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2012 Residential and Commercial Cost Tables

Overview of Methodology

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Introduction

The Department of Local Government Finance ("Department") has provided updates to Appendix C and Appendix G found in the 2002 Real Property Guidelines, commonly referred to as "cost tables" or "cost schedules," to help local assessors complete an accurate and uniform reassessment in 2012. The Department determined that the optimal method of completing the cost tables was to rely on a nationally-recognized source for cost information. Some such sources cater to the construction industry to help builders estimate costs, while others cater to the appraisal and insurance industries to help place an overall value on a property. After a bidding process, the Department selected a source (Craftsman Book Company) that caters to the construction industry. Because such estimates are used as a basis for construction contracts, they need to be more accurate than estimates used by appraisers and insurance companies – building contractor survival and profitability depend upon estimating accuracy.

The main difference between the estimating procedure for a builder and the process used in the appraiser/assessor's cost approach estimate involves preparing a single job estimate versus estimating the cost for a specified classification or type of real property. A contractor uses a specific building plan to estimate the cost for one property, whereas an assessor must estimate the cost that is ***typical*** for a specific class of property. The concept of defining what is "typical" for a specific class of property involves creating a ***model*** that describes that class of property and the construction characteristics that are usually found within that class or type of property. The Department's approach in developing the 2012 cost schedules was to use a construction cost source used by building contractors, which should be more accurate than any other source, and combine those more accurate costs with improved models that are capable of greater estimating accuracy, thus achieving greater overall accuracy in the new cost schedules.

Models require assumptions such as the typical perimeter for each size within the typical size range, wall height, materials, design complexity, quality, and other features typically found. A builder's blueprint is very specific and nothing is assumed. On the other hand, a model for a property class or use is mostly constructed from assumptions. When the Indiana manual was developed about 35 years ago, building design, materials, and codes were different from what is typically found in modern construction. One of the important tasks undertaken in the development of new cost schedules for the 2012 general reassessment was the realignment of underlying assumptions to conform to today's building designs and materials. The estimates are for the cost of constructing new buildings providing the same functional utility as the existing buildings do for owners, but not necessarily exact replacements of the existing structures. The new structure would use current building materials, design, and technology to provide a functionally equivalent building. This is the concept that underlies replacement cost new (RCN).

Assessor Implementation of the New Cost Tables

As mentioned in the previous section, the cost tables in the 2002 relied upon assumptions about the typical building structure of various property types (models). For example, the model for commercial office space (GCM General Office) assumed that the building would have many partitions—reflecting prominence of physical offices—whereas currently office space consists of very few partitions and the use of cubicles to create individual workspaces. As another example, basements in residential properties have become increasingly expensive to build, while the price of building a second story has not increased at nearly that rate, so it is much more typical in 2011 to find a newly constructed residence without a basement than it was in the past.

Each assessor is ultimately responsible for using cost information, combined with property sales and knowledge of his or her jurisdiction, to place an accurate market value-in-use on each property. Cost information provides an initial value estimate based on the cost to build a similar property, from which the assessor then applies market factors or other adjustments in order to arrive at the appropriate value. For example, sales may indicate that in a highly desirable neighborhood, residential properties are selling for a price that is significantly higher than the replacement cost new plus land, so the assessor would apply a neighborhood market factor to arrive at the assessment. Similarly, an assessor placing a value on a modern commercial office space would likely apply a partition adjustment to account for the fact that the property has fewer partitions than the original model included. The goal of valuing these properties is always to estimate their market value-in-use. Cost information is useful for this because newly constructed properties compete for buyers with properties that have already been built. However, **the final assessment should always consider evidence from local market transactions in addition to published costs.**

Local assessors use a number of factors to develop assessments for properties that differ from the base model that the cost tables assume: the adjustments in Schedule C, lighting adjustments, obsolescence, effective age, partition density, and market factors based on sales data. **It is very important for assessors to understand that all existing adjustments on properties are based upon old model assumptions, and must be reviewed as part of the 2012 general reassessment with the introduction of the new cost tables.** For example, the new cost tables have updated the assumptions in the commercial office space model to significantly reduce the number of partitions (reflecting heavy reliance on cubicles). If the commercial office space had a large partition adjustment in it, using the new cost table data with the old partition adjustment would create an inaccurately low assessment. The model now assumes fewer partitions, so considerably less partition adjustment would be necessary for this property.

