These Exam Prep Tabs are based on the 30th edition of the Walker's Building Estimator's Reference Book, Copyright Frank R Walker Company. The exam will focus heavily on this reference book, as it parallels the CSI (construction specification institute, construction indexing system) and covers technical concepts in detail. A thorough preparation for the exam would include a close review of Chapter 1, General requirements (CSI division 001) as it covers many construction details. You can expect 3 or 4 test questions from this first chapter.

Walker's addresses quantity details, and pricing details, for various construction categories. The examination will focus on quantity details and methods of calculating quantities, but will not place much emphasis on pricing details. If the test poses a pricing question, it will usually provide the prices and expect a calculation of the quantities involved to arrive at a final price.

Each Tabs sheet has five rows of tabs. Start with the first tab at the first row at the top of the page, and proceed down that row placing the tabs at the locations listed below. Place each tab in your book setting it down one notch until you get to the bottom of the page, and then start back at the top again. After you have completed tabbing your book, then start with the highlights.

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General Requirements

The Role of the Estimator: The following requisites are essential for the making of a good estimator: Highlight the first sentence for items 1 thru 7.

The Role of the Contractor: Erecting a building is a complex undertaking and seldom is one firm capable of doing all phases of the work. Yet the owner or developer usually prefers to let one contract and make one firm responsible for the completion of the project.

The average percent of work performed by subcontractors for a general contractor cannot be precisely determined, but surveys conducted by the Associated General Contractors of America indicate from 40% to 70%.

The American Subcontractor Association claims that 90% of the work force in the building construction industry is employed by subcontractors.

Usually there is a retainage of at least 5 to 10% by the general contractor to the subs and in turn by the owner to the general contractor. Retainage is not completely released until the project is substantially complete. It has become common practice to reduce the retainage by 50% when the project is 50% satisfactorily completed.

Construction Management: In Construction Management (CM), a general contractor or engineering company enters into a contract with the owner prior to the bidding period and acts in a managerial and advisory role. Bid packages for the project are usually taken under the construction manager's supervision.

They will provide reports on the project cost status, payment status, and an analysis of each contract and the project cash flow. The construction management approach has gained a wider acceptance in recent times, specially in federally sponsored construction.

Bidding for a Contract: Construction contracts are awarded in one of two ways — competitive bidding or negotiation.

Cont. of prior page: the information that must be submitted will follow that contained in AIA document A-305 Contractor's Qualifications Statement.

Once on a bidding list, a contractor will receive an Invitation to Bid or Bid Notice for each prospective job.

Often the invitation to bid is accompanied by an Instruction to Bidders further defining the job restrictions such as completion dates, milestone dates, visiting job site, special conditions, etc.
The bid bond guarantees that the bidding contractor, if awarded a contract, will enter into the contract and furnish a performance and payment bond if required. If they do not honor their bid they forfeit the amount of the bond.

Bid bonds and the later performance, material, labor, maintenance, completion, supply, and subcontractor bonds are often encountered in public work, but may not be required in private work, where the contractor's reputation is deemed sufficient and the cost of bonds unwarranted. Bid bond costs are customarily minimal, and the cost of bonds is borne by the contractor.

**Negotiating a Contract:** A variation of the negotiated contract is fast track, design build construction. In this arrangement the project may be started before all the plans are fully developed. Each phase of the job, such as foundation, masonry, carpentry, etc., is bid separately, just before the phase is required to be installed. Some advantages and disadvantages are: Highlight items 1 thru 3.

As the phases are bid, the successful subcontractors may be assigned to a general contractor in the same manner as a lump-sum contract; or the general may act in the role of a project manager, in which case each subcontractor for each phase will have a direct contract with the owner. This variation is referred to as multiple bidding.

**Contract Documents:** Once it is determined which contracting firm is to do the job, a formal contract will be drawn up. The Contract Documents usually should include the Owner-Contractor Agreement; the General Conditions of the Contract; Supplementary Conditions of the Contract (if any); the Working Drawings, giving all sheet numbers with revisions; Specifications, giving page numbers; and Addenda or Bulletins issued prior to contract

Highlight all bold letters titles for the AIA documents.


