These 1 Exam Prep Tabs are based on *Masonry Level Three*.

Each Tabs sheet has five rows of tabs. Start with the first tab at the first row at the top of the page; 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 last tab (usually the index or glossary). Then start with the highlights.

**Special Note to our Students:** If you are a 1 Exam Prep student, here is how to really get the most from these 1 Exam Prep Tabs. Follow the above instructions, but before placing the tab, find the tab's topic in the outline of your appropriate module. Now locate and highlight several items listed in the outline just before the topic, and just after. See how the topic fits in the outline and how it relates as a concept to the broader concept spelled out in the outline. If you take a few minutes to do this, when you take the test key words in the test questions will remind you of where the information is in the manual!

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*This concludes the tabs for this document. Please continue with the highlights on the following page.*
2.1.0  **Construction Sequences:** All building construction requires substantial planning, but this is especially true ... be responsible for the method of construction.

For most tall buildings, the first step ... a skeleton frame of steel concrete.

OSHA requires guardrails (Figure 2) whenever there is danger of falling through an opening ... When the construction has progressed to a height 60 feet above grade, OSHA requires that permanent ladders must be replaced by at least one temporary stairway.

Working platforms are typically designed to support 50 pounds per square foot.

2.2.0  **Building Design:** High-rise masonry buildings usually have frames of reinforced concrete, steel, or a combination of these materials.

The critical element in this type of masonry design is not loadbearing ... It is provided for exterior wall walls by other structural elements of the building, angle irons, anchors, and other braces.

Anchorage between walls and supports must be able to resist wind loads and other lateral forces acting either inward or outward.

| Table 1 | Lateral Support Requirements for Non-reinforced Concrete Masonry Walls |

2.3.0  **Exterior Walls:** Two type of veneer walls are used in high-rise construction ... They are attached to structural frame.

2.3.1  **Panel Walls:** Panel walls are exterior nonbearing walls ... concrete slab or beam, or by steel shelf angles.

2.3.2  **Curtain Walls:** Curtain walls are exterior nonbearing walls designed ... without intermediate support.

Curtain walls are tied to concrete or steel frames.

Therefore, a curtain wall must be tied to a frame with flexible anchors made of galvanized steel or some other noncorrosive metal.

2.3.3  **Parapet Walls:** The parapet is that part of a wall that extends above the roof line.
Possible leak lines for parapets are at the coping joints and at the interference with the roofing.

2.4.0 **Interior Walls:** Interior walls are usually partition walls. These are nonbearing walls one story or less in height which support only their own weight.

Based on the International Building Code, the ratio of height to thickness should be 36 to 1 for partition walls.

### Table 2

<table>
<thead>
<tr>
<th>Maximum Wall Height-to-Thickness Ratio</th>
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### Table 3

<table>
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<th>Maximum Wall Spans</th>
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</table>

#### 3.1.0 **Working Around Cranes:**
- Tower Cranes
- Mobile cranes
- Conventional derrick cranes

The operators should recognize signals only from the designated person supervising the lift.

#### 3.1.2 **Nonverbal Modes of Communication**

**Figure 18**

**Standard Hand Signals**

When moving a mobile crane, audible travel signals must be given using a crane’s horn:
- Stop
- Forward
- Reverse

#### 3.2.0 **Working Around Materials Hoists:** A materials hoist can be mounted on a scaffold (Figure 19), a ladder (Figure 20) ... diesel or electric motor.

The maximum rated capacity must be marked on the hoist ... lift up to 5,000 pounds up to 300 feet.

#### 3.3.0 **Moving and Stocking Materials:** Stack masonry units carefully and safely ... the following requirements before performing this work: (8 bullets)

Masonry stockpiles are loaded onto elevated workstations when scaffolding is clear of all workers.
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>3.4.0</td>
<td><strong>Elevated Workstations:</strong> Arrange materials and equipment with the following requirements in mind: (6 bullets)</td>
</tr>
<tr>
<td>3.5.0</td>
<td><strong>Disposal Chutes and Waste Bins:</strong> In section 1926.852 of the OSHA regulations, materials are dropped from more than 20 feet.</td>
</tr>
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<td>4.1.1</td>
<td><strong>Electrical Hazards:</strong> To prevent electrical shock, tools must provide at least one of the following types of protection:</td>
</tr>
<tr>
<td></td>
<td>- Double insulated</td>
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<tr>
<td></td>
<td>- Powered by a low-voltage isolation transformer</td>
</tr>
<tr>
<td></td>
<td>- Grounded with a three-wire cord</td>
</tr>
<tr>
<td></td>
<td>A ground fault circuit interrupter (GFCI) … caused by the current leakage to ground.</td>
</tr>
<tr>
<td>4.1.2</td>
<td><strong>Fire Prevention:</strong> To reduce the risk of fire, protect all materials stored in the building or within 10 feet of the building with a noncombustible covering.</td>
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<td></td>
<td>Be prepared to put out a fire. Post at least one portable chemical fire extinguisher next to each storeroom.</td>
</tr>
<tr>
<td>4.1.4</td>
<td><strong>Appropriate Personal Equipment:</strong> Fall protection equipment must be worn when you are working 6 or more feet above a lower level.</td>
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<tr>
<td>4.2.1</td>
<td><strong>Guardrails:</strong> Guardrails are the most common type of fall protection.</td>
</tr>
<tr>
<td>4.2.2</td>
<td><strong>Safety Nets:</strong> Safety nets are used for fall protection on bridges … 30 feet beneath, the work area.</td>
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<tr>
<td></td>
<td>The net must extend 8 feet to 13 feet beyond the edge of the work area depending on the actual vertical distance between the net and the work area.</td>
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<tr>
<td>4.2.3</td>
<td><strong>Personal Fall Arrest Systems:</strong> Fall protection equipment catches a worker after they have fallen.</td>
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<td></td>
<td>A personal fall arrest system uses specialized equipment, including a body harness … and equipment connectors.</td>
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<tr>
<td></td>
<td>Lanyards are short, flexible lines with connectors on each end, They connect the body harness to the lifeline.</td>
</tr>
</tbody>
</table>
Do not use the equipment if you find any damage. Replace any cabling that has more than 10 percent of the total wires frayed or broken in any running foot.

4.4.0 **Personnel Lifts:** OSHA regulations require that when construction has progressed to a height of 60 feet above grade, ladders should be replaced with at least one temporary stairway.

4.5.0 **Controlled Access Zones:** A controlled access zone is a designated work area which certain types of work … personal fall-arrest systems, or safety nets.

