost-analysis equation[6] shown as Eq. 1 in Part C of the example box. By doing this, insurance dollars over the life of the building can be discounted to present value to facilitate a direct comparison of initial costs and insurance costs.

CHOOSING THE PARAMETERS

Discount Rate

For the analysis to be meaningful, it is very important that realistic discount and escalation rates be used. The real discount rate is often taken as the prime interest rate on one-year U.S. Treasury bills less inflation. In this example, a conservative figure of 5% is used. Historically, however, based on quarterly data over the last 35 years, the real discount rate has averaged only 1.4%.[7]

Escalation Rate

The escalation of insurance rates is harder to predict for a number of reasons. Some of them are listed below.

1. Historical data over a period of time is not readily available or easily attainable (for proprietary reasons).
2. Rates vary by geography.
3. Rates vary by insurance company.
4. Rate development is not scientific by nature; and therefore rates often vary from one underwriter to the next, even within the same insurance company.

Economic hardships suffered by the insurance industry recently have caused rates to increase significantly. If anything was learned from this it is that the rate development process should become less volatile in the future. Since huge rate increases have already been initiated, it is likely that high insurance rates are here to stay. In light of this information, an escalation rate of 10%, less 2% inflation, does not seem unreasonable and is used in the example. The sensitivity of this assumption will be examined later in this report.

Other Parameters

Values for the other parameters are shown in Part C of the example box. Substituting them into Eq. 1 and solving for *P* results in a life-cycle insurance savings of $24,005 per unit for the concrete and masonry building. This figure

Table 2. Calculation of Annual Insurance Premiums, in Dollars

Coverage type	Wood frame (Building 1)			Fire resistive (Building 2)		
	Limits	Rate	Premium	Limits	Rate	Premium
Building	1,228,700	1.056	12,975	1,325,400	.067	888
Contents	50,500	.378	191	50,500	.085	43
Extended coverage, building	1,228,700	.173	2,126	1,325,400	.053	702
Extended coverage, contents	50,500	.173	87	50,500	.053	27
Loss of rents	216,000	.655	1,415	216,000	.042	91
Totals			16,794			1,751

Building 1 (frame) .... $16,794/30 units = $560/unit
Building 2 (fire resistive) .... $1,751/30 units = $58/unit
Savings in annual insurance premiums .... $502/unit more for concrete and masonry

Limits are 100% values.
Rates are in dollars per $100 of value.
80% coinsurance rates are used.

represents the present-day dollars of insurance premiums that are saved over the 30-year period due to constructing with concrete and masonry.

LIFE CYCLE MORTGAGE AND PROPERTY TAX COSTS

Differences in real-estate taxes and mortgage payments for the two buildings, assuming a 20% cash down payment and a mortgage interest rate of 10% amortized over 25 years, are also considered. Annual mortgage payments are $281 per unit higher for the concrete and masonry structure. The difference in real-estate taxes adds another $187 per unit (Chicago area), bringing the total to $468 per unit more for the concrete and masonry building.

Because differences in mortgage payments and real-estate taxes are assumed constant, the present value of these quantities is calculated using Eq. 2 in Part C of the example box.

Solving the equation indicates that the life-cycle cost of mortgage payments and taxes for the concrete and masonry building is $6,596 per unit more in present-day dollars than the wood-frame building. However, comparing differences in all costs including construction, insurance, real estate taxes, and mortgage payments for the two structures over a 30-year period results in a *savings* of $16,764 per unit for the concrete and masonry building. For a 30-unit building, this translates into the concrete and masonry building actually costing the owner $502,920 less in present-day dollars than the wood-frame structure.

EXAMPLE 2
COST COMPARISON ANALYSIS FOR SPRINKLERED BUILDINGS

Assuming both buildings in Example 1 were sprinklered, a similar analysis can be made.

Repeating the procedure in Example 1 and applying a 15% sprinkler credit for each building results in per-unit insurance costs of $489 for Building 1 and $51 for Building 2—a savings of $438 per unit for the concrete and masonry structure.

It should be noted that the 15% credit on insurance costs given to each building is typical of that being given by some insurance companies. It is by no means a standard, as many insurance companies allow no credit for sprinklers in low-rise multifamily occupancies.

