How to Estimate the Cost of ACM (Aluminum Composite Material) Exterior Wall Cladding Systems

CPE Candidate No. 0113012

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Section 1 - Introduction

This technical paper will familiarize the reader with Aluminum Composite Material (ACM) Cladding Systems and provide an overview of the fundamental cost factors professional estimators should explore and evaluate when providing cost estimates for these systems.

Main CSI (Construction Specifications Institute 2004 Master Format) Division

Division 07 42 43 – Composite Wall Panels

Related CSI (Construction Specifications Institute 2004 Master Format) Divisions

Division 05 40 00 – Cold-Formed Metal Framing
Division 07 25 00 – Weather Barriers
Division 07 60 00 – Flashing and Sheet Metal
Division 07 92 00 – Joint Sealants

Brief Description of Subject Matter

ACM is most commonly constructed on the envelope of buildings and functions as the structure's primary weather barrier.

ACM consists of a composite polyethylene or phenolic core material that is bonded or 'sandwiched' between two layers of aluminum, each approximately .020” thick. The overall thickness of the ACM material (plank) is most commonly specified as 4mm and 6mm sheets. The outer exposed aluminum surface layer is prefinished with a fluoropolymer resin paint system providing superior durability and longevity to the elements.

There are many businesses throughout the USA and Canada that specialize in the fabrication of ACM systems. Although details vary between fabricators, ACM is commonly classified into two main types of distinct applications: “Dry” and “Wet” systems.

“Wet” systems utilize caulking at panel joints to prevent water infiltration. Although fabricated material costs are typically cheaper with wet systems, labor costs can increase due to large amount of caulking that is required at panel joints. Maintenance costs should also be considered as caulking can fail over time. A detail of a wet system will be found in Section 8 of this paper.
“Dry” type ACM provides a watertight rain screen using engineered extrusion systems that conceal drainage through the use of baffles and weep holes. Dry systems are usually categorized as pressure equalization or rear ventilated systems. Both provide capillary action and eliminate water penetration through the building envelope by the use of specially engineered gasket and extrusion systems. Fabricated Dry systems are slightly more expensive. However, because they can be more efficient to assemble, and because they require significantly less caulking, labor costs can offset material costs. A detail of a dry system will be found in Section 8 of this paper.

**Objective of this Technical Paper**

The objective of this technical paper will be to provide the professional estimator with enough information to calculate the construction costs associated with Aluminum Composite Material systems. Whether at the conceptual stages of project development or in hard bid scenarios when interpreting final construction documents, the reader will understand the risks and key price factors influencing construction costs.
Section 2 – Types and Methods of Measurement

The material takeoff will require the estimator to measure several components that incorporate a complete ACM scope of work.

The Bill of Materials in a typical ACM takeoff include:

- ACM panels measured in SF
- Backer Rod and Sealant (caulking) measured in LF
- Secondary Framing (hat channels) measured in LF
- Underlayment material measured in SF
- Screws and fasteners measured by Each
- Shims measured by Each
- Electrical, Mechanical and Plumbing penetrations measured by Each
- Electrical fixtures measured by Each
- Freight measured as Lump Sum

Labor will be calculated per man-hour and must include:

- Field measurement
- Unloading material from delivery trucks
- Material Inventory
- Material staging and “shake out”
- Installation
- Cleanup

Overhead, profit, and taxes are typically measured as a percentage of the construction costs.

Estimators will calculate most materials and quantities from the Architectural plans. Elevations, roof, floor, reflective ceiling plans, and detail pages will typically contain the majority of the information required to estimate ACM. Sections will aid in conceptual understanding. Structural plans should always be cross-referenced for framing and sub framing requirements. M, E and P drawings need to be reviewed for penetrations, which will affect production rates during field installation.
Section 3 – Specific Factors to Consider in Takeoff and Pricing.

Small Quantities vs. Large Quantities

One of the main cost-driven areas of ACM lies with the prefinished color selection of the exterior finish surface of the panel. Manufacturers typically stock a small variety of standard colors that are available with short lead times and in all quantities. Custom or special colors add a whole new dimension to the project by increasing lead times and requiring minimum quantities of plank material to be ordered. Minimum order requirements vary between material manufacturers; however, additional costs are built into the orders through items such as setup fees and various surcharges.