Controlled access zones are on the side of the wall without the scaffolding … Entry is restricted to masons actively constructing the wall.

**Specialized Materials and Techniques**

2.0.0 **Weather Considerations:** Hot weather can cause mortar joints to set too rapidly.

If temperature falls below 40F, hydration is required.

Admixtures are sometimes added to the mix to chemically change … because they speed up or slow down the setting time.

2.1.0 **Weather Data and Information:** Accurate weather forecasting is an important part of planning all-weather construction.

Although ideal, cold, and hot are relative terms for masonry construction, ideal is generally between 40 F and 90 F.

2.2.0 **Hot-Weather Masonry Construction**

2.2.1 **Mortar and Masonry Performance:** The primary concern in hot weather is evaporation of water from the mortar.

2.2.2 **Materials Storage:** The primary objective in hot-weather masonry construction is to avoid moisture loss.

Table 2 Brick Masonry Construction in Hot Weather

2.2.3 **Construction Practices:** In addition to the practices listed in Table 2, the following procedures are suggested: (4 bullets).

2.3.0 **Cold-Weather Masonry Construction**
2.3.1 **Mortar and Masonry Unit Performance:** The major concern during cold-weather construction is to keep all equipment, materials, and supplies at a temperature well above freezing point.

2.3.2 **Material Selection and Storage:** Early high-strength (Type III) portland cement substituted for normal (Type I) cement … because it increases the rate of strength development.

Calcium chloride is not recommended in reinforced masonry construction … do not use more than 1 quart solution with each 94-pound bag of masonry cement.

Air-entraining agents are sometimes used thaw durability.

Regardless of the materials selected, they must be protected to prevent freezing … temperature below 40 F.

2.3.3 **Construction Practices:** In fact, U.S. federal regulations now call for heated enclosures on all government projects.

Table 3

**Brick Masonry Construction in Cold Weather**

3.0.0 **Surface Bonding:** Surface bonding is a fast, mortarless method of building with concrete block.

3.1.0 **Materials:** One of the most useful qualities of surface bonding cement is its strength. It contains glass fibers that provide great tensile resistance.

3.2.1 **Preparation:** Prepare existing masonry for surface bonding by removing anything that would interfere with the bonding of the mortar. Brush the wall using a detergent cleaning solution.

Support intersecting loadbearing walls using a ¼-inch strap anchor.

3.2.2 **Dry Stack Construction Procedures:** Dampen the wall before surface-bonding cement is applied.

Spread the mix into open joints. Completely cover the block at a minimum surface thickness of 1/8 inch. Use one coat on each side of the block for structural applications.

Begin troweling 5 to 10 minutes after the mortar is sprayed on the wall.
Apply the second finish coat after the first coat has been troweled down, has taken its initial set, and is capable of supporting the second coat – usually within 15 to 20 minutes.

**Surface Coatings:** Surface coatings decrease the permeability of the masonry when it is exposed to severe weathering.

Surface coatings may be broadly classified into two groups: Decorative and clear coatings … Clear coatings protect the masonry without changing its appearance, although some coatings may impart a gloss.

**Surface Coating Material:**
- Fill coats
- Portland cement paints
- Latex paints
- Oil-based paints
- Rubber-based binders
- Epoxy coatings
- Alkyd resins
- Urethane resins
- Silicone

**Surface Preparation:** Do not wash new masonry with acid cleaning solutions if paint is to be applied … Use a solution of 2 to 3 ½ pounds per gallon of zinc sulfate and water.

If an oil-based paint or an alkyd is used, the masonry surface … to age 3 to 6 months before painting.

**Application:** Thin only with solvents recommended by the coating manufacturer … between 45 F and 95 F for other types.

**Stone**

**Material Types:** Stone is divided into two main types for building construction purposes: natural stone and cultured stone.

**Natural Stone:** Natural stone is divided into three categories … igneous, sedimentary, and metamorphic.

Limestone is typically white, light gray or … Its strength is between 4,000 and 20,000 pounds per square inch (psi).
Section | Highlight
---|---
| Sandstones are composed of grains of sand held together by cementing substance to form a compact rock.
| Typically sandstone weighs 135 to 155 pcf. It is fairly hard if well cemented. Its strength is between 3,000 and 20,000 psi.
| Granite is the hardest, strongest, and most difficult and costly to work.
| It weighs 156 to 170 pcf and has a strength of 15,000 to 30,000 pcf.
| Marble is formed from limestone that has been subject to intense heat and pressure.
| Marble is classified according to its soundness into four grades … The Grade A is uniform in appearance and requires no filling.

5.1.2 **Physical Properties of Natural Stone:** The flexural strength of stone is around 1/10 of its compressive strength … typically between 1,000 and 2,000 lbs.

The following is a list of building stones in descending order of their fire resistance:
(5 bullets)

5.1.3 **Cultured Stone:** Cultured stone is another term for artificial or manufactured stone.

Most factory-produced stones have zero flame spread and meet the requirements of practically all building codes.

5.2.1 **Bond Patterns and Bond:** Patterns are generally classed as ashlar, squared stone, or rubble.

In ashlar masonry, the joints are held to ½ inch or less … Ashlar stonework is cut to the dimensions shown on shop drawings prepared for a particular job.

Rubble is fieldstone that requires little or no squaring, cutting … are found in fields and streams.

5.2.3 **Sawing and Cutting:** The stone mason normally uses hand tools to cut and shape stone. These include a variety of masonry hammers and chisels.

The face hammer is smaller than a sledgehammer but larger than a normal brick hammer … This type of hammer is also called a stone axe or stonemason’s hammer.

The mash hammer is used with a chisel for cutting or breaking medium-sized stone into pieces … edges or small projections of stone. The bush hammer weighs 2 to 4 pounds.
Section 5.2.4  
Mortar for Laying Stone: Use type N mortar for general stonework. Mix 1 part Portland cement …. all exterior walls except retaining walls.

5.3.1  
Construction Types:  
- Dry-laid stone  
- Dry-stack construction  
- Full mortar stone construction  
- Natural or manufactured stone veneers  
- Formed based stonemasonry

5.3.2  
Coursing: It is a definite horizontal layer of masonry materials … it is known as broken range.

Use the plumb line to lay the cornerstone for each end of the wall.

5.3.3  
Helpful Techniques: Thick walls require internal bonding … Leave enough space on the other face to lay a stable stone.

5.3.5  
Tooling and Jointing: Rake or tool the joints after brushing where joint finish is required … wet the wall, and put in fresh mortar.

