LIFE-CYCLE COSTING REVEALS MASONRY'S LONG-TERM VALUE

A comparative analysis of four wall systems showed 4-inch brick with 8-inch concrete masonry to be the most cost-effective

Stephen J. Kirk of Smith, Hinchman & Grylls Associates Inc. presented this information at The Third National Concrete and Masonry Engineering Conference (NCMEC III), co-sponsored by Brick Institute of America, Mason Contractors Association of America, National Concrete Masonry Association, Portland Cement Association, The Aberdeen Group, and other industry organizations.

When deciding which exterior-wall system to choose for a building, you can compare initial construction costs relatively easily. But to select the wall system that will be the most cost-effective over time, you need to estimate the costs to be incurred during the building's anticipated life. Life-cycle costing (LCC) is an economic analysis of building-system alternatives, in which projected costs are expressed in present-year value.

In 1994, the Council for Masonry Research (CMR) commissioned Smith, Hinchman & Grylls Associates Inc. (SH&G) to conduct an LCC analysis of four exterior wall systems:

1. 4-inch brick with 8-inch concrete masonry
2. glass curtain wall
3. metal panel system
4. heavy-duty exterior insulated finish on steel studs

The study was designed to determine which exterior-wall alternative provides the best long-term economic value based on initial costs, cyclical renewal costs, and annual costs. SH&G based the initial costs on actual product data

Alternative 1: 4″ brick with 8″ concrete block — **Best estimate**

INITIAL COSTS (construction costs)

Description	Quantity	Unit price (best est.)	Estimate	Present worth
4-inch brick	83,200 wall ft²	$8.00	$665,600	$665,600
8-inch concrete block	83,200 wall ft²	$5.50	$457,600	$457,600
Sealant	2,700 linear ft	$1.50	$4,050	$4,050
Insulation	83,200 wall ft²	$1.40	$116,480	$116,480
Interior gypsum and metal studs	74,880 wall ft²	$1.75	$131,040	$131,040
Interior-wall painting	74,880 wall ft²	$0.30	$22,464	$22,464
General conditions, overhead and profit	15.00%		$209,585	$209,585
Total initial cost		**$21.46**		**$1,606,819**

CYCLICAL RENEWAL COSTS (based on average frequency)

Description	Year	Present-worth factor	Estimate	Present worth
Sealant at joints	13	0.4150	$14,445	$5,994
Cleaning	15	0.3624	$163,488	$59,255
Miscellaneous repair	20	0.2584	$217,152	$56,116
Total replacement/salvage costs				**$121,365**

ANNUAL COSTS

Description	$/Gross ft²/Year (best estimate)	Present worth of annuity factor	Estimate	Present worth
Energy/fuel cost	$2.75	11.654	$853,743	$9,949,165
Maintenance and repair		11.654	$0	$0
Total annual costs (present worth)				**$9,949,165**

Total life-cycle costs (present worth) **$11,677,349**

Source: Smith, Hinchman & Grylls Associates Inc. (Reference)

Alternative 2: Glass curtain wall — **Best estimate**

INITIAL COSTS (construction costs)

Description	Quantity	Unit price (best est.)	Estimate	Present worth
Glass curtain wall	83,200 wall ft²	$28.00	$2,329,600	$2,329,600
Sealant at joints	11,000 linear ft	$1.50	$16,500	$16,500
Window gasket	20,800 linear ft	$4.25	$88,400	$88,400
Mullion coating	20,800 linear ft	$0.00	$0	$0
Insulation	83,200 wall ft²	$1.40	$116,480	$116,480
Interior gypsum and metal studs	74,880 wall ft²	$1.75	$131,040	$131,040
Interior wall painting	74,880 wall ft²	$0.30	$22,464	$22,464
General conditions, overhead and profit	15.00%		$405,673	$405,673
Total initial cost		**$37.38**		**$3,110,157**
Initial cost present worth difference (compared to Alternative 1)				**$1,503,338**

CYCLICAL RENEWAL COSTS (based on average frequency)

Description	Year	Present-worth factor	Estimate	Present worth
Sealant at joints	13	0.4150	$61,600	$25,561
Gasket replacement	20	0.2584	$120,328	$31,095
Mullion coating	20	0.2584	$163,488	$42,248
Total replacement/salvage costs				**$98,904**

ANNUAL COSTS

Description	$/Gross ft²/Year (best estimate)	Present worth of annuity factor	Estimate	Present worth
Energy/fuel cost	$3.15	11.654	$977,924	$11,396,316
Glass cleaning (twice per year)		11.654	$169,728	$1,977,939
Total annual costs (present worth)				**$13,374,255**
Total life-cycle costs (present worth)				**$16,583,316**

Life-cycle present worth difference (compared to Alternative 1) **$4,905,967**

from a recent project—a 310,452-square-foot university research facility in Minneapolis. CMR supplied the cyclical renewal cost data, based on Minneapolis rates and verified by SH&G. The project life cycle was 25 years and the discount rate, 7% (Reference).