**The Cost of Money**

**Sources of Money:** The main sources of money are: Highlight items 1-8.

**Mortgage Loans:** Once a loan is approved and accepted, there are certain charges called closing costs. and a part of these costs, known as points, origination fees, or the discount, cover the cost of setting up the loan.
The usual range of points is from 1% to 3%, but in states where there are legal limits set on the interest that may be charged, points have been quoted as high as 7% as a way to get around the usury laws.

**Mortgage Banker:** For consummating the transaction, they charge a flat fee of around 1% to 2% of the loan placed. This fee is in addition to the usual closing costs that are charged by the lender.

**Selling the Lender**

**Short Term Loans:** The construction loan is a short term loan to cover the building costs during the erection of the project.

One such source is those who loan the difference between the floor and ceiling of the mortgage, this is known as gap financing. To obtain such a commitment one must pay in advance a flat fee, usually around 5% of the amount to be loaned. If the project reaches the income level to qualify for the full mortgage, and the gap loan is not needed, the fee is not refundable.

How much front money, or equity, an owner will need to launch the project will vary with the type of project, the money market, and the owner's reputation. It is often said that an owner with a proven need, a piece of property free of debt, and an architect's set of plans can obtain all the financing they will need.

**Interim Financing:** Progress, at this point, should place the contractor in a position to obtain from the bank a general commitment as to the limit and terms under which they would participate in granting short term loans (usually 30 to 90 days)

**The Working Drawings:** Each sheet should have a title block in the lower right-hand corner with the sheet number; the number of sheets in each set; the date made plus each date it has been revised, and the initials of the person or persons who drew and approved the sheet. The student should be familiar with the different letters usually assigned to the drawings.

**Type of drawings:** Most working drawings for building construction are based on orthographic projection, which is a parallel projection to a plane by lines perpendicular to the plane. In this way all dimensions will be true. If the plane is horizontal, the projection is a plan; if vertical, it is an elevation for outside the building, or a sectional elevation if through the building.

The only descriptive drawing that presents a building as the eye sees it is the perspective. A perspective is seldom useful for presenting information on working drawings.

Highlight drawings in these pages
The architect's scale, with the inch divided into 1/4, 1/8, 1/16, 1/32, is standard for building construction in the United States. The engineer's scale, with the inch divided into tenths, is sometimes used in structural work or on site plans.

The metric scale is divided into centimeters and millimeters, 2.54 centimeters equaling one inch.

There were also processes that transfer blueprints to cloth drawings or to sepia prints, which could be altered, added to, and printed just like an original tracing.

Highlights symbols and specifications from page 39 thru page 57.

**Bidding Requirements Contract Forms and Conditions of the Contract**

What follows is a complete listing of the 16 CSI divisions and their subdivisions: Highlight those items from page 59 thru 87.

**Subdivision:** Materials will list the materials to be used in one of several ways, often found in combination. The closed specification will list a single trade name, and the specified product that must be furnished. The contractor's option specification (or bidder's choice) lists more than one trade name, and the contractor may choose from those listed.

A variation is the product approval specification which asks the contractor to submit any substitutions prior to submitting a bid. If the architect approves the substitute, it will be put in an addenda sent to all contractors. This "or approved equal" type specification is the most common.

The performance specification describes not the material but what work is required to produce strength, mechanical ability, or similar measurable results.

**Alternates:** On the typical lump sum proposal form, the Alternate follows the Statement of the Lump Sum price in a form such as the following: Highlight the sample given in the book.

**Cash Allowance:** Sometimes the architect does not have a final decision from the owner on certain items. Rather than leave them out of the lump sum proposal, the architect will state a definite budget amount in the specification that is to be included in the bid.

**Unit Prices:** Where quantity of materials is in doubt, but quality is known, the specification may ask for unit prices. For example, unit prices are often asked for concrete per square yard, piling per lineal foot, partition block per square foot, etc. These prices should be complete with all costs, profit, and overhead included.
### Page 101-102

**Addenda**: These, plus changes the architect and owner may wish to make after the plans and specifications have been issued but before bids are turned in, are incorporated in the Addenda.