Sometimes a special mortar is used with ashlar stonework … Rake the mortar joints to a depth of ¾ inch.

The raked joint is a popular finish for random or square rubble … prevent the stones from moving out of position.

Another mortar joint for stone walls is the rolling bead or convex joint … After the mortar has cured, dampen and reopen it.

5.4.0  
Form-Based Stonemasonry: Form-based stonemasonry is a method for constructing cast-in-place stone walls. It is best suited for use with rounded stones in varied sizes, or cobblestones.

5.4.3  
Construction Sequence: The first step is to lay out the wall and place the footings.  
(Step 1 – Step 1)

5.5.0  
Cultured Stone Installation: offers 50 to 60 percent cost savings.
6.0.0 Acid Brick: A technical but more accurate name for acid brick is chemical resistant masonry.

6.1.0 Uses of Acid Brick: Acid brick is used to serve one of two purposes ... Acid brick structures do not resist tension well, but are capable of carrying heavy compressive loads.

6.2.0 Acid Brick Materials: Acid brick structures have four parts ... and the external support structure of concrete or steel.

6.2.1 Masonry Units: The most common types of acid brick are the following:
- Red shale brick
- Fireclay
- Carbon brick

6.2.2 Membranes: Acid brick linings are not, in themselves ... they require a membrane to fully protect the concrete or steel substrate.

Membranes fall into two classes ... A semi membrane provides some penetration, but the amount is limited to what the substrate can handle.

6.3.0 Laying an Acid Brick Floor

6.3.2 Membrane Selection and Application: The most common membrane in floor construction is a three –part asphaltic membrane ¼ to 3/8 inch thick.

6.3.5 Expansion Joints: There are basically three types of expansion joints use with acid brick linings. (3 bullets)

Normally, acid brick construction requires expansion joint placement at the following points: (4 bullets).

7.0.0 Refractories: Refractories are special masonry units that are used ... resistance to temperature and corrosion is required.

7.1.1 Brick Shapes and Sizes: The basic size in the United States is ... called a 9-inch straight or square.

Figure 45 Standard shapes, 9-inch refractory

7.2.1 Refractory Mortars: They are designated to fill the void ... thinnest possible joint.

Mortar may be applied in several ways ... one method uses a conventional buttering technique.
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<tr>
<td>Another method is known as the dip method.</td>
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</table>

**7.2.5 Kiln Jack Method**

**7.3.0 Curing and Heat-Up:** The best temperature range for laying and curing refractory … the first 24 hours after laying.

**8.0.0 Glazed Masonry Units:** Hollow masonry units made of burned clay or shale … face an enduring beauty and hardness.

**8.1.2 Grades and Types:**
- Grade S
- Grade SS
- Type I
- Type II

**8.1.3 Sizes and Shapes:** Use ¼, 3/8, or ½-inch mortar joints with structural clay tile.

Two common sizes of structural glazed tile are the 6T and 8W series.

Figure 53: Sizes of structural clay tile

One of the most frequently used shapes in glazed structural tile is the bullnose.

The standard method of tile construction is horizontal coring … this is known as end construction.

**8.2.0 Bonding and Coursing:** In the stack bond pattern, each tile is laid directly over the one underneath; with all the head joints … This particular bond is the pattern most frequently used.

Horizontal joint reinforcement is also used with structural tile and is especially … The joint reinforcement is normally placed 16 inches on center.

**9.0.0 Glass Block:** The three categories of glass block are: (3 bullets).

**9.2.0 Variations:** The standard nominal sizes are 6, 8, or 12 inches square x 3 7/8 thick … A ¼ inch mortar joint is standard with glass block.

**9.3.0 Detail procedures:** There are two methods for installing glass block in masonry wall: … with a maximum a height of 20 feet and a maximum width of 25 feet.

Figure 62 Chase method for glass block
10.1.0 **Pier and Panel Wall Barrier:** The pier and panel wall is composed of a series of single-wythe, usually 4 inches thick.

The most easily constructed and economical return is one that is perpendicular to an adjacent panel.

The panels, supported on piles or clip angles attached to piers, act as thin, supported beams.

The piers act as vertical cantilevers and must be designed to resist all lateral loads transferred from the panels.

10.3.0 **Cantilever Walls:** To function properly, this wall must be supported on a continuous foundation, usually made of reinforced concrete. … caused by loads placed perpendicular to the wall.

2.1.2 **Cracking and Spalling:** Cracking is the distress that occurs most often in masonry walls … typical shapes and pattern of cracks.

The following are poorly designed locations where cracking typically occurs:
- Long walls
- Corners
- Offsets and setbacks
- Shortening of structural frames+
- Foundations
- Deflection and settlement: Deflection and settlement cracks are identified by a tapered opening.
**Section** | **Highlight**
--- | ---
- Encased columns
- Parapet walls
- Embedded items

2.1.3 **Water Penetration:** The movement of water and air into and within masonry structures leads to other problems such as efflorescence … as result of condensation of water vapor.

Condensation is usually due to moisture originating inside buildings.

Another source of moisture that may contribute to future … efflorescence is the water that enters the assembly during construction.

The key to preventing mold is controlling moisture.

2.1.4 **Efflorescence:** Efflorescence is a white or gray crystalline deposit of water-soluble salts on the surface of brick masonry.

Efflorescence occurs when water soluble salts in solution are brought to the surface of the masonry and deposited there by evaporation.

2.1.5 **Stains:** Silicate stains may also occur adjacent to trim elements, precast concrete, and (occasionally) large expanses of glass … scumming that occasionally occurs on brick in the manufacturing process.

2.3.0 **Inspection checklist:** Note that it is broken down into locations, such as north and below grade.

3.1.0 **Tuckpointing:** Tuckpointing is the process of cutting the old …refilling the joint with new mortar.

The general procedure for tuckpointing is as follows: (Step 1 – Step 4).

For best results, the original mortar proportions should be duplicated … may not properly bond to the original mortar.

The tuckpointing mortar should be prehydrated to reduce excessive shrinking.

3.2.0 **Efflorescence Removal:** The best way to deal with efflorescence is to take measures to prevent it … goes a long way toward preventing efflorescence.

A typical solution consists of 1 part muriatic acid and 10 parts water.