ACM is also affected by economies of scale as it relates to project production and overhead rates. Efficiency usually increases through repetition. Buying power increases as volume increases.

Seasonal Effect on Work

Because ACM is installed outside and exposed to the earth’s elements, so are the laborers/installers. Kind care and consideration must be considered when finalizing production rates. It is not uncommon in the Southwest to have a 40-degree variation in temperature within an hour’s drive of each other. Extreme heat correlates directly with lost productivity. Always review the project schedule and estimate during which season the project will be ready for exterior finishes. Apply productively factors when temperatures fall outside the baselines.

Geographical Location

The further away the project is from the home office, the more expensive manpower becomes and the harder it becomes to manage. Travel and subsistence have a direct impact on project costs, while long drives/trips by project management tie up valuable resources in the home office.

On projects with prevailing wage requirements, labor rates will vary by region. Always consider the local wage determination rates when estimating labor costs.

The geographic region of the ACM fabricator also plays an important factor in the estimate. Freight costs increase project costs as well as add to the procurement lead times. Distance traveled can also affect LEED regional materials credits.

General conditions, labor rates, freight and taxes are all affected by the project’s geographical location and need to be accounted for in the estimate.
Section 4 – Overview of Labor, Material, Equipment, Indirect Costs and Approach to Markups

Labor

Labor costs are calculated per man-hour and can vary significantly between private and public works projects. Typically, construction firms have competitive advantages in only one of these markets, although a merit shop competing in both markets is feasible.

On prevailing wage projects, the approximate hourly wage rate, including labor burden, is as follows:

- Journeyman $72.00 per hour
- 1st Period Apprentice $34.00 per hour
- 10th Period Apprentice $54.00 per hour (this is the highest level apprentice)

The minimum ratio of apprentice hours to journeyman hours is 1/5 or 20%. The maximum allowable ratio is 1/1 or 50%. This ratio will affect final labor costs and can be difficult to determine at bid time. For this reason, average hourly rates are used frequently throughout the estimating process.

Productivity rates will vary depending on the projects details, building heights, geographical location, seasons of work, etc.... Productivity evaluation is the art of estimating and can become the make-it or break-it factor relative to the project’s bottom line.

Below are hypothetical productivity rates for an ACM system found on a two-story building.

- Unload Trucks: **2 Hrs** per flatbed truck
- Inventory Material: **4 Hrs** per flatbed truck
- Stage Materials: **2 Hrs** per area
- Install Underlayment: **100-125 SF/HR** (800-1000 SF/MD)
- Secondary Framing: **75-100 LF/HR** (600-800 LF/MD)
- ACM Walls (1st Floor): **8.75-11.25 SF/HR** (70-90 SF/MD)
- ACM Walls (2nd Floor): **7.5-10 SF/HR** (60-80 SF/MD)
- ACM Fascia / Coping: **7-9.5 SF/HR** (55-75 SF/MD)
- ACM Soffits: **7-9.5 SF/HR** (55-75 SF/MD)
- Caulking / Backer Rod and Sealant: **15-20 LF/HR** (120-160 LF/MD)
- Cleanup: 1 Hr Per Crew / Day
Material

Fabricated ACM typically ranges anywhere from $15-$35 per SF of coverage area in the majority of situations. The vast range in cost can be contributed to the many fabricators and their unique engineered systems, color selections, paint finishes, architectural design, orientation, thickness and type of plank material.

Because of the large disparity in fabricated material costs, it is very important to understand the technical specifications and not deviate from the construction documents, especially in the hard bid environment.

The material components of a standard ACM takeoff include the fabricated ACM panels, secondary framing (hat channels), shims, underlayment material (Tyvek, building paper or ice and water underlayment), fasteners, flashings, and backer rod and sealant.