Similarly, in most residential assessments, a sales comparison approach is used to derive an accurate assessment. Using the base of replacement cost new, assessors analyze the sales of properties by neighborhood to determine how much the market is above or below the cost value. They then apply a market factor to bring the cost value in line with the market. As the underlying cost data changes, the calculated “jumping off point” will also change, but the local market is unaffected by these changes. Therefore, the market factor necessary to arrive at an accurate assessment will likely need to be revisited and updated so that each property still reflects market value-in-use despite changes in the underlying replacement cost new.

The Department is confident that with the model assumptions updated to reflect current, real-world building practices, assessors will be able to use the cost tables to generate more accurate assessments with less reliance on the adjustments described above**. To achieve this result, as part of the 2012 reassessment, assessors must review the adjustments currently on the property and make necessary changes to arrive at an accurate market value-in-use for properties.**

Methodology for Updating the Cost Models: Residential

The residential cost model contains 38 key assumptions at 15 benchmark size points between 100 square feet and 5,000 square feet. At each size these assumptions define such elements as the exterior wall perimeter, pitch of standard roofs, attic, and half story, number of exterior doors and windows, number of interior doors by floor level, linear feet of interior wall partitions, and many other residential construction features. These assumptions were defined by careful analysis and documentation of the characteristics for 269 modern floor plans of 1-story, 1 1/2 story, and 2-story homes. In addition, 28 floor plans of 1-story and 2-story average quality homes from four major Indianapolis area homebuilders were analyzed and their 2011 selling prices obtained from builder websites. These homes were used in testing the accuracy of the new cost schedules. Table 1 contains the test results for these 28 model homes.

Table 1: Indiana 2012 Cost Schedule Computed Values of 28 Model Homes

Model Ref	Total Size	Floor1SF	Floor2SF	Access Date	Model Price	Land Value	Grade C RCN	RCN + Land	A/S_ratio
M-Fulton	1,152	1,152	-	3/16/2011	104,990	21,000	96,400	117,400	1.12
W-Concord	1,267	1,267	-	3/16/2011	110,000	21,900	99,900	121,800	1.11
M-Angelica	1,345	1,345	-	3/16/2011	127,990	25,100	101,500	126,600	0.99
R-Newport	1,426	1,426	-	3/16/2011	129,995	25,400	104,700	130,100	1.00
M-Sanibel	1,368	1,368	-	3/16/2011	130,990	25,600	102,300	127,900	0.98
W-Jackson II	1,433	1,433	-	3/16/2011	135,900	26,500	106,100	132,600	0.98
R-Hudson	1,450	1,450	-	3/16/2011	129,995	25,400	105,600	131,000	1.01
W-Ascott	1,607	1,607	-	3/16/2011	140,900	27,400	111,200	138,600	0.98
M-Argosy	1,804	1,804	-	3/16/2011	137,990	26,800	121,700	148,500	1.08
M-Kentmore	1,958	1,958	-	3/16/2011	153,990	29,600	127,800	157,400	1.02
B-Camden	1,888	1,888	-	3/16/2011	150,900	29,100	126,100	155,200	1.03
M-Cheswicke	2,245	2,245	-	3/16/2011	159,990	30,700	137,600	168,300	1.05
B-Dogwood	2,201	2,201	-	3/16/2011	159,900	30,600	139,200	169,800	1.06
R-Jackson	1,917	837	1,080	3/16/2011	137,995	23,500	120,500	144,000	1.04
M-Farrel	1,536	768	768	3/16/2011	119,990	20,700	110,000	130,700	1.09
M-Braiden	1,720	886	834	3/16/2011	125,990	21,600	118,700	140,300	1.11
M-Columbia	2,159	844	1,315	3/16/2011	151,990	29,600	124,300	153,900	1.01
W-Bedford	1,800	724	1,076	3/16/2011	119,900	23,900	114,000	137,900	1.15
R-Franklin	2,460	1,084	1,376	3/16/2011	148,995	29,100	139,800	168,900	1.13
M-Wakefield	2,090	1,054	1,036	3/16/2011	129,990	25,700	131,100	156,800	1.21
W-Bristol II	2,459	1,051	1,408	3/16/2011	159,900	31,000	141,000	172,000	1.08
B-Harrison	2,133	976	1,157	3/16/2011	149,900	29,200	130,700	159,900	1.07
B-Hartford	2,442	1,074	1,368	3/16/2011	164,900	31,900	136,300	168,200	1.02
W-Compton	3,010	1,214	1,796	3/16/2011	177,900	34,100	163,000	197,100	1.11
B-Independence	2,347	1,091	1,256	3/16/2011	159,900	31,000	137,400	168,400	1.05
R-Jamestown	3,007	1,393	1,614	3/16/2011	164,995	31,900	161,900	193,800	1.17
M-Torrey	2,760	1,530	1,230	3/16/2011	171,990	33,100	162,600	195,700	1.14
M-Augusta	3,287	1,577	1,710	3/16/2011	194,990	37,100	174,600	211,700	1.09
				Median Price	**144,948**			**Median ratio**	**1.06**
								COD	**4.75**