Efflorescence spots are scrubbed using the acid solution and a fiber brush.
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<tbody>
<tr>
<td>4.1.0</td>
<td><strong>Cleaning Techniques:</strong> Dirt may also cause or aggravate deterioration of the masonry. Prolonged dampness increases the chemical reactivity of the masonry with common air pollutants.</td>
</tr>
<tr>
<td>4.1.2</td>
<td><strong>General Preparations:</strong> Before any actual cleaning begins, all cleaning procedures and solutions should be tried on a sample test area of approximately 20 square feet.</td>
</tr>
<tr>
<td>4.1.3</td>
<td><strong>Bucket and Brush Hand Cleaning:</strong> Bucket and brush cleaning is probably the most popular but misunderstood of all the methods used for cleaning brick masonry. A recommended general procedure using procedure using proprietary compounds, detergents, or acid solutions is as follows: (Step 1 – Step 8).</td>
</tr>
<tr>
<td>4.1.5</td>
<td><strong>Sandblasting:</strong> The air compressor should be capable of producing 60 ton 100 psi at a minimum air flow capacity of 125 … nozzle at a minimum rate of 300 pounds per hour.</td>
</tr>
<tr>
<td>4.2.3</td>
<td><strong>Miscellaneous External Stains:</strong> A poultice works by dissolving the stain and leaching or absorbing the solution. The poultice dries to a powder.</td>
</tr>
<tr>
<td>4.4.0</td>
<td><strong>Replacing Brick and Mortar Joints:</strong> To ensure a good bond with brick and stone, dampen the cleaned joints with water just before … Fill joint with mortar applied in thin, ¼-inch layers.</td>
</tr>
<tr>
<td>5.1.0</td>
<td><strong>Repairing Water Intrusion:</strong> Small openings and cracks in the mortar joints can be sealed … No. 30 sieve, and ¼ part fine hydrated lime.</td>
</tr>
<tr>
<td>5.1.1</td>
<td><strong>Portland Cement Paint:</strong> Portland cement-based masonry paints can also reduce water penetration.</td>
</tr>
<tr>
<td>5.1.2</td>
<td><strong>Bituminous Coatings:</strong> Bituminous coatings are used when leaks occur at the joints between the basement floor and the walls.</td>
</tr>
<tr>
<td>5.1.3</td>
<td><strong>Exterior Repairs:</strong> One source of moisture penetration is missing or deteriorated caulking and sealant in contact areas between brickwork and other materials.</td>
</tr>
<tr>
<td>6.1.0</td>
<td><strong>Repairing Chimneys:</strong> A general guideline for chimney height states that the chimney opening should be at least 3 feet above a flat roof … as shown in figure 35.</td>
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**Figure 35**  
Minimum chimney clearance

**Figure 36**  
Design details for chimney top
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<tr>
<td>6.1.2</td>
<td><strong>Chimney Racked Faces:</strong> The transition between the wide fireplace and the narrower chimney with its exposed brick is called the raked face.</td>
</tr>
</tbody>
</table>
| 6.1.3   | **Appliance Chimneys:** Appliance chimneys have two specific items that should be maintained – the cleanout and the thimble.  
- Cleanout door  
- Thimble |
| 6.2.0   | **Repairing Fireplaces:** Tuckpointing the mortar joints uses the same techniques described earlier in this module.  
Temperature changes that occur during use of the fireplace tend to loosen mortar and brick within the structure.  
Continuous heating and cooling may cause the firebrick to deteriorate. |

**Commercial Drawings**

| 2.2.0   | **Commercial Plan Contents:** A complete set of commercial construction plans typically includes the following drawing types: (5 bullets).  
In some commercial drawing sets the site plans are called civil drawings. They are marked C1, C2, C3, and so forth. |

Figure 3  
Typical drawing lines

Figure 4  
Typical materials symbols

| 2.2.1   | **Architectural Drawings:** The architectural drawings are usually labeled with page numbers … The architectural drawings will include the following: (6 bullets). |

Figure 5  
Topographic symbols

| 2.2.2   | **Structural Drawings:** Structural drawings provide a view of the structural members of the building … designated by the letter S.  
The structural drawings usually include the following: (4 bullets) |

| 2.2.3   | **Mechanical Drawings:** These drawings have a prefix of H, P, and FP … The plan view format is commonly used on these drawings. |

| 2.2.4   | **Plumbing Drawings:** Plumbing drawings are considered part of the mechanical plans. |
2.2.5 **Electrical Drawings:** In addition to schematics of the branch circuits for the building, electrical drawings will include the following: (7 bullets).

Like mechanical drawings, electrical drawings use the plan view to show system layout.

3.0.0 **Reading and Understanding Drawings:** When reading commercial plans, it is best to follow step-by-step process to avoid confusion and to catch all the important details. (Step 1 – Step 9).

3.1.1 **Site Plans:** Commercial site drawings show many of the same features as residential drawings, but are far more detailed. They include details on site improvement features, existing and finish contour lines, paving areas, and site access.

Features on the commercial site plans that may not be found on residential plans include the following: (6 bullets).

A known elevation on the site that is used as a reference point during construction is called a bench mark … with a physical description and its elevation relative to the datum.

Site plans are drawn using a convenient scale. This may be 1/8 inch to 1 foot, or it may be an engineering scale, such as 1 inch to 20 feet.

3.1.2 **Floor Plans:** The drawing scale is normally ¼ inch to 1 foot for the plan views.

The grid lines are useful for locating features that are repeated on one floor or from one floor … where they locate footings on columns.

3.1.3 **Schedules and Details:** The architectural drawings will include schedules for doors, windows, and interior wall finishes … Common features include: (3 bullets).

Door and window schedules are designated by number or letter on the drawings.

Certain areas of a floor plan, elevation, or other part of a drawing … They are called details.

3.1.4 **Elevations and Sections:** The scale of the drawing depends on the detail required … or as large as ¾ inch to 1 foot.

Elevations and sections are also drawn for landings, stairways, and backfilled retaining walls.
3.2.0  **Structural Drawings:** Structural drawings provide detailed information on the structural features of the building.

The structural drawings include plan views, sections, details, schedules, and notes. They provide information on the size and placement of load bearing elements.

Typical structural drawings include foundation plan, floor framing plans, and a roof framing plan.

Plan views are typically drawn to scale of 1/3 or 1/4 inch to 1 foot; sections are 1/2 or 3/4 inch to 1 foot; details are 1 or 1 1/2 inch to 1 foot.

The structural drawings will show the type of framing and loadbearing for the building.

Exterior masonry is typically nonbearing curtain or panel walls … and placement of reinforcing materials and of various jointing techniques.

Figure 20  Footing/pier drawing and schedule.