### Page 102

**Change Orders** are modifications issued after the contract is signed.

### Page 103 - 104

**Setting Up the Estimate**: There are various reasons for these failures, but probably the most common one is the inability of the person estimating costs to come up with realistic and profitable estimates.

Some of the most important considerations that such companies make before bonding an applicant are: Highlight items 1 thru 3''

### Page 106

**Estimate Types**

### Page 107

**Budget/Feasibility Estimate**: The budget or feasibility estimate, once it has been developed, is effectively cast in stone.

### Page 108-109

**Schematic Design milestone Estimate** — 3% to 5% Overall Completeness;

**Design Development Milestone Estimate** — 35% to 60% Overall Design Completeness; 70% to 98% Construction Documents Milestone Estimates;

**Construction Documents Milestone and Bid Cost Estimate** — 100% Overall Design Completeness" The student should highlight the titles only.

### Page 111-112

**Estimate Check Lists and Practices**: A master checklist for every estimator should include the Bid Document Inventory, Estimating Assignment, Direct Estimate, Wage Rate Development, Bid Document Reviews, Takeoff General Practices, etc.

### Page 114

**Federal Unemployment Tax Act (FUTA)**: This tax applies to the first $7,000 of wages paid each employee during the calendar year 2013. The rate is 6.0% but a credit of up to a maximum 5.4% of total wages for contributions paid into State Unemployment Funds for a total federal tax rate of 0.6%. Federal Unemployment Tax is imposed on employers and must not be deducted from wages of employees.

### Page 114-115

**State Unemployment Tax; Worker's Compensation**: Rates vary widely among the states, craft labor and staff labor categories. In states where medical benefits are limited, it may be advisable to carry full or extra-legal medical coverage; **Property Damage Insurance**

### Page 117

**Office Overhead Expense**: This is sometimes referred to as General and Administrative (G&A) costs.

### Page 118

Overhead may run 6% to 15% for smaller firms. Larger firms may have overhead that are as little as 1% to 2% of the annual volume.
119-121 Office Furniture and Equipment; Insurance; Project Indirect Costs; Mobilization; Project Staff; Temporary Buildings & Construction; Temporary Utilities. The student should highlight the titles only.

122 Construction Equipment: The advantages in renting or leasing include: highlight items 1 thru 5.

123-125 Project Office Expense; Small Tools & Consumables; Weather Protection; Outside Services; Insurance Taxes & Bonds; Contractor's Equipment Floater; Installation Floater. The student should highlight the titles only.

126 Bid Bonds: Bids are invited by advertisements, and the bidder may have to submit with the bid a certified check, usually for a 5% of the bid, or a bid bond, usually for 10% of the bid.

127 Performance and Payment Bonds - a performance bond to indemnify the owner against loss resulting from the failure of the contractor to complete the work in accordance with the plans and specifications; and a payment bond to guarantee payment for all bills incurred by the contractor for labor or materials for the work. The federal government, under the Miller Act, requires that a contractor furnish two separate bonds, one for the performance and one for the payment of labor and materials.

Maintenance Bonds

128 License or Permit Bonds: If the contractor regularly operates within an area requiring such bonds, this cost should be carried under office overhead, because is a normal cost of doing business.

Supply and Subcontractor Bonds; Home Office Support; Demobilization; Escalation (Cost Growth); Finance Expenses. The student should highlight the titles only.

129 Profit - On small jobs, alterations, remodeling and similar work, a contractor is justified in adding 20% to 30% profit to the actual cost, but must ask themselves whether they can actually obtain this amount.

On new work, where it is possible to estimate cost with a fair degree of accuracy, a contractor is entitled to 10% to 15% on the actual cost of the work (job overhead included in the actual cost of the job), but it is safe to say that competitive figures submitted for many jobs show a 5% instead of a 10% to 15%. A contractor is entitled to a fair profit of 10% profit, but getting it is another matter.