Methodology for Updating the Cost Models: Commercial and Industrial

General model assumptions for commercial and industrial properties are provided in Appendix D of the assessment guidelines. For each major commercial and industrial category (GCR, GCM, GCI) the assumptions for the building exterior shell are provided. The GCR category defines wood joist construction, which is very similar to residential construction. The GCM category defines fire resistant construction for a wide range of commercial building uses for office, retail, recreational, and many similar uses. The GCI category defines various types of industrial uses for warehouses, manufacturing, etc. Hence, within each of these major categories the exterior building construction is identical for each wall type. Within each major category (GCR, GCM, GCI) the interior finish varies according to the specific use such as retail, office, etc. The interior finish information in the model description is often less specific, such as “typical for use.” For most of the use models, delineation of the number of linear feet of interior partitions is not specified at all. Because of this, assumptions for partition linear feet had to be extensively reviewed and updated, resulting in a significant reduction in the assumed number of linear feet of most GCR and GCM use models. This resulted in a cost reduction for many use models because of the high construction cost of interior partitions. Assumptions for amount of interior partitioning are discussed below.

Unlike residential construction, commercial and industrial buildings have a very wide range of sizes. A single floor can be as small as 1,000 square feet and as large as more than 1,000,000 square feet, whereas typical residential properties have 1,300 to 1,600 square feet per floor level and rarely more than 5,000 square feet per floor level. Unlike the residential cost schedules, the commercial and industrial cost schedules are organized within perimeter to area ratio (PAR) groupings. The perimeter to area ratio (PAR) is calculated as follows:

PAR = 100 x (Perimeter Linear Feet / Floor Area Square Feet)

For example, a 200 x 200 building has a perimeter of 800 linear feet and area of 40,000 square feet. The perimeter to area ratio is calculated as:

PAR = 100 x 800/40000 = 2

The assessment guidelines instruct assessors to round to the nearest whole number PAR. However, a wide range of building sizes and perimeters may be represented by a single whole number PAR as illustrated by the size information contained in Table 2.

The first column in Table 2 shows the perimeter to area ratio (PAR) whole number in bold font followed by the approximate calculated PAR numeric range that would round to the whole number PAR. The second and third columns provide the dimensions and square foot area of the commercial or industrial building selected to be the benchmark for cost schedule development for that PAR. The fourth and fifth columns provide the dimensions and square foot area of the smallest feasible building size that would compute to the PAR whole number for that row. The final two columns provide the dimensions and square foot area of the largest feasible building size that could compute to the PAR for that row.