3.2.1  **Foundation Plans:**
- Shallow plans
- Intermediate foundations: Drilled piers are concrete or reinforced concrete piers formed by placing …. carry column loads or grade beams.
- Deep foundations

3.2.2  **Framing Plans:** The structural engineer draws a framing plan or diagram for the roof and for each floor level that will be framed.

Looking at this diagram, or at any framing plan, you should see the following: (3 bullets).

You may also see details for locations of stairs, recesses, and chimney placements.

The columns on a framing plan are shown from the top … Joists fasten between beams or between beams and walls.

There is a great deal of information on the framing plans … separate bays or spans between columns.

3.3.0  **Mechanical Drawings:** Mechanical drawings provide information about the HVAC systems, plumbing systems, and fire protection systems.
There are many situations where you will be required to make passage for or work around mechanical items … review all the mechanical drawings for information on the dimensions and measurements.

3.3.1 **HVAC Systems:** Mechanical plans typically contain schedules that identify the different types of HVAC equipment.

3.3.2 **Plumbing Systems:** Plumbing drawings usually appear as plan view drawings and as isometric drawings called riser diagrams.

Piping for distribution of natural gas within the structure is often considered part of the plumbing work.

3.4.0 **Electrical Drawings:** Electrical drawings identify the layout of the electrical distribution system, the lighting requirements, and the telecommunications and computer connections.

All systems begin at the service source … Like water and natural gas, it begins with a meter installed by the utility company.

4.0.0 **Written Specifications:** Those who use the construction drawings and specifications must always be alert … These are some situations where discrepancies might occur: (3 bullets).

4.2.0 **Format of Specifications:** For convenience in writing, speed in estimating, and ease of reference, the most suitable … products, and activities.

The most commonly used format in North America is the Master Format.

**Estimating**

1.0.0 **Introduction:** The estimating process is basically the same whether the project is a 20-story high-rise or the block foundation for a bungalow.

1.1.0 **Estimating for Jobs:** Estimating materials quantities is an important part of planning and scheduling of a construction project,. This type of estimating is often called takeoff work.

Estimating procedures vary from trade to trade … In this system; the first calculation is the total square feet in a certain structural unit.

1.2.0 **General Rules:** The first step in estimating, then, is to find out what needs to be built.
The next step is to estimate the materials needed to build each structural items on your initial list. Use a worksheet like the one shown in Table 1 to list for each different structural item.

Use a worksheet like the one shown in Table 1, or use you company’s estimating as a guide to ensure that you have included all of the materials, elements, and procedures in your estimate.

Table 1

Quantity Takeoff Sheet

2.0.0 Estimating Brick and Mortar: The amount of brick can be estimated by either coursing method or the square foot method.

2.1.0 Coursing Method for Brick: The first step in this method requires finding the size of the brick. (Step 1 – 7, Note: #5 has important information).

Table 4

Sizes of Modular Brick

2.2.0 Square Foot Method for Brick: Today, most masonry materials are based on the 4-inch modular system.

To understand the square foot estimating procedure, follow the steps in the example given below.

The following calculations use Table 5 … The figures in this table do not allow any waste. (Step 1 – 6 Note: #5 has important information).

2.3.0 Allowing for Openings: When estimating for openings, a calculated number of brick should be deducted from the total number of brick … Do this by subtracting the total square feet of the openings from the total wall area. (Step 1 – 4).

2.4.1 Rule of Thumb: The rule of method uses equivalent values for the materials used to make masonry mortar. This method uses the following base values … (2 bullets) … This method works for Type N or O mortar made with masonry cement.

The calculation is simplified using the following steps: (Step 1 – 5).

Because sand is delivered in bulk and spread on the ground, there will always be some amount of waste … tons of sand are needed, allow at least ¼ ton for waste.

2.4.2 Table Method: The table method of estimating relies on standard volumes of materials required to meet mix proportions for one unit of mortar. In this case, the volume is figured in cubic feet.
The calculation for the individual materials is as follows:
- Portland cement
- Lime
- Sand

2.4.3 **Collar Joints:** You must increase the amount of mortar if the collar joints are to be filled. Table 8 provides values for the additional amount of mortar for the collar joints.

3.1.0 **Coursing Method for Block:** (Step 1 – 7, Note: #6 has important information).

3.2.0 **Square Foot Method for Block:** (Step 1 – 4, Note: #3 has important information).

3.3.0 **Openings and Lintels:** If a wall has openings, you need to calculate this area in square feet, then deduct that amount from the total square feet of the wall area.

Standard lintel blocks must extend a minimum of one-half block lengths, or 8 inches… Add 16 inches for the overlap needed for each opening. Divide this figure by 16 to get the number of block. (Step 1 -3).

3.4.0 **Estimating Mortar for Single-Wythe Block Walls**

3.4.1 **Rule of Thumb:** The rule of thumb for estimating masonry cement for blocks is as follows … (2 bullets) … As with brick, the rule of thumb estimate is good for the most …to get the number of bags of masonry cement. (Step 1-4).

Table 9 Material Quantities for Single-Wythe CMU Walls

3.4.2 **The Table Method:** This method is based on estimating the amount of mortar per square foot … Table 9 gives the quantities of mortar per 100 units for different sizes of concrete block. (Step 1 – 3, Note: #1 has important information).

3.5.0 **Estimating Mortar for Multi-Wythe Walls:** The amount of mortar and other material will depend on the configuration of the wall.

Table 10 shows material quantities per 100 square feet for various types of composite walls.

Table 10 Material for composite Walls Per Square Feet

3.6.0 **Estimating Grout:** Grout is typically ordered …the wall itself (Step 1-3)