131 Construction Scheduling: There are three methods of construction scheduling: Highlight 1 -3.
131 - 135
**Planning; Project Scope and Work Breakdown Structure; Construction Means and Methods; Drawings and Specifications; Technology; Labor Availability and Skills Pool; Procurement Strategy; Institutional Constraints; Project Phasing and Staging; Weather Considerations.** The student should highlight the titles only.

136
**Scheduling Methods/Tools:** The use of bar charts started the industrial revolution of the late 1800s. An early industrial engineer named Gantt developed these charts to improve factory efficiency. Bar charts are often called 'Gantt Charts'.

Critical Path Method (CPM) for project scheduling began in the 1950s in two parallel applications. The US Navy developed the Project Evaluation and Review Technique (PERT) to develop the schedule for the construction of its Polaris Program.

There are two methods for CPM calculations. arrow diagramming and precedence diagramming. In the arrow diagramming method, project activities are shown as arrows. Circles at the beginning and end of activities are called nodes. Pairs of nodes or letters are used to identify each activity.

In the precedence diagram, activities and their durations are shown "on the nod." Sequence between tasks is shown with arrows between related activities.

137
**Precedence diagramming** is capable of representing activities that start or end in parallel with other activities.

**Identification of Activities —** An activity is any significant unit of work within the WBS' work package. There is no one "right" way to define activities for a given project.

138
**CPM calculations:** As stated earlier precedence diagramming (also called network diagram) graphically represents the relationships between the project activities.

138- 139
**Early Start (ES); Early Finish (EF); Late Finish (LF); Late Start (LS); Forward Pass — Formula (ES + Duration = EF); Backward Pass; Finish to Start or FS; Start to Start or SS; Finish to Finish or FF; Network Logic Diagram.** The student should highlight the titles only.

**Total Float:** is the amount of time an activity can be delayed without delaying the end date of the project, and is defined as the difference between the LS and ES of an activity. Activities with 0 Total Float are critical activities.

141-142
**Critical Activity; Contingency Time; Resource Constraints; Monitoring/Updating; Measuring Progress.** The student should highlight the titles only.
Concrete

Steelforms for Joist Constructed Floors and Roofs

Estimating Quantities of Steelform: In estimating the area of floor and roof construction requiring removable or permanent ... No deductions are to be made for beams or for tees of beams or for wide joists.

Ceco Steelform Construction: Ceco steelform construction is a combination of concrete joist construction and thin top slabs.

Forms Other Than Wood

Lightweight Steel Forming Material for Concrete: High-strength corrugated steel forming material is often used for forming reinforced concrete floor and roof slabs.

Tables showing Concrete Quantities for LONG form.

Estimating: Corrugated steel forming material is sold by the square, with the area determination based on sheet width times actual sheet length.

Finishing Lightweight Concrete Floor and Roof Fill

Finishing Concrete Roof Fill: Concrete fill for flat roofs are usually struck off, darbied ... 1,500 to 1,700 s.f. of roof fill per 8-hr. day.

Where concrete fill is placed on pitch or gable roofs, finishing is more difficult ... and additional helper is usually required.

Precast Concrete — Flexicore Floor and Roof Slabs:

Precast Concrete Roof Slabs: Precast concrete roof slabs are of three general types: rib, flat, and channel.

Rib tile: Auxiliary pieces are furnished to suit the particular design required, such as ridges ... and other specials required in connection with hip or valley.

The other two types of precast concrete roof slabs, flat and channel, are used over all roof decks ... for the application of any type of built-up roofing.

Labor Placing Precast Concrete Roof and Floor Slabs: Because of their size and weight, it requires 2 workers to handle precast concrete roof or floor slabs ... 2 more on the floor or roof placing them for the mason, and a mason and helper to lay and caulk the joints.

Cementitious Decks — Gypsum Plank
Monolithic or Poured-in-Place Gypsum Roof Construction: The effective cross sectional area of reinforcing shall be not less than 0.026 sq. in. per foot of slab width.

The weights, excluding sub purlins and insulating values of poured gypsum roof decks are as follows: Highlight table.

The following are approximate prices only on the various types of poured-in-place gypsum roof decks.