Table 2: Perimeter-to-Area Ratio (PAR) Analysis

Perimeter to Area Ratio PAR	Approximate Cost Model Size Used for the PAR* Dimensions	SF Area	Approximate Smallest Feasible Size for the PAR** Dimensions	SF Area	Approximate Largest Feasible Size for the PAR** Dimensions	SF Area
1: 0.5-1.4	400 x 400	160,000	265 x 290	76,700	800 x 800	640,000
2: 1.5-2.4	200 x 200	40,000	150 x 180	27,000	165 x 800	132,000
3: 2.5-3.4	88 x 272	24,000	105 x 130	13,650	90 x 800	72,000
4: 3.5-4.4	62.5 x 256	16,000	90 x 90	8,100	60 x 800	48,000
5: 4.5-5.4	47 x 264	12,500	65 x 85	5,525	45 x 800	36,000
6: 5.5-6.4	38 x 261	10,000	60 x 65	3,900	35 x 800	28,000
7: 6.5-7.4	33 x 229	7,500	50 x 60	3,000	30 x 800	24,000
8: 7.5-8.4	29 x 172	5,000	45 x 50	2,250	25 x 800	20,000
9: 8.5-9.4	26 x 158	4,100	40 x 45	1,800	25 x 440	11,000
10: 9.5-10.4	23.4 x 139	3,250	35 x 45	1,575	25 x 130	3,250

* All the actual cost model PARs are within 1% of each whole number PAR
** For buildings up to 800 x 800 feet in size

Notice the wide range of building sizes that could feasibly occur for any given PAR. For example, PAR 6 is the most common PAR, but a building with PAR 6 could be as small as 3,900 square feet and as large as 28,000 square feet. Because of economies of scale in production processes (which will be discussed later), the variation in cost to construct this wide range of building sizes could be very significant. The 2012 Indiana cost model for PAR 6 uses a benchmark building size of 10,000 square feet to estimate the square-foot rate contained in the industrial and commercial cost schedules. Microsoft Excel ***Solver*** was used to find the best dimensions for each PAR by setting the object function to minimize perimeter for a given PAR and size (square foot area) by allowing the length and width dimensions to be adjusted. In deciding the final benchmark building sizes, another consideration was to insure that the perimeter was never greater for smaller building sizes than the next larger size, which would have caused exterior wall cost to be higher for a smaller building. The final selections have perimeters always increasing as size (area) increases. This demonstrates that selection of the optimal building size and perimeter for each PAR to serve as the cost calculation benchmark for the PAR is important. The Department relied upon objective formulas and rules to arrive at the benchmark dimensions.

Another important update to the models was a change in the assumed amount of interior partitioning. The amount of interior partitioning can be referred to as ***partition density*** as used in a few places in the commercial model descriptions in Appendix D. For example, if a particular model were said to have *partition density* of 10%, it would mean that for every 100 square feet of floor area of the specified use model there would be about 10 linear feet of interior partition wall length. Assumptions used to develop the 2002 and earlier cost schedules were not explicitly stated in the guidelines. To ascertain the amount of partitioning used in the development of the earlier cost schedules, the Department used the partition square foot adjustment rate contained in Appendix G, Schedule C - Base Price Components and Adjustments to derive the partition density for each model. The GCM Use Models are further grouped by type as Unfinished (UF), Semi-finished (SF), Finished Open (FO), and Finished Divided (FD), with each type having progressively more partitioning. Table 3 summarizes the amount of interior partitioning derived for various GCM uses in the 2002 cost schedules compared with the amount assumed for the 2012 cost schedules.