Other trades in the Southwest region of the United States typically perform the framing and sheathing scopes of work. These related trades have a critical impact on the ACM field installation, which is contingent on proper backing within allowable tolerances. For this reason ACM panels cannot enter the fabrication process until final field measurements have been taken. It is critical for the project team to recognize this requirement and account for the lengthy lead times associated with these systems.

Equipment Overview

The use of proper equipment is highly correlated with efficiency and increased productivity rates. Whether owning or renting, always carry the proper equipment costs in the estimate. Typically, the longer the equipment is on rent, the cheaper the average daily rate becomes.

Below is a list of standard equipment used on projects with ACM:

- Unload Truck – Forklift / Reach Lift (ACM is typically shipped in wood framed crates or skids)
- Roof Loading – Reach Lift
- 1st Floor Wall Panels – Ladders, Rolling Scaffolding, Scissor Lifts or Small Boom Lifts
- 2nd to 4th Floors – Scissor or Boom Lifts (Heights variable with building height)
- High Rise Buildings – Large Boom lifts or Building Cranes
- Canopies and Soffits – Ladders, Rolling Scaffolding, Scissor Lifts or Boom Lifts
The field crew will need some form of mechanical equipment to assist with installation at all stages of project schedule. Trying to cut costs by short-changing equipment usually has a negative effect on the bottom line.

**Indirect Costs**

Indirect costs are the construction costs other than most labor, material, and equipment that do not become part of the tangible structure, but are necessary to complete the design and construction of the project.

Examples of Indirect costs related to ACM construction include:

- Home Office Overhead
- Project Management and Supervision
- Payroll Burden
- Construction Fees, Building Permits, Etc.
- Tools and Safety Equipment
- Transportation
- Insurance
- Safety programs
- Bond Costs
- Engineering
- Taxes
- Freight / Transportation

Many times, the majority of these items are applied to the estimate as a percentage based on company averages. If applied to the estimate as a percentage, rates should be based on historical averages and adjusted to each estimate based on project specific risk factors.
Section 5 - Special Risk Considerations

Custom Colors

As mentioned previously, custom colors can add significant costs to the project when only a small amount of ACM will be procured. ACM plank manufacturers require minimum amounts of prefinished coil to be purchased when dealing in custom or exotic colors. Costs will fluctuate depending on the quantities, set-up fees, and non-inventory charges unique to each material manufacturer. Because of this, it is recommended to consult the ACM fabricator prior to providing any estimates when dealing in small quantities. It is reasonable to assume that custom color quantities less then 2,500 SF will be subject manufacturer's minimums.

Another cost factor affecting the finish on ACM is the number of paint coats required. A standard paint finish consists of a 2-coat fluoropolymer resin paint system. If a 3-coat system has been specified, the project will be subject to the manufacturers minimums referenced above. It is interesting to note that both 2-coat and 3-coat systems carry the same manufactures finish warranties. Review the specifications in detail.

Custom colors will also substantially effect procurement time. Manufacturers require physical samples to be submitted and color matched. After color samples have been submitted, procurement can take up to 3 months.

Fire Rated Core – NFPA 285

NFPA (National Fire Protection Association) 285 tests the flammability characteristics of non-load bearing exterior wall assemblies containing combustible components. ACM, which is composed of plastic cores and typically used as part of the exterior wall assembly, is subject to the NFPA 285 test when the product is constructed 50 feet above grade on non-combustible building types I, II, III and IV. The significance of NFPA 285 as it relates to ACM cladding systems is that the panels will require the use of fire-rated cores when being installed above the 50 feet mark.

Fire rated cores are more costly and add approximately $2.00 SF to the material price. Fire rated core material is also subject to longer lead times, which can impact the construction schedule.

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1 Section 11, Item 1
Another important item to note is that because NFPA 285 is an assembly test, the materials that you use during construction must be the same materials that were used during the approved controlled test. Make sure to include the exact underlayment material that was used during NFPA 285 certification. ACM fabricators will have this information available upon request.