Table 11 and Table 12; both tables include a 3 percent allowance for waste.
<table>
<thead>
<tr>
<th>Section</th>
<th>Highlight</th>
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</thead>
<tbody>
<tr>
<td>Table 11</td>
<td>Grout in Two-Wythe Brick Walls</td>
</tr>
<tr>
<td>Table 12</td>
<td>Grout in Concrete Block Walls</td>
</tr>
<tr>
<td>4.1.0</td>
<td><strong>Joint Reinforcement:</strong> Joint reinforcement is usually placed…the most common.</td>
</tr>
<tr>
<td>4.1.1</td>
<td><strong>Linear Foot Method:</strong> (Step 1-4 - #4 has important information)</td>
</tr>
<tr>
<td>4.1.2</td>
<td><strong>Square Foot Method:</strong> (Step 1-5 #2 has important information) Joint reinforcement is shipped in …linear-foot packages.</td>
</tr>
<tr>
<td>4.2.1</td>
<td><strong>Calculating Rebar Quantities:</strong> (Step 1-6)</td>
</tr>
<tr>
<td>4.3.0</td>
<td><strong>Masonry Ties:</strong> The required number of masonry…square foot method.</td>
</tr>
<tr>
<td>4.5.0</td>
<td><strong>Additional Items:</strong> Miscellaneous items are often …on the drawings.</td>
</tr>
<tr>
<td>5.0.0</td>
<td><strong>Estimating Stone:</strong> Use the following guidelines when dealing with stone estimating: (7 Bullets)</td>
</tr>
<tr>
<td>5.1.0</td>
<td><strong>Stone Veneers:</strong> Stone veneers are always estimated in terms of square feet.</td>
</tr>
<tr>
<td>5.2.0</td>
<td><strong>Stone Volume Estimates:</strong> Many types of stone are estimated…fill a truck.</td>
</tr>
<tr>
<td>5.2.1</td>
<td><strong>The Cubic Yard Method:</strong> The cubic yard system is a simple and effective way of estimating stone. (Step 1-4)</td>
</tr>
<tr>
<td>5.2.2</td>
<td><strong>The Perch Method:</strong> The only difficulty in estimating…24.75 cubic feet.</td>
</tr>
</tbody>
</table>

**Site Layout-Distance Measurements and Leveling**

<table>
<thead>
<tr>
<th>Section</th>
<th>Highlight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0.0</td>
<td><strong>Site/Plot Plans and Topographical Maps:</strong> Site layout involves extensive use of … the job site.</td>
</tr>
<tr>
<td>3.0.0</td>
<td><strong>Characteristics Of Contour Lines:</strong> Contour lines show changes…achieved during construction.</td>
</tr>
<tr>
<td>4.0.0</td>
<td><strong>Site Layout Control Points:</strong> Best of the tremendous liability…lines or boundaries.</td>
</tr>
<tr>
<td>4.1.0</td>
<td><strong>Types of Control Points:</strong> Primary control points are used…on the site.</td>
</tr>
</tbody>
</table>
Control point concrete monument.

Primary control point markers are typically…by protective laths.

Building layout points are used to locate…24” to 36” being typical.

Working control point marker.

Communicating Information on Control Markers and Other Markers: Some guidelines for marking stakes are as follows (6 Bullets)

Distance Measurements Tools and Equipment: Site layout involves making horizontal…type of tape.

Tapes: When making measurements, the proper amount of tension must be applied to get accurate results.

Common tape equipment

Range Poles: Range poles are used to help…are more visible.

Plumb Bobs and Gammon Reels: When suspended vertically from…a reference point.

Hand Sight Levels: The hand sight level is a short…of the user.

Chaining Pines: Chaining pins are used to mark …viewing them easier.

Accuracy and Tolerance: Mistakes will happen, but they….again and again.

Taping a Distance (Step 1-7).

To aid in maintaining the tape in the horizontal (level) position when making measurements, a method called breaking the tape is used … in a series of steps until the full tape length has been traversed.

Converting Between Distance Measurement Systems

Converting Feet and Inches to Decimal Feet: (Step #1 - 4).

Converting Decimal Feet to Feet and Inches: (Step #1 – 4).

Corrections for Tape Length: The calibration of the tapes used in the field must be checked periodically … this eliminating errors due to expansion and contraction.
<table>
<thead>
<tr>
<th>Section</th>
<th>Highlight</th>
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</thead>
<tbody>
<tr>
<td>8.0.0</td>
<td><strong>Estimating Distances by Pacing:</strong> The procedures for finding your average pace length and determining an unknown distance by pacing are briefly outlined here: (Step 1 -5).</td>
</tr>
<tr>
<td>9.0.0</td>
<td><strong>Electronic Distance Measurements:</strong> Electronic distance measurement (EDM) is a widely used technology. EDM involves the use of an instrument called an electronic distance measurement instrument (EDMI). There are two classes of EDMIs: electro-optical instruments and microwave instruments.</td>
</tr>
<tr>
<td>10.1.1</td>
<td><strong>Builder’s Level:</strong> The builder’s level is an instrument used to check and establish grades … when laying out building lines.</td>
</tr>
<tr>
<td>10.1.2</td>
<td><strong>Transit:</strong> The transit is also commonly called a transit level because it can be used for similar purposes as a level … other operations that are not possible with the builder’s level.</td>
</tr>
<tr>
<td>10.3.0</td>
<td><strong>Leveling Rods:</strong> Two people are required when the conventional leveling instrument is used … called a leveling rod. As shown, each line and space on an architect’s rod is 1/8” wide … 1/100’ wide.</td>
</tr>
<tr>
<td>Figure 26</td>
<td>Reading a leveling rod</td>
</tr>
<tr>
<td>10.5.0</td>
<td><strong>Testing the Calibration of the Leveling Instrument</strong></td>
</tr>
<tr>
<td>10.5.1</td>
<td><strong>Horizontal Cross-Hair Test:</strong> The object of the horizontal cross-hair test is to ensure … to the vertical axis of the instrument.</td>
</tr>
<tr>
<td>11.1.0</td>
<td><strong>Terminology Used in the Differential Leveling Process:</strong></td>
</tr>
<tr>
<td></td>
<td>- Elevation</td>
</tr>
<tr>
<td></td>
<td>- Bench mark (BM)</td>
</tr>
<tr>
<td></td>
<td>- Backsight (BS)</td>
</tr>
<tr>
<td></td>
<td>- Foresight (FS)</td>
</tr>
<tr>
<td></td>
<td>- Height of instrument (HI)</td>
</tr>
<tr>
<td></td>
<td>- Turning point (TP)</td>
</tr>
<tr>
<td></td>
<td>- Closed loop</td>
</tr>
<tr>
<td>11.2.0</td>
<td><strong>Differential Leveling Procedure</strong></td>
</tr>
<tr>
<td>12.0.0</td>
<td><strong>Field Notes:</strong> General guidelines for writing and keeping field notes are as follows: (12 bullets, Note: #9 has important information).</td>
</tr>
</tbody>
</table>
**Section 14.0.0**

**Highlight**

**Batter Boards:** On some construction jobs, wooden … and other construction layout lines.

A batter board usually consists of a 2 x 4 or 2 x 6 horizontal board … into the ground.

The placement of batter boards is normally done after the exact locations of the building corners have been established.

If it is necessary to drive the stakes in soft soil, or if the stakes extend 3’ or more out of the ground, they should be braced to prevent ant movement.

Figure 37 Typical use of batter boards

**Section 15.0.0**

**3-4-5 Rule:** The 3-4-5 rule has been used in construction for centuries … The 3-4-5 rule is based on the Pythagorean Theorem.