Table 3: Partition Density Assumptions Used for 2012 and 2002 GCM Use Models

GCM Use Type Partition Density	2012	2002	Type
Utility Storage	0.010	0.010	UF
Car Wash Auto	0.040	0.041	SF
Ice Rink	0.040	0.061	SF
Auto Service	0.040	0.039	SF
Auto Showroom	0.045	0.045	FO
Bowling Alley	0.037	0.037	FO
Theaters	***0.050***	0.111	FO
Health Club	***0.090***	0.295	FO
General Retail	0.040	0.042	FO
Discount	***0.040***	0.076	FO
Regional Shopping Ctr stores	***0.040***	0.047	FO
Neighborhood Shopping Ctr	0.042	0.042	FO
Department Store	***0.060***	0.125	FO
Supermarket	***0.060***	0.135	FO
Convenience Market	0.060	0.088	FO
Dining/Lounge	***0.060***	0.253	FO
Hotel-Motel Service	***0.120***	0.275	FD
Bank	***0.120***	0.406	FD
General Office	***0.120***	0.202	FD
Medical Office	***0.180***	0.321	FD
Country Club	***0.120***	0.283	FD
Funeral Home	***0.120***	0.258	FD
Nursing Home	***0.160***	0.356	FD
Hotel-Motel Unit	***0.180***	0.392	FD
Apartment	***0.173***	0.159	FD

The densities displayed with red italics for the 2012 cost models were changed from those used in the 2002 cost models. The 2012 cost model densities displayed using font without italics were unchanged from 2002. An example will assist in visualizing the partition density concept. Imagine a 25′ x 40′ building (approximately the size of a small house), which has 1000 square feet of floor area. Then visualize three 25′ interior partitions spaced 10′ apart dividing the floor area into four rooms that are 10′ x 25′. Now visualize one 40′ partition bisecting the first three partitions and dividing the floor area into eight 10′ x 12.5′ rooms. The three 25′ interior partitions plus the one 40′ partition creates 115 feet of interior partitions. Thus, the partition density is 115 linear feet/1,000 square feet = 11.5% for this building with relatively small rooms. The extensive research into the characteristics and features of modern home designs determined that the typical 1-story 1,000 square foot ranch style home has an average partition density of 10.5%. Now imagine that the 1,000 square foot floor area is occupied by a branch banking office, many of which are relatively small. The 2002 model for banks assumed an interior partition density of 40.6%, which is about four times the density of a typical small home. For this model assumption to be correct, each of the 10′ x 12′ rooms in the previous example would have to be divided into four more rooms that were approximately 5′ x 5.4′ in size causing the 1,000 square foot branch banking office to consist of a grid of 32 extremely small 5′ x 5′ rooms. This is very unrealistic, further emphasizing the importance of model assumptions: Irrespective of the cost per linear foot of partition walls extracted from any national cost source, the assumption made concerning the amount of interior partitioning in the cost model, as well as all the other assumptions, will be ultimately influence the building cost.

Accounting for Economies of Scale in the Residential, Commercial, and Industrial Cost Tables

One major tenet of economic theory is a concept known as "economies of scale." The simplest way to describe economies of scale is that when more units of something are produced, it costs less to produce each unit. Economic efficiencies result from carrying out a process such as building construction on a larger and larger scale. "Scale economies can be present in nearly every function of a business, including manufacturing, purchasing . . .," wrote Michael E. Porter, author of *Competitive Strategy* (Porter, 1980, p. 7). The fundamental reason that this occurs is the fact that nearly all production processes involve fixed costs and variable costs, and the fixed costs are spread over the larger number of units as volume increases. Howard J. Weiss and Mark E. Gershon, authors of *Production and Operations Management*, separated economies of scale into two types—construction and operations. "The construction economy of scale is that construction costs rise less than proportionately to building size," they wrote (Wiess and Gershon, 1989, p. 45).

In addition to specialization and the division of labor with the various construction trades, there are various inputs that a building contractor controls in a larger construction project that contribute to economies of scale.

1. *Lower material costs:* When a builder buys materials in bulk for larger jobs – for example, concrete, plywood, or steel – the builder can take advantage of volume discounts.

2. *Specialized equipment:* As the scale of a construction project increases, a builder can employ the use of specialized labor and equipment resulting in greater efficiency. For example, beyond a certain size, spreading and grading a 6" crushed rock base for a slab is done more economically with a D-4 tractor than by hand or with smaller equipment, which are more labor-intensive.