**Framing / Secondary Framing**

Framing tolerances become critical when installing ACM panels. To this degree, panels cannot enter the fabrication phase until accurate framing measurements have been taken. Always state in the written proposal the importance of timely framing completion and accuracy. Review any preliminary CMP schedules and analyze what is expected versus what is reality. Providing clear upfront requirements in the proposal will reduce risk and add credibility to the estimate. It is very common for construction teams to underestimate the ACM procurement, fabrication, and installation durations. Be upfront and educate early on.
Section 6 - Ratios and Analysis (Testing the Bid)

Quality control checks using ratios based on historical analysis should always be performed following the estimate. Carrying out this fundamental step can help expose costly, inadvertent errors. Mistakes can easily be made in construction estimates, which are typically composed of hundreds of calculations and mathematical formulas.

Although historical data averages should always be gauged against each estimate, they should never be used to qualify estimates without taking the necessary time to perform a detailed takeoff of the project. Ratios will fluctuate based on the materials specified, project complexity, labor rates used, productivity rates assigned, margins and other business decisions made. Submitting binding numbers based only on historical averages carries greater risk.

Total ACM Costs (“Turn-Key”)

Most ACM systems can be furnished and installed within the $30-50 SF range, although it is completely possible to have an average square foot price double that amount in unique circumstances.

Material Costs (FOB from fabricator)

Fabricated ACM, FOB jobsite typically ranges between $15-$35 SF.

Labor Productivity Rates

Final labor productivity rates usually range between 45-65 SF a man-day (8 hrs) complete. This number includes all onsite labor hours needed to complete the ACM wall assembly described in sections 2 and 4.

THESE ARE ONLY RULES OF THUMB AND SHOULD NOT BE CONSIDERED ABSOLUTE. EACH PROJECT CARRIES ITS OWN SET OF UNIQUE CIRCUMSTANCES AFFECTING PROJECT COSTS.
Section 7 – Other Pertinent Information

LEED

Project LEED requirements should be referenced in the 07 42 64 – Metal Composite Material specification section or found itemized on the LEED project scorecard usually located in the front-end documents.

The two common credits that effect ACM are:

- MR4 – Recycled Content
- MR5 – Regionally Manufactured Materials

The estimator will need to consider these requirements during the estimate. Proprietary specifications commonly rule out Regional Material Credits, while Recycled content percentages differ amongst manufacturers of ACM material.

Radius Panels

Using curved panels will greatly increase fabricated material costs. It is important to note that not all radii can be met. Check with fabricators and verify that the architect’s vision is feasible when providing conceptual estimates.

Optimization

Optimization refers to minimizing waste (drop) of plank material during the fabrication process. Maximizing yield minimizes costs.

ACM plank material comes in standard widths of 4’-2” and 5’-2”. Standard lengths are 12’-2” and 16’-4”. Custom lengths are available but subject to additional costs. Maximizing panel size and eliminating drop will lower the average SF price. Examples of great optimization sizes include panel heights of 48” and 60” (assuming 1” returns on the panels). An example of an insufficient panel height would be 36”. A 36” panel would yield 12” (25%) of waste using a 4’-2” wide sheet of plank material, assuming the returns are 1”.

In hard bid environments, panel sizes are fixed and must be bid as detailed on the drawings. In design-build contracts, always consider waste and optimize total yield if possible. Fabricators will be the best resource for questions pertaining to design.
**Panel Weight**

4mm ACM Panels
- Standard PE Core material weighs approximately 2 LB/SF
- Fire Rated Plus Core material weighs approximately 2.3 LB/SF.

6mm ACM Panels
- Standard PE Core material weighs approximately 3 LB/SF.
- Fire Rated Plus Core material weighs approximately 3.75 LB/SF.

**Sheet Metal Flashings**

General sheet metal such as parapet copings and transition flashings are sometimes incorporated into the design. ACM manufacturers typically do not include these items in their pricing. Estimators need to explicitly state whether the proposal includes or excludes associated sheet metal flashings. Because sheet metal flashings are sometimes required to match the color of the ACM material, strict coordination must be made between the ACM and General Sheet Metal subcontractors.