Metals

Estimating Quantities of Structural Steel: When estimating the quantity of structural steel required for any job … should be estimated separately, because each involves different labor operations in fabrication and erection.

Items to Be Included in a Structural Steel Estimate: 1-8.

Basis for Estimating All Classes of Structural Steel Work: Highlight table.

Bolting Field Connections. Most Structural steel projects have sections bolted together.

The most common bolts are ASTM A-325, high strength bolts for structural steel joints, 3/4" diameter x 2" long, at an approximate cost per bolt unit of $0.95 each. Each bolt unit consists of bolt, washers, and nut. Other grades sometimes required for connections are A490M-04a Standard specification for High Strength Steel Bolts, Classes 10.9 and 10.9.3 — Grade A307-04 Standard Specification for Carbon Steel Bolts and Studs. 60,000 PSI Tensile Strength carbon steel externally threaded standard connection (decrease the cost about 15% per bolt unit

Junior Steel Beams: Junior beams (M shapes) are lightweight, hot-rolled structural beams … Sizes and properties are given below:

Highlight chart

The cost of cutting, punching holes, and coping junior beams will run approximately as given below:

Metal Joists

Metal Decking

Lightgage Framing
Lightgage framing systems can supply complete wall, floor, and roof construction for buildings up to four stories in height, or can be used in combination with other framing systems for interior, load bearing partitions, exterior curtain walls, fire separation walls, parapets, penthouses, trusses, suspended ceilings, and mansard roofs.

Joists come in 6", 8" 10" and 12" depths and in 12, 14, 16, and 18 gauge material.

Joist bridging, which may be stock 'V' units or solid channels, must be supplied in the center of all spans up to 14’; at third points on spans from 14’ to 20; at quarter points on spans from 26’ to 32’; and at 8’ centers on all spans over 32’.

Estimating Lumber Quantities: One board foot is always 144 cubic inches.

Example of calculating board foot (take name of lumber in inches and multiply it out, then divide by 12 to convert to decimals, and then multiply by lineal foot = board foot.

Estimating Wood Joists — Table - Number of Wood Floor Joists Required for any Spacing

Table: Board Feet Required per 100 Sq Ft of Surface when used for Studs, Joists Rafters, Wall and Floor, Furring Strips, etc.

Estimating number of Wood Studs — When estimating the number of wood partition studs, take the length of each partition and then the total length of all partitions.

Example of how to calculate total quantities. Ask your instructor for help if needed.

Table: Board Ft of Lumber Required for Wood Stud Partitions 2x4 Studs; 16" o.c. Single Top and Bottom Plates (include small letters).

Estimating the number of headers and plywood spacers

Sample Gable End Roof Outrigger or Lookout Estimate

Sample Gable/End Vaulted End Wall Framing Estimate

Table - Gable End Framing at 16” o.c.
To Obtain Area of Roofs for Ant Pitch

Nails Required for Carpentry Work

Table: Recommended Sizes and Quantities Commonly Used

Table: Bright Common Nail Specifications

Table: Bright Box Nail Specifications

Table: Recommended Sizes and Quantities Commonly Used

Hand driven nails for roofing - Asphalt and Fiberglass Shingle Nails: Roofing nails should be long enough to penetrate ¾” into the wood deck lumber, or completely thru the plywood decking.

Tables: Different types of roofing nail specifications

Metal Roof Nails with Rubber Washers

Metal Roof Nails with Silicone Washers

Table: Metal Roofing Nail Specifications

Tables: Pole Barn — Post and Framing Nail Specifications & Nail Reference Data Specifications

Hardware Accessories Used for Wood Framing; Framing Accessories; Metal Connector Plates (TrussPlates)

Wood Floor and Roof Trusses: Wood roof trusses are used for spans as short as 25'-0” and can be used up to 200'-0”.

Prices of wood trusses are governed by the following conditions: 1 -4.

The spacing of wood roof trusses that directly support roof sheathing … ceiling is not required, spacings of 4’–o” to 4’-10” are advantageous.