3. *Learning curve effect:* Each new commercial building construction project is unique with a new set of plans and requirements. The learning curve effect refers to the capability of workers to improve their productivity by regularly repeating the same type of action. The increased productivity is achieved through practice, self-perfection and minor innovations resulting in a

reduction in the number of work-hours necessary to achieve a specified amount of output such as placing 1,000 square feet of concrete or hanging 1,000 square feet of drywall. Studies have indicated that the learning curve effect can result in a reduction of 18-20% in the work-hours necessary to achieve a specified amount of output each time the amount of output or size of the job is doubled (McGuigan, Moyer & Harris, 2002).

This important concept must be acknowledged when using national cost reference books to estimate building construction cost. The published rate will be most accurate for the approximate building size that was assumed by the publisher and will be increasingly inaccurate as building size differs from the assumed size. As presented in Table 2, a building having a PAR of 5 might have a floor size as small as 5,525 square feet or as large as 36,000 square feet. These two buildings, despite an identical PAR, would have a different per-square-foot cost to build because fixed costs for the larger building would be spread to a greater number of square feet, and because of the three factors detailed in the previous paragraph. So while national cost estimates are driven by the PAR, economies of scale will also be a significant factor in the cost per square foot for the construction of a building.

Published reference materials instruct cost estimators to make an adjustment to the costs to account for economies of scale. “Every estimator knows that as quantity built increases, the unit cost decreases . . . when comparison projects are either much larger or much smaller than the proposed project, adjustments need to be made for the economy of scale,” wrote John D. Bledsoe (1992, p. 14), PhD, PE, author of the reference book *Successful Estimating Methods . . . from Concept to Bid*. National cost data sources, including the source used for the 2012 cost tables vary in the application of such adjustments in their cost reference tables. Size adjustments are only applied when the publisher provides cost tables that show the cost per square foot for a particular building type within an expected size range. The Craftsman cost reference that was used to develop the 2012 cost tables (NCE, 2010) does not contain such tables; therefore, economy of scale size adjustments were included in the cost calculation models developed for Indiana. The Craftsman *National Building Cost Manual* (NBC, 2010), *RS Means Square Foot Costs* (Means, 2010), and the *Residential Cost Handbook* (Marshall & Swift, 2010) do have tables that present square foot costs across a range of sizes. An analysis of the cost tables in each publication has indicated that the only publisher using a size adjustment to account for economies of scale is Means (2010). The cost per square foot change relative to size reflected in Craftsman (NBC, 2010) and Marshall & Swift (2010) results from the relationship between perimeter and floor area. Interestingly, use of the Means (2010) tables to calculate RCN for the homes listed in Table 1 produced the best COD as presented in Table 5 below. The economies of scale size adjustment incorporated in the 2012 Indiana cost tables based upon Bledsoe (1992) and those found in Means (2010) tables are nearly identical.

The Department relied upon the size adjustment method explained by Dr. Bledsoe in Chapter 2, pp. 13-22 of his reference book to account for economies of scale in the 2012 Indiana cost tables. Identical methodology and factoring was utilized for residential, commercial, and industrial tables. Bledsoe uses the term *Size Factor* to refer to the difference in size between two buildings in his size adjustment method. For example, the building size used for PAR 8 in the commercial cost model as shown in Table 2 was 5,000 square feet and the size of the representative PAR 2 building was 40,000 square feet; therefore, the size factor was (40000/5000) = 8. According to Bledsoe, when the size factor is in the range of 0.9 to 1.1 (building sizes are within 10% of one another), there is little difference for which a size factor cost multiplier is needed; however, when sizes differ significantly (more than 10%) a cost adjustment multiplier is required for accurate estimates. Bledsoe's research has determined that an exponential relationship exists between size factor and the total cost multiplier (TCM) that requires an exponent in the range of 0.9 for buildings and simple projects to 0.6 for complex projects. The economies of scale calculation used for the 2012 cost tables uses the exponent of 0.9 since the calculation applies to buildings. Simply put, the exponential formula causes the economies of scale factor to rise at a lower rate than the increase in size. For example, a building that is 320% larger than the representative building only experiences an economies-of-scale-based cost reduction per square foot of 11%. Table 4 presents the cost adjustment multipliers used in developing the 2012 commercial and industrial cost schedules.