Stated mathematically: (equation)

For most construction layout and checking, right triangles that are multiples of the 3-4-5 triangle are used (such as 9-12-15, 12-16-20, 15-20-25, and 30-45-50.).

Best to use the highest multiple that is practical.

**Orientation to the Job**

**Section 1.0.0**

**Overview of the Construction Industry:** The construction industry is one of the largest … steel and auto industries combined.

**Section 1.1.0**

**Historical Importance of the Construction Industry:** The construction industry will continue to change as engineers and architects search for … technical and management methods.

**Section 1.2.0**

**Growth and Economics of the Construction Industry:** The tight labor market and the boom information technology … qualified construction workers.

To compensate for the lack of skilled construction labor … changes their approach to recruitment.

**Section 1.3.0**

**Changing Values of Workers:** Today workers select companies where they can learn and develop new skills.

Training and education, the use of new technologies, and opportunities for advancement and growth … the construction industry to attract job candidates.
<table>
<thead>
<tr>
<th>Section</th>
<th>Highlight</th>
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</thead>
<tbody>
<tr>
<td>2.1.0</td>
<td><strong>Training</strong>: The need for continuing craft training is necessary if the industry is to meet the forecasted worker demands. Replacement needs will exceed growth demands by 250 percent. The DOL suggest that companies and community groups from partnerships and create apprenticeship programs.</td>
</tr>
<tr>
<td>2.1.1</td>
<td><strong>Craft Training</strong>: The Society of Human Resources management (SHRM) offers the following tips to supervisors in charge of training their employees. (1-3).</td>
</tr>
<tr>
<td>2.2.0</td>
<td><strong>New Technology</strong>: Benefits cited by survey respondents included increased productivity and speed … and better financial controls and communication.</td>
</tr>
<tr>
<td>2.2.1</td>
<td><strong>The Internet</strong>: The internet provides its users the ability to access information and transmit information to other electronically.</td>
</tr>
<tr>
<td>2.2.2</td>
<td><strong>E-mail</strong>: E-mail refers to mail that is typed into computer, then sent electronically to a recipient via the internet.</td>
</tr>
<tr>
<td>2.2.3</td>
<td>The World Wide Web: The World Wide Web can be used to conduct research on various topics by simply conducting a search of keywords.</td>
</tr>
<tr>
<td>2.2.4</td>
<td><strong>E-Commerce</strong>: E-commerce results in time and money benefits for both the contactor and the vendor. The contractor benefits from the ability to: (3 bullets). The vendor benefits because: (2 bullets).</td>
</tr>
<tr>
<td>3.4.0</td>
<td><strong>Sexual Harassment</strong>: Sexual harassment is defined as unwelcome behavior of a sexual nature … instead of on their professional qualifications. The Equal Employment Opportunity Commission (EEOC) enforces sexual harassment laws within industries. Employers should clearly communicate to employees that sexual harassment will not be tolerated … and appropriate action when an employee complains.</td>
</tr>
<tr>
<td>3.5.0</td>
<td><strong>Gender and Minority Discrimination</strong>: The EEOC requires that companies are equal opportunity employers … regard for race, sex, religion, age, etc. To prevent discrimination cases, employers should develop valid job-related criteria for hiring, compensation, and promotion.</td>
</tr>
<tr>
<td>4.1.0</td>
<td><strong>Major Categories of Construction Projects</strong></td>
</tr>
</tbody>
</table>
4.1.1 Residential Construction

4.1.2 Commercial and Institutional Construction: Commercial and institutional construction projects usually involve the use of materials … pre-cast concrete, sprinkler systems, escalators, and elevators.

4.1.3 Industrial Construction

4.1.4 Civil Construction

5.0.0 The Construction Organization:
- Formal organization
- Informal organization

Members in an organization perform best when: (4 bullets, #3 has important information.

5.2.0 Authority and Responsibility: Authority is the power to act or make decisions in carrying out an assignment.

5.3.0 Job Descriptions: Job descriptions set a standard for the employee … simplifying the training of new employees.

A job description should contain the following: (5 bullets).

5.4.0 Policies and Procedures: A policy is a general statement establishing guidelines for a specific activity.

Procedures are the ways that policies are carried out..

Leadership Skills

1.0.0 Introduction to Supervision: The term craftworker refers to a person who performs the work of his or her trade(s) … a project manager is responsible for managing the construction of one or more construction projects.

Craftworkers and crew leaders differ in that the crew leader manages the activities that the skilled craftworkers on the crews actually perform.

3.1.0 Characteristics of Leaders: First and foremost, effective leaders lead by example.

Next, effective leaders tend to have a high level of drive, determination, persistence, or a “stick-to-it” attitude.
Third, effective leaders are typically effective communicators.

Effective leaders have the ability to motivate their followers … and become effective members of the team.

### 3.3.0 Leadership Styles:
- Autocratic leaders
- Democratic leaders
- Hands-off leaders

If a workers attitude is an issue, then democratic action is required.

### 4.1.0 Verbal Communication: Verbal communication refers to the spoken words exchanged between two or more people when communicating.

### 4.1.3 The Receiver: The first step to becoming a good listener involves realizing … on a bust construction site.

Some barriers to effective listening are: (7 bullets)

Some tips for overcoming these barriers are: (7 bullets)

### 4.4.0 Communication Issues: The key to an effective communication is to acknowledge that people are different and be able to adjust your communication style … avoiding the use of words that people may find confusing.

### 5.0.0 Motivation: Motivation refers to behavior set into action because of a need felt by the individual to perform.

### 5.1.0 Employee Motivators: Frequently, the needs that motivate individuals are the same as those create job satisfaction. They include: (7 bullets).

### 7.1.0 Delegating Responsibilities: Some tips for delegating work are: (5 bullets).

### 7.2.0 Implementing Policies and Procedures: Here are some tips for implementing policies and procedures: (4 bullets).