Continuing with a life-cycle cost analysis using the same parameters in Example 1 results in insurance savings of $20,944 per unit in present-day dollars for the concrete and masonry building.

Considering differences in costs of construction, sprinkler, insurance, mortgage, and real-estate taxes over the 30-year period, the savings for the concrete and masonry building is $14,043 per unit.

For a 30-unit building, this translates into a savings of $421,290 in present-day dollars over the life of the building.

SPRINKLERED-NONSPRINKLERED COMPARISONS

In analyzing the results of the two examples, one can see that concrete and masonry construction costs less in both cases—sprinklered and nonsprinklered. A comparison is shown in Table 3.

Table 3. Average per Unit Life-Cycle Savings Obtainable by Constructing with Concrete and Masonry

	Construction type		
	Wood fame (Building 1)	Fire resistive (Building 2)	Savings
Protection	nonsprinklered	nonsprinklered	$16,764
	sprinklered	sprinklered	$14,043
	nonsprinklered	sprinklered	$15,312
	sprinklered	nonsprinklered	$17,807

Savings shown are per unit differences considering insurance, construction, mortgage, real estate tax, and sprinkler costs and are based on the following:

a. comparison of concrete and masonry structure (Building 2) to wood-frame structure (Building 1)
b. rates prepared by NATLSCO[2]
c. 15% sprinkler credit applied where applicable
d. annual escalation of insurance rates = 8%
e. cost analysis period = 30 years
f. real discount rate = 5%
g. 10% mortgage rate amortized over 25 years; 80% loan

SENSITIVITY ANALYSIS

To determine how economic trends affect the analysis, the real discount rate, *i*, the escalation rate of insurance premiums, *e*, and the mortgage rate must be examined. If the average historical discount rate of 1.4% indicated earlier is used with the parameters in Part C of the example box, the factor in brackets by which the difference in premiums, *A*, is multiplied increases from 47.818 to 92.142, thereby almost doubling the savings.

If interest rates go up and 12% returns on investments become common, inflation is likely to increase also, keeping the real discount rate relatively unchanged. So even though the cost of money is higher, the bracketed quantity in the example box, Part C, remains about the same. For the nonsprinklered analysis, using the parameters in Example 1, a 14% mortgage rate amortized over 25 years, and an 80% loan, the total difference in savings considering construction, taxes, mortgage, and insurance costs is $15,466 per unit more for concrete and masonry over the life of the building. For the sprinklered analysis, the corresponding difference in savings is $12,803 per unit. (It should be noted, however, that at 14% interest, neither building is likely to maintain a positive cash flow at the assumed rental rates.)

On the other hand, if the escalation of insurance rates changes, increasing at an annual rate of 20% instead of 10%, less 2% inflation, and the discount rate remains at 5%, the bracketed quantity in Part C increases from 47.818 to 292.029. Keeping the mortgage terms fixed at 10% interest, 25-year amortization, and 80% loan, the result is a per-unit savings of $139,358 for the nonsprinklered case and $121,008 per unit for the sprinklered case. For a 30-unit building, using the lesser savings of the two scenarios (sprinklered case), an owner of the concrete and masonry structure would save $3,630,240 over the 30-year duration!

It is easy to see that the escalation of insurance rates is the controlling factor and why it is so important to keep insurance costs down. The additional construction cost, including sprinklers, and associated finance charges attributed to constructing with concrete and masonry is miniscule by comparison.

SUMMARY AND CONCLUSIONS

This report is targeted at prospective building owners, building officials, developers, landlords, and tenants. The advantages of concrete and masonry construction as it affects these interests is summarized below.

Landlords and prospective owners—Greater profit potential of a property is achieved through savings in insurance, energy, and maintenance costs. The flexibility in determining rental values contributes to a lower vacancy rate. Increased durability of building materials will support a higher resale value.

Developers—The same advantages above apply if the developer chooses to retain ownership of the property upon completion of the project. Better marketability of concrete and masonry will likely lead to a quicker sale once the project is completed. The use of concrete and masonry design should be investigated, as construction cost comparisons with wood-frame construction reveal that differences are not as great as commonly believed.