Table 4: Economies of Scale Cost Adjustment Multipliers Used for Each PAR

Perimeter to Area Ratio	Cost Model Size Used for the PAR		Comparing PAR Size to 12500 SF	
PAR	Dimensions	SF Area	Size Factor	Cost Multiplier
1: 0.5-1.4	400 x 400	160,000	12.80	0.870
2: 1.5-2.4	200 x 200	40,000	3.20	0.890
3: 2.5-3.4	88 x 272	24,000	1.92	0.937
4: 3.5-4.4	62.5 x 256	16,000	1.28	0.976
5: 4.5-5.4	47 x 264	12,500	1.00	1.000
6: 5.5-6.4	38 x 261	10,000	0.80	1.023
7: 6.5-7.4	33 x 229	7,500	0.60	1.052
8: 7.5-8.4	29 x 172	5,000	0.40	1.096
9: 8.5-9.4	26 x 158	4,100	0.33	1.118
10: 9.5-10.4	23.4 x 139	3,250	0.26	1.144

Economic Conditions, Labor Rates, and Local Modifiers from National Cost Publishers

Since the last general reassessment in 2002, the real estate market has experienced volatility. There has been more turbulence in real property values and real estate prices than at any time since the Great Depression of the 1930s. The Case-Shiller Home Price Index published by Standard & Poor's is the leading measure for the US residential housing market, tracking changes in the value of residential real estate both nationally as well as in 20 metropolitan regions. The index for Chicago, the metropolitan location tracked in the index that is nearest to Indianapolis, was 119.64 in April 2002. The index reached its highest level in May 2007 at 170.14, an increase of 42% in five years, followed by the collapse of the real estate bubble and the ensuing financial crisis. In April 2011 the index for Chicago was 113.45, a decrease of 33% from the peak and 5% below the index level in 2002 at the time of the last general reassessment in Indiana. On August 23, 2011 the Associated Press reported, “ If the current pace continues, 2011 would be the worst year for new-home sales on records dating back at least half a century” (Kravitz 2011). According to the Associated General Contractors of America (Wilkerson 2011), construction industry unemployment in July 2011 was 13.6%, 50% higher than the national unemployment rate of 9.1% . Turbulent real estate prices and a depressed construction industry with high unemployment have made it very difficult for national cost publishers to estimate local construction costs.

In addition to the Craftsman Book Company cost publications that were used for developing the Indiana 2012 cost schedules, 2011 cost books from the other two major national publishers, R.S. Means and Marshall & Swift, were purchased to cross-check the new cost schedules. Calculated costs from all three publishers are similar to one another, being about 20-30% higher than actual new construction costs based upon verified economic data from the Indianapolis region. To survive in very difficult times, many healthy Indiana construction companies are doing projects with little to no profit and substantially reducing their overhead expenses; less healthy companies are failing.

Both Craftsman and R.S. Means provide cost detail about labor, material, and equipment cost; Marshall & Swift does not. Hence, we were able to compare the labor costs utilized by Craftsman and R.S. Means to the Fall 2010 Common Construction Wage Rates collected by the Indiana Department of Workforce Development (Indiana 2010). Therefore, the national cost data provided by these national sources is overstated for Indiana, since true cost reflects lower labor rates. This fact necessitates the application of a Verified Economic Modifier (VEM) to bring the costs in line with the true cost. The Department calculated the VEM by use of ratio studies that compared the initially-calculated replacement cost new (RCN) based upon Craftsman component and assembly unit costs (NCE, 2010) with the actual new construction costs for homes from Indianapolis area builders. The initially-calculated costs were adjusted using a VEM of -30% and the Department then calculated cost estimates for 13 one-story and 15 two-story model homes using the VEM-adjusted cost data. Costs for the same homes were also calculated using cost tables from R.S. Means (Means, 2010), Craftsman (NBC, 2010), and Marshall & Swift (Marshall & Swift, 2010), as well as using the Indiana cost tables without a VEM adjustment (NCE, 2010). These costs were all compared against Indiana sales data. Table 5 shows the statistical results of the five different cost calculations for the 28 model homes listed in Table 1. Note that the best median sales ratio and second-best coefficient of dispersion (COD) occur with the VEM-adjusted cost tables and that the median ratios for all three national cost sources produce median ratios that are 21-36% too high when combined for 1- and 2-story homes.