Of the four wall systems analyzed, SH&G found the masonry alternative to have the second-lowest initial costs at $1,606,819, only 4% higher than the $1,546,985 estimate for the heavy-duty insulated finish alternative (see tables). The masonry system's total initial costs were about 48% less than the estimate for the metal panel system, $2,376,537, and about 94% less than the estimate for the glass curtain wall, $3,110,157.

The masonry alternative also had the second-lowest cyclical renewal (repair, replacement, and cleaning) costs, with total replacement/salvage costs at $121,365, 23% higher than the $98,904 estimate for the glass curtain wall. The cyclical renewal costs for both the heavy-duty insulated finish system and the metal-panel system, at $449,887 and $450,110, respectively, were about 270% higher than for masonry.

Alternative 3: Metal panel system — **Best estimate**

INITIAL COSTS (construction costs)

Description	Quantity	Unit price (best est.)	Estimate	Present worth
Metal panel system (aluminum)	83,200 wall ft²	$22.75	$1,892,800	$1,892,800
Sealant at joints	13,200 linear ft	$1.50	$20,250	$20,250
Insulation (included in panel)	83,200 wall ft²	$0.00	$0	$0
Interior gypsum and metal studs	74,880 wall ft²	$1.75	$131,040	$131,040
Interior wall painting	74,880 wall ft²	$0.30	$22,464	$22,464
General conditions, overhead and profit	15.00%		$309,983	$309,983
Total initial cost		**$31.74**		**$2,376,537**
Initial cost present worth difference (compared to Alternative 1)				**$769,718**

CYCLICAL RENEWAL COSTS (based on average frequency)

Description	Year	Present-worth factor	Estimate	Present worth
Coatings	13	0.4150	$264,992	$109,962
Sealant at joints	13	0.4150	$66,218	$27,477
Panel cleaning	5	0.7130	$169,728	$121,013
Panel cleaning	10	0.5083	$169,728	$86,281
Panel cleaning	15	0.3624	$169,728	$61,517
Panel cleaning	20	0.2584	$169,728	$43,860
Total replacement/salvage costs				**$450,110**

ANNUAL COSTS

Description	$/Gross ft²/Year (best estimate)	Present worth of annuity factor	Estimate	Present worth
Energy/fuel cost	$2.85	11.654	$884,788	$10,310,953
Panel cleaning (see above)		11.654	$0	$0
Total annual costs (present worth)				**$10,310,953**
Total life-cycle costs (present worth)				**$13,137,600**

Life-cycle present worth difference (compared to Alternative 1) **$1,460,251**

Alternative 4: Heavy-duty insulated finish, metal studs — **Best estimate**

INITIAL COSTS (construction costs)

Description	Quantity	Unit price (best est.)	Estimate	Present worth
Heavy-duty insulated finish	83,200 wall ft²	$13.00	$1,081,600	$1,081,600
Sealant at joints	11,000 linear ft	$1.50	$16,500	$16,500
Insulation (included in system)	83,200 wall ft²	$0.00	$0	$0
Gypsum and metal stud sheathing	74,880 wall ft²	$3.00	$224,640	$224,640
Interior wall painting	74,880 wall ft²	$0.30	$22,464	$22,464
General conditions, overhead and profit	15.00%		$201,781	$201,781
Total initial cost		**$18.59**		**$1,546,985**
Initial cost present worth difference (compared to Alternative 1)				**(–$59,834)**

CYCLICAL RENEWAL COSTS (based on average frequency)

Description	Year	Present-worth factor	Estimate	Present worth
Sealant at joints	11	0.4751	$49,445	$23,490
Repair cracks	15	0.3624	$247,520	$89,712
Replace surfaces	15	0.3624	$517,920	$187,718
Coatings	15	0.3624	$228,384	$82,776
Cleaning	15	0.3624	$182,624	$66,191
Total replacement/salvage costs				**$449,887**

ANNUAL COSTS

Description	$/Gross ft²/Year (best estimate)	Present worth of annuity factor	Estimate	Present worth
Energy/fuel cost	$2.85	11.654	$884,788	$10,310,953
Maintenance and repair		11.654	$0	$0
Total annual costs (present worth)				**$10,310,953**
Total life-cycle costs (present worth)				**$12,307,825**

Life-cycle present worth difference (compared to Alternative 1) **$630,476**

SH&G reported that, due to its energy efficiency and durability, the masonry system had the lowest estimated annual costs at $9,949,165, about 3.6% lower than the $10,310,953 estimates for both the metal panel and the heavy-duty insulated finish systems and 34% lower than the $13,374,255 estimate for the glass-curtain-wall system.

Analyzing these life-cycle cost data, SH&G found the masonry alternative to be the most cost-effective exterior wall system. Comparing the total life-cycle costs of each alternative, the masonry system, at $11,677,349 offered a 5% savings over the heavy-duty insulated finish system, at $12,307,825; a 13% savings over the metal panel system, at $13,137,600; and a 42% savings over the glass curtain wall system, at $16,583,316.

Reference

Stephen J. Kirk and Stephen Garrett, both of Smith, Hinchman & Grylls Associates Inc., "Life Cycle Costing: Case Study of Exterior Walls," *Proceedings from NCMEC III '95, The Third National Concrete and Masonry Engineering Conference*, held June 15-17, 1995, San Francisco.

PUBLICATION #M960555