Building officials—Upgrading to 2-hour noncombustible is not cost prohibitive. Insurance savings alone that are associated with concrete and masonry construction over a period of time will even pay for the cost of installing a sprinkler system. Occupants and owners are thereby provided with the ultimate in fire protection—a balanced system design of 2-hour noncombustible construction and automatic sprinklers (and smoke detectors).

Tenants—Insurance rates applied to concrete and masonry constructed buildings are very stable. Unlike other construction types, where insurance premiums may fluctuate tremendously from year to year, tenants living in concrete and masonry constructed buildings are not subjected to excessive rent increases due to the unpredictable nature of fluctuating premiums. More importantly, they are provided with a degree of safety that protects them against careless actions of their neighbors.

Concrete and masonry construction can help reduce the billions of dollars of property damage that occurs every year in residential buildings. As damage to property decreases so does the number of potential homeless. High insurance costs for frame buildings often cause owners to cut back in the amount of coverage that is needed, so that if a fire does occur, there are not enough insurance funds available to fully recover the loss. This leads to prolonged vacancies, which in turn can lead to a decline in the overall upkeep of buildings and eventually entire neighborhoods.

The following conclusions can be drawn from this report:

1. Initial construction cost differences between concrete and masonry low-rise multifamily dwellings and those of wood frame are much less than commonly believed.
2. With the 1986 Tax Reform Law limiting the tax shelter benefits of income property, the long-range income-producing potential of a building becomes increasingly important.
3. Choosing an appropriate real discount rate is essential for meaningful results when conducting a life-cycle cost analysis. As a rule of thumb, this figure should be between the historical rate of 1.4% and a value determined by the prime rate on one-year U.S. Treasury bills minus the inflation rate.
4. Escalating insurance rates, the rate of inflation, and the number of years in which a building can be fully depreciated all influence the results of a life-cycle cost analysis. While the parameter having the greatest influence, the escalation of insurance rates, cannot directly be controlled by the consumer, he can control which set of rates will be applied, based on the type of building construction he chooses.
5. Insurance savings associated with 2-hour-rated concrete and masonry construction are so substantial over the life of the building that they will offset any additional construction, sprinkler, *and* finance costs many times over under most reasonable economic conditions.
6. Only by having the walls, floors, and *roof* constructed of concrete or masonry can one be guaranteed of getting the lowest-base insurance rates.
7. For new construction, it is less expensive to install a sprinkler system in a concrete and masonry building than in a wood-frame building.

REFERENCES

1. Carr, Robert I., *Comparative Costs of Fire Separations for Multiunit Residential Buildings,* Technical Report No. 3, Center for Construction Engineering and Management, Department of Civil Engineering, University of Michigan, Ann Arbor, Michigan, July 1986.
2. *Insurance Rate Analysis Low Rise Multifamily Buildings,* NATLSCO, National Loss Control Service Corporation, Long Grove, Illinois, January 1986.
3. "Building Valuation Data," *Southern Building,* November/December, Southern Building Code Congress International, Inc., Birmingham, Alabama, 1986.
4. "Building Valuation Data Report," *The Building Official and Code Administrator,* November/December, Building Officials and Code Administrators International, Inc., Country Club Hills, Illinois, 1986.
5. "Building Valuation Data," *Building Standards,* November/December, International Conference of Building Officials, Whittier, California, 1986.
6. Marshall, Harold E., *Recommended Practice for Measuring Simple and Discounted Payback for Investments in Buildings and Building Systems,* NBSIR 84-2850, U.S. Department of Commerce, National Bureau of Standards, Washington, D.C., March 1984, page 9.
7. Roy, Robert, "Choosing the 'Right' Discount Rate," Portland Cement Association, Skokie, Illinois, 1986.

EXAMPLE 1
NONSPRINKLERED BUILDINGS

Two 3-story buildings of identical size and shape are analyzed. According to the definitions above, Building 1 is considered as frame construction with 1-hour-rated separation floors and walls and an unrated roof. Building 2 is categorized as fire resistive, having 2-hour-rated concrete or masonry separation floors, walls, and roof. Both are comprised of ten 1008-sq ft units per floor, or 30 units each. All units contain two bedrooms, a kitchen, a living-dining room area, and one bathroom. The height of each building is 24 feet.