Table 5: Results for Residential New Construction Cost Estimation from Four Different Cost Sources

13 1-story & 15 2-story model homes from 4 builders	Median Sales Ratio (Median)			Coefficient of Dispersion (COD)		
	1-story	2--story	Combined	1-story	2--story	Combined
Final Model Estimates from Craftsman NCE	1.02	1.09	1.06	3.84	4.08	4.75
2011 Marshall & Swift Residential Cost Handbook	1.18	1.31	1.21	4.44	4.68	6.78
2011 Craftsman NBC Manual Estimates	1.23	1.40	1.26	4.30	5.11	7.30
2011 R.S. Means Residential Cost Data	1.21	1.31	1.32	3.88	3.35	4.73
Initial Model Estimates from Craftsman NCE	1.30	1.40	1.36	4.25	4.20	4.99

While the residential VEM could be derived and verified using sales data, commercial and industrial properties have few valid, arms-length sales upon which to rely when verifying the VEM. The Department conducted a separate study to ensure that the commercial and industrial VEM was similar to that for the residential real estate market. This is described below.

General Commercial Residential (GCR) construction, which is called light commercial construction in the industry, is similar to residential construction. Both employ wood joist framing, but light commercial buildings are usually larger structures, have greater wall height, and must comply with additional code requirements for public occupancy and commercial use. For these reasons the construction cost of GCR buildings should be somewhat higher than single family residential properties, but is more similar to residential construction than any other commercial or industrial model. The Department compared single family residential construction costs by size from the 2012 Appendix C with the GCR apartment construction costs from the 2012 Appendix G by PAR for the same size buildings after applying an identical VEM to both. The GCR apartment construction costs are higher by an amount that could be reasonably explained by additional code requirements and wall height. This confirms that the use of identical VEM for residential and commercial real estate markets is appropriate. The Department therefore included a VEM of -30% in the commercial and industrial cost tables. Table 6 details of the results of this study.

Table 6: Comparison of 2012 Residential Costs with 2012 GCR Apartment Costs

Size (sq. ft.)	2012 Costs - Residential	PAR	2012 Costs - GCR Apartment	Difference
1,000	69.80	**13**	79.67	14%
1,300	62.92	**12**	75.30	20%
1,800	55.94	**11**	71.26	27%
3,200	50.66	**10**	66.39	31%
4,000	49.08	**9**	62.63	28%
5,000	47.90	**8**	59.45	24%
7,500	46.33	**7**	54.78	18%
10,000	45.55	**6**	51.14	12%

The Department distributed a draft version of Appendix C in early May for review and comment. The final release of Appendix C with modifications based upon review comments was distributed by the Department on July 1, 2011 along with a draft version of Appendix G requesting review and comments during July. Comments from assessors resulted in modifications of Appendix G cost schedules, primarily related to HVAC and electrical costs, prior to its final release in August.

Conclusion

The Department has calculated and published cost tables for use in the 2012 reassessment that differ from the previous tables in a number of ways. First, the underlying property models (representing a typical property for each type) were updated to reflect current building practices and property use. Detailed models for residential, commercial, and industrial properties were all updated. Second, the Department included economies of scale into the methodology for converting a single-size national unit cost into a schedule of unit costs by size. Third, the Department brought the national cost estimates in line with the Indiana real estate market and construction industry through the application of a scientifically-derived Verified Economic Modifier (VEM). **These updates create a need for assessors to review and potentially revise market factors, schedule C adjustments, effective age, obsolescence, and any other factor that was used to bring the previous replacement cost new in line with market value-in-use.** The resulting cost tables are expected to produce more accurate replacement cost estimates for properties and allow assessors to produce a market value-in-use for a property that requires fewer market and property-factor adjustments.

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