Bowstring Bolted Roof Truss

Approximate Prices of Wood Bowstring Truss

Highlight table
Crescent Type Roof Truss — Recommended span is from 20'-0" to 85'-0"

Approximate Prices of Crescent Type Wood Roof Trusses

Belgian Roof Truss: It is used on some higher class store buildings and low cost churches and is recommended for spans from 20'-0" to 85'-0".

Belgian roof trusses are less efficient than the bowstring type, because the connections generally govern the member sizes. They cost about 50% more than bowstring type trusses.

The Double fink truss is also referred to as a Belgian truss and is used for spans from 36'-0" to 60'-0".

Flattop Roof Truss: Spans should not exceed 65’ where cost is an important factor.

Parallel Chord 4x2 Truss: This type of truss can be manufactured with duct chase openings so that wiring, piping, and ducts can run within the chords.

Parallel Chord 2x4 Truss: Roof slopes should be at least 1/4" per foot of span.

Modified Queen Post Truss

Fink Truss — The fink truss is generally suitable for spans from 16' to as long as 46' and for all classes of construction. It is an efficient and cost effective truss configuration, 50% to 60% the cost of comparable steel truss.

Three Hinged Arch

Cantilever Truss — Trusses with single or double cantilever sections are possible. Cantilevers can approach one-fourth of the distance of the main interior truss span.

Clerestory Truss — is used extensively in industrial and agricultural buildings, in spans up to 60'.

Inverted Truss — Vaulted Ceiling Truss — Mono-Pitch Truss — Dual-Pitch Truss
Pitched Warren Truss — This truss form is most economical in spans from 30' to 70', on center spacings from 2' to 8'.

The W-Type is the most popular type and is adaptable for spans from 18' up to 40'; roof slope from 2 in 12 to 6 in 12 and higher.

The Triple-W is used for spans up to 80' with slopes of 3 in 12 and higher. Centerline spacings can be from 2' to 20'.

The Kingpost truss is usually recommended for shorter spans. The economical range is up to 26' under most loading conditions.

Other Types of Commonly Used Wood Trusses - The Double ink truss is generally used for spans from 36' to 60'. An extremely long truss with cantilevered ends can be manufactured in three sections. Trusses of this type, 128' in overall length, have been fabricated in this manner.

Truss Openings

Installation of Wood Trusses

Table: Center Duct Depth/Opening

Installation Sequence for Temporary and Permanent Bracing of Wood Truss: Install the first truss with a ground bracing system, which is constructed as follows: 1-6.

For the first group of three to six trusses, the sequence is as follows: 1-6.

Note that all bracing lumber should be no less than 2" x x 10'. A Minimum of two 16d double head nails should be used at each connection.

Mechanical Erection of Trusses: Highlight table for erecting roof trusses.

Hand Erection of Trusses by Hand: Highlight table for erecting roof trusses by hand.

Framing and Erecting Rafters for Gable Roofs

Framing and Erecting Rafters for Hip Roofs

Framing Light Timbers for Exposed Roof Beam Construction

Framing for Roof Saddles on Flat Roofs

Laying Wood Sheathing on Flat Roofs
Laying Wood Sheathing on Pitch or Gable Roofs

Building and Insulating Sheathing: Insulating sheathing is furnished in sheets 4’ wide and 6’, 7’, 8’, 9’, 10’ and 12’ long. and 1/2” and 25/32” thick, the same thickness as wood sheathing.

Insulating Roof Decking: Decking should be laid so that cross joints are staggered and occur only over supports. Decking should be face nailed to all framing members. spacing nails 4" to 6" apart and keeping back 3A" to 1” from edges of plank. Nails should be galvanized common of sufficient length to pass through decking and penetrate supports at least 1-1/2” and should be driven flush but not countersunk.

Plywood Roof and Wall Sheathing, Subflooring and Underlayment - Roof and Wall Sheathing: Nailing of plywood sheathing should be at 6” o.c. along panel edges and 12” o.c. at intermediate supports. Use 6d common nails for panels of 1/2- or less in thickness, and 8d for greater thickness.