PART A
Establishing Limits

BUILDING LIMITS

Building 1 (Wood frame)

Typical construction cost: $40/sq ft
Cost of brick masonry:
average perimeter wall area:
592 ft × 24 ft = 14,208 sq ft
cost per square foot of floor area:
14,208 × $1.35 / (1008 × 30) = $.63
Total construction cost:
$40.63/sq ft × 1008 sq ft/unit × 30 units = $1,228,651

Building 2 (Fire resistive)

Building 1 cost: $40.63/sq ft
Additional cost of concrete and masonry building: $3.20/sq ft
Total construction cost:
$43.83/sq ft × 1008 sq ft/unit × 30 units = $1,325,419
Per-unit difference in construction cost:
($1,325,419 − $1,228,651)/30 = $3,226/unit more for concrete and masonry

CONTENTS LIMITS

$1.67/sq ft × 1008 sq ft/unit × 30 units = $50,500

LOSS-OF-RENTS LIMITS

$600/month/unit × 12 months/year × 30 units = $216,000

EXTENDED COVERAGE LIMITS

Identical to their corresponding building and contents limits.

PART B
Calculating Insurance Premiums

Using Table 1 rates, annual premiums for Buildings 1 and 2 are as shown in Table 2.

PART C
Life-Cycle Cost Analysis

LIFE-CYCLE INSURANCE COSTS

Using

$$P = A\{(1 + e)/(i - e) \times [1 - ((1 + e)/(1 + i))^n]\} \quad \text{Eq. 1}$$

where

- A, *the annual insurance savings, was calculated in Part B as $502*
- n, *the number of years of the analysis period, is assigned at 30 to reflect the new allowable depreciable life of a building*
- P *is the present value of insurance savings over the 30-year period*
- i, *the real discount rate, is set at 5%*
- e, *the annual escalation of insurance rates, less inflation, is assumed at 8%*

Substituting and solving for P,

$$P = \$502 \times [(1.08/-.03) \times (1 - (1.08/1.05)^{30})]$$
$$P = \$502 \times [47.818] = \$24{,}005/\text{unit}$$

LIFE CYCLE MORTGAGE AND PROPERTY TAX COSTS

Using

$$P = A'[((1 + i)^n - 1)/i(1 + i)^n] \quad \text{Eq. 2}$$

Substituting: $A' = \$468$
$i = .05$
$n = 25$ *and solving for P,*
$$P = \$468 \times [((1.05)^{25} - 1)/.05(1.05)^{25}]$$
$$P = \$468 \times [14.094] = \$6{,}596/\text{unit}$$

Per-unit cost savings for the concrete and masonry building can be expressed

$$\text{Savings} = P_{insurance} - P_{mortgage + taxes} - .2P_{construction}$$
$$= \$24{,}005 - \$6{,}596 - (.2 \times \$3{,}226) = \$16{,}764/\text{unit}$$

(Construction cost difference is multiplied by 20% to reflect the down payment at the time of purchase.)

EXAMPLE 2
SPRINKLERED

Building 1 (Wood frame)

Nonsprinklered construction cost	*$1,228,651*
Sprinkler installation cost	*37,800*
Total initial cost (to nearest hundred)	*$1,266,500*

Building 2 (Fire resistive)

Nonsprinklered construction cost	*$1,325,419*
Sprinkler installation cost	*33,264*
Total initial cost (to nearest hundred)	*$1,358,700*

Per-unit difference in construction and sprinkler cost:
($1,358,700 − $1,266,500)/30
= $3,073/unit more for concrete and masonry

Applying a 15% insurance-rate credit for sprinklers to each and repeating the procedure in Example 1, per-unit cost savings for the concrete and masonry building is expressed as

$$\text{Savings} = P_{insurance} - P_{mortgage + taxes} - .2P_{construction + sprinklers}$$
$$= \$20{,}944 - \$6{,}286 - (.2 \times \$3{,}073) = \$14{,}043/\text{unit}$$

Concrete and Masonry Industry Firesafety Committee
5420 Old Orchard Road, Skokie, Illinois 60077-4321

Printed in U.S.A.

SR277.01B