**ACM Fabricators Scopes of Services**

There is a division between ACM fabricators in the marketplace. Many fabricators provide turnkey services, which include everything from shop drawings down to the smallest fasteners on their pre-fabricated and fully engineered systems. On the other hand, other ACM fabricators provide only “parts and pieces”. When working with the latter, always account for the additional costs associated with shop drawings, engineering calculations, quality control, and field fabrication in the estimate. In hard bid situations, diligently review the fabricator’s proposal to fully comprehend what they are providing.
Sample "Wet" System Detail

SAMPLE DETAIL OF "WET" ACM SYSTEM

2 Section 11, Item 2
Sample “Dry” System Detail

SAMPLE DETAIL OF "DRY" ACM SYSTEM

3 Section 11, Item 2
Sample Elevations

**NORTH ELEVATION**

**WEST ELEVATION**

ACM MINI ESTIMATE  SECTION 8
SCALE:1-100  CANDIDATE #0113012
Sample Reflective Ceiling Plan
Sample Roof Plan

- ACM - Canopy
- Backer Rod and Sealant
- Prefinished Sheet Metal Coping
- Drip Flashing at Wall to Canopy
- Hat Channels at Canopy

ACM MINI ESTIMATE  SECTION 8
SCALE:1-100  CANDIDATE #0113012
Sample Section
Sample Details

Parapet Coping

WALL FRAMING
- Backer Rod and Sealant
- Pre-finished S/M Coping
- Sheathing
- Underlayment
- ACM Extrusion
- 4mm ACM Panel

Inside Corner

- Backer Rod and Sealant
- ACM Extrusion
- 4mm ACM Panel
- Underlayment
- Sheathing

Base Detail

WALL FRAMING
- Sheathing
- Underlayment
- 4mm ACM Panel
- ACM Extrusion
- Extrusion Fastener

Door Head and Jamb

- 4mm ACM Panel
- Underlayment
- Sheathing
- ACM Extrusion
- Door Frame
- Backer Rod and Sealant
### Section 9 - Sample Takeoff and Pricing Sheet

**Sample Takeoff Summary** (Based on Section 8 Sample Drawings)

<table>
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<tr>
<th>Name</th>
<th>Qty</th>
<th>Units</th>
<th>Color</th>
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<tr>
<td>ACM - Canopy</td>
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<td>SQ FT</td>
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<td>ACM - Walls</td>
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<td>Electrical Lights</td>
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<td>Drip Flashing at Wall to Canopy</td>
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**Sample Pricing Sheet** (Bid Calculation)

**Job Name:** Mini "Dry" ACM Estimate (Prevailing Wage)  
**Date:** June 15, 2103  
**Job Location:** Chapter 68  
**Architect:** CPE Candidate No. 0113012  
**Drawings:** Section 8  
**Addenda:** None Noted

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<th>MATERIALS</th>
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**Material Subtotal**  
$13,391.50

**Tax @ 8.5%**  
$1,138.28

**Material Total**  
$14,529.78

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**Labor Total**  
$5,579.00

* Labor Rate of $72 = Journeyman Hourly Rate.
* Labor Rate of $58 includes (2) man crew with (1) Journeyman and (1) Mid Level Apprentice.

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**Material Total**  
$1,325.00

**Tax’s and Fees @15%**  
$195.00

**Equipment Total**  
$1,484.00

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Section 10 – Glossary/ Terminology

CSI 2004 Master Format
Construction Specification Institute Master Format is the standard of organizing project requirements and construction trades in the building industry. The 2004 Master Format organizes the project specifications into a 50-division format.

LEED - Leadership in Energy and Environmental Design
The LEED program is administered by the United States Green Building Council and promotes sustainable construction practices. LEED provides third party verification and certification based on a standardized rating system.

PE Core
Polyethylene core is a common plastic that is used in manufacturing ACM plank material

NFPA
The National Fire Protection Agency is a United States trade association that creates standards and codes for various products that effect public safety. ACM is subject to the NFPA 285 test.
Section 11 – References

1. NFPA 285
   National Fire Protection Association

2. Elward Systems Corporation
   680 Harlan St.
   Lakewood, CO 80214