Labor Placing Insulating Roof Decking

Plywood Roof and Wall Sheathing, Subflooring and Underlayment

Roof and Wall Sheathing

Labor Placing Plywood on a Hip Roof

Insulating Shingle Backer Strips

Labor Placing Insulating Shingle Backer Strips

Prefabricated Structural Wood

Glued Laminated Beam Construction: Beams glued laminated construction are popular where price is not the controlling factor.

They are used in schools, auditoriums, churches, stores, and ranch-style homes and are made of kiln-dried structural woods bonded together by glue, applied under controlled conditions of temperature and pressure.

Roof insulations accomplished through the use of standard insulating boards … 2” or 4” decking is recommended.

Glue Laminated Three Hinged Arch: Another type of glued laminated construction is the three-hinged arch, which gains its support from floor level, incorporating column and abeam in one compact design.
Purlins are generally used to span the resulting bays and are covered with two inch decking and suitable insulating material.

**Labor Framing Woof Roof Trusses**

**Finish Carpentry**

**Exterior Finish Carpentry**

**Placing Corner Boards, Fascia Boards, Etc.**

**Placing Exterior Wood Cornices, Verge Boards, Etc.**

**Thermal Moisture Protection**

**Waterproofing**

**Membrane Waterproofing — Estimating the Quantity of Felt or Fabric Required for Membrane Waterproofing**

**Weight of Tar or Asphalt Felt for Membrane Waterproofing:** Tar or asphalt felt for waterproofing is currently furnished in 4 square rolls of 432 sft weighing 60 lbs per roll.

Double thickness asphalt felt is also furnished in 60 lbs per roll containing 216 sft and this felt is known and No.30.

When specifying the grade or weight of felt to be used, it is customary to state that "felt shall weigh not less than 15 lbs per 108 sft". This is known as No. 15 felt. Felt is furnished in 4 square rolls of 432 sft, so there are 32sft per roll or 8 sq. ft. per 100 sq. ft. allowed for laps.

Tar or asphalt saturated fabric is usually sold by the roll containing 50 syds or by the syd.

**Applying Membrane Waterproofing**

**Vapor Barriers/Retardants**

**Insulation**

**Table — Different Material R Values**

Heat transfer thru the building enclosure is by three means: convection, conduction, and radiation.

Convection is the thermally produced upward and downward movement of air.
Conduction is the transmission of heat thru a material.

Radiation is the emission of energy from a surface.

**Rigid Insulation**

**Reflective Insulation:** Where the heat flows down from a hot roof to a ceiling below, 93% of the heat transfer is by radiation and only 7% by conduction.

**Roof and Deck Insulation**

**Roof Shingles and Roofing Tiles:** Roofing is estimated by the square, containing 100 sq. ft.

**Rules for Measuring Plain Double Pitch or Gable Roofs:** Multiply the length of the ridge (A to B) … Multiply this by 2 to obtain the total sq. ft. of roof surface.

**Rule for Measuring Hip Roofs:** To obtain the total number of sq. ft. of roof surface, add … equals the number of squares in the roof.

**Rules for Measuring Conical Tower Roofs and Circular Buildings:** Highlight examples given.

**A Short Method of Figuring Roof Areas** — To obtain the number of sq. ft. of roof area, where the pitch (rise and run) of the roof is known, take the entire flat or horizontal area of the roof and multiply by the factor given below for the roof slope applicable and the result will be the area of the roof.

**Table — Showing different factors to convert flat areas into various slopes**

**Asphalt Shingles — Estimating Quantities of Asphalt Shingles:** When measuring roofs of any shape, always allow one extra course of shingles for the "starters" at the eaves. The first or starting course of shingles must always be doubled.

Asphalt shingles must be properly nailed 6 nails to a strip and nailed low enough on the shingle (right at the cut-out); otherwise, they will blow off the roof.
Nails Required for Asphalt Shingles: When laying square butt strip shingles, use 11 ga. aluminum nails, 1" long, with a 7/16" head.

Wood Shingles and Shakes

Estimating the Quantity of Wood Shingles

Table: Number of Shingles and Quantity of Nails Required

Wood shingles are usually sold by the square based on sufficient shingles to lay 100 sq. ft. of surface, when laid 5" to the weather, 4 bundles to the square.

Slate Roofing

Items to be Included in an Estimate for Slate Roofing

Table: Showing Units per Square and Number of Nails per Square

Porcelain Enamel Shingles: Are manufactured to have an exposed surface of 10"x10" with 144 shingles per square. Weight is 225 lbs. per 100 sq. ft. Finish is fused on at 1500 deg. F and provides a long lasting, self-cleaning finish that will not peel or blister.

Metal Shingles

Clay Roofing Tile

Preformed Roofing and Siding

Preformed Metal Siding: It is made with various corrugations, varying in width and depth, but the 2-1/2" corrugation width is the most commonly used.

When used for siding one corrugation lap is usually sufficient, but for roofing two corrugations should be used and if the roof has only a slight pitch, the lap should be three corrugations.

When used for siding, a 1" to 2" end lap is sufficient, but when laid on roofs it should have an end lap of 3" to 6" depending on the pitch of the roof. For a 1/3 pitch, a 3" lap is sufficient; for a 1/4 pitch, a 4" lap should be used; and for a 1/8 pitch, a 5" end lap is recommended.

Corrugated Aluminum Roofing and Siding

To provide adequate drainage the roof surface should never have a slope less than 2-1/2" per foot, and preferably not less than 3" per foot.
For roofing, sheets should have a side lap of 1-1/2 corrugations. For sidings, should be lapped 1 corrugation.

Membrane Roofing: Fig. 1: Flat Roof with Parapet Walls

Rules for Measuring Flat Roof: When measuring flat roof surfaces that are to be covered with composition, tar and gravel, tin, metal, or prepared roofing, the measurements should be taken from the outside of the walls on all four sides to allow for flashing up the side of each wall. The flashing is usually 8" to 1'-0" high.

Fig. 2: Flat Roof Overhanging Walls

Quantity of Roofing Gravel Required for Built-Up Roofs — Roofing gravel should be uniformly embedded into a heavy top pouring of asphalt or pitch so that approximately 400 lbs of gravel or 300 lbs of slag is used per 100 sft of roof area.

Prepared Rolled Roofing

EPDM Roof Systems: Ethylene Propylene Diene Methylene Rubber is popular known in the trade as EPDM. EPDM membranes can be produced in various colors, including black, reinforced, reinforced, or non-reinforced, and in thicknesses ranging from 30 to 90 mils.

Flashing and Sheet Metal — Sheet Metal Roofing

Standing Seam Metal Roofing

The following table gives the covering capacity of painted or galvanized steel sheets of the different sizes. Include table following the paragraph.

V Crimped Roofing: When estimating quantities of V crimped roofing, allow for the end lap but there is no waste in the width as only the actual covering capacity is charged for by the manufacturer.

The following table gives the quantity of V-crimp roofing required to cover 100 sft of roof with end laps 1” to 6". — Highlight the table following the paragraph.

Copper Roofing — Flat Seam Roofing — Standing Seam Roofing

Sheet Metal Flashing and Trim

Roof Accessories
Erecting and Glazing Metal Skylights: An average skylight (single, double pitch or hip) up to 8'x12' in size containing 100 sft should be erected and glazed complete by a sheet metal worker and glazing in 8 to hrs time at the following labor cost — highlight the table following the paragraph.

Erecting Skylights with Side Sash: If the skylights have side sash, the erection cost will vary with the number of sash in the skylight and whether stationary or pivoted. On an average it will require 1 to 1-1/2 hrs labor time for each sash in the skylight, at the following labor cost per sash - Highlight the table following the paragraph.

Painting

Eaves

Cornices, Exterior

Roofs: For flat roofs or nearly flat, measure actual area … and add 50 percent.

Mensuration

Highlight Formulas, Conversions, and Examples

Computing Areas and Volumes

Area: Formulas and Pictorials

Table of Feet and Inches Reduced to Decimals

Conversion Factors S.I. Metric — English Systems

Glossary: The test will ask at least one question from here

Construction Safety: OSHA / pit issues

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