### 8.1.0 Problem Solving vs. Decision Making: Decision making refers to the process of choosing an alternative course of action … and finding out how to bring the two together.
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Safety</strong></td>
<td></td>
</tr>
<tr>
<td>1.0.0</td>
<td><strong>Safety Overview:</strong> To be successful the crew leader must: (5 bullets) … Crew leaders have the most impact for ensuring … and enabling a job’s completion on time and within budget.</td>
</tr>
<tr>
<td>2.1.0</td>
<td><strong>Insured Cost</strong></td>
</tr>
<tr>
<td>2.2.0</td>
<td><strong>Uninsured Costs</strong></td>
</tr>
<tr>
<td>3.0.0</td>
<td><strong>Safety Regulations:</strong> To reduce safety and health risks and the number of injuries and fatalities … including the Occupational Safety and Health Act (OSHA) of 1970.</td>
</tr>
<tr>
<td>3.1.0</td>
<td><strong>Workplace Inspections</strong></td>
</tr>
<tr>
<td>3.2.0</td>
<td><strong>Safety Responsibilities:</strong> Each employer must set up a safety and health program to manage workplace safety and health and to reduce injury, illness, and fatalities.</td>
</tr>
<tr>
<td>4.1.0</td>
<td><strong>Safety Program:</strong> Safety programs should consist of the following: (6 bullets).</td>
</tr>
<tr>
<td>4.2.0</td>
<td><strong>Safety Policies and Procedures:</strong> Employers are responsible for following OSHA and state safety standards. Basic safety requirements should be presented to new employees during their orientation to the company.</td>
</tr>
<tr>
<td>4.4.0</td>
<td><strong>Safety Information and Training:</strong> The employer should provide periodic information and training to new and long term employees.</td>
</tr>
<tr>
<td>4.5.0</td>
<td><strong>Safety Record Systems:</strong> OSHA law requires that employers keep records of hazards identified and documents the severity of the hazard. Logs must be maintained and retained for five years following the end of the calendar year.</td>
</tr>
<tr>
<td>5.0.0</td>
<td><strong>Supervisor Involvement in Safety:</strong> To be effective leaders, supervisors must be actively involved in the safety program.</td>
</tr>
<tr>
<td>5.1.0</td>
<td><strong>Safety Meetings:</strong> A safety meeting may be a brief informal gathering of a few employees or a formal meeting with instructional films and talks by guest speakers.</td>
</tr>
<tr>
<td>5.2.0</td>
<td><strong>Inspections:</strong> Supervisors must make regular and frequent inspections to prevent accidents from happening.</td>
</tr>
</tbody>
</table>
5.3.0 **First Aid**: The primary purpose of first aid is to provide immediate and temporary medical care … such as heart pains or heart attacks.

The supervisor should be at least trained in administrating and teaching first aid … OSHA requires that at least one person trained in first aid be present at the job site at all times.

6.0.0 **Promoting Safety**: The key to effectively promote safety is good communication.

---

**Project Control**

1.1.0 **Construction Projects**: Construction projects are made up of three phases:

1.1.1 Development phase

1.1.2 Planning phase

1.1.3 Construction phase

2.0.0 **Project Delivery Systems**: Project delivery systems focus on three main systems: general contracting, design-build, and construction management.

2.1.0 General Contracting

2.2.0 Design-Build

2.3.0 Construction Management

3.1.0 **What is Planning?** Planning involves: (7 bullets).

3.2.0 **Why Plan?** Some of the reasons for planning include: (4 bullets).

4.0.0 **Stages of Planning**: the two most important occur before a project begins, in the pre-construction phase and during the completion of the construction.

4.1.0 **Pre-Construction Planning**: There are two phases of the pre-construction planning. The first is when the proposal, bid, or negotiated price for the job is being developed.

The second phase occurs after the contractor is awarded the contract … knowledge of any project documents that pertain to the project.

4.2.0 Construction Planning

5.0.0 **The Planning Process**
5.3.0 Determining Tasks

6.0.0 The Planning Process

6.3.0 **Planning Tools:** A supervisor is responsible for planning what tools will be used on the job. This includes: (4 bullets).

7.0.0 **Ways to Plan:** To help keep track of events such as job changes, interferences, and visits, the supervisor should keep a job diary.

A job diary is a small book in which the supervisor records … may be important at a later date.

8.0.0 **Estimating:** Before a project is built, an estimate of the cost needs to be prepared.

**Direct cost include:** (4 bullets)

**Indirect costs include:** (4 bullets).

8.1.0 **The Estimating Process:** A complete estimate is developed as follows: 1-8.

9.0.0 **Scheduling:** A construction schedule for a project shows: (5 bullets).

9.1.0 **The Scheduling Process:** Step 1-3.

9.2.0 **Bar Charts:** Bar charts can be used for both short-term and long-term jobs.

Bar charts provide management with the following: (4 bullets).

Figure 17  
**Bar Chart**

9.3.0 **Network Schedule:** The network schedule is similar to a road map … and overall completion times.

9.4.0 **Short-Interval Production Scheduling**

Figure 18  
Network Schedule

10.0.0 **Cost Awareness and Control:** Control refers to the comparison of estimated performance against actual performance.

10.1.0 **Categories of Costs:** There are two general categories of costs associated with every job, estimated costs, and actual costs.
<table>
<thead>
<tr>
<th>Section</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>The estimated project cost is a sum of all individual jobs and estimated costs.</td>
</tr>
<tr>
<td></td>
<td>Actual costs are the costs for which the contractor is responsible, such as the cost of the delivered materials and the payroll for the employees … work are below or equal to the estimated costs.</td>
</tr>
<tr>
<td>10.2.0</td>
<td><strong>Field Reporting System:</strong> A field reporting system is made up of a series of forms … including the crew leader.</td>
</tr>
<tr>
<td></td>
<td>If the cost is greater than the estimate, management and the crew leader … reduce the cost to get it below or equal to the estimate.</td>
</tr>
<tr>
<td>10.3.0</td>
<td><strong>Supervisor’s Role in Cost Control:</strong> The supervisor should note that there are many other methods to get the job … increasing the size of the crew.</td>
</tr>
<tr>
<td>11.1.0</td>
<td><strong>Control:</strong> An effective control process can be broken down into the following steps: (Step 1 -3).</td>
</tr>
<tr>
<td>11.2.0</td>
<td><strong>Materials Control</strong></td>
</tr>
<tr>
<td>11.2.3</td>
<td><strong>Verifying Material Delivery:</strong> The supervisor should check the condition of the material … before signing the invoice.</td>
</tr>
<tr>
<td>11.3.0</td>
<td><strong>Equipment Control:</strong> To control equipment usage, the supervisor must ensure that the equipment is operated in accordance with its design.</td>
</tr>
<tr>
<td>11.4.0</td>
<td><strong>Tools Control:</strong> Tools control is a twofold process … tools provided by the company.</td>
</tr>
<tr>
<td>11.5.0</td>
<td><strong>Labor Control:</strong> To estimate the amount of labor required, the supervisor will have to determine the following two things: (2 bullets).</td>
</tr>
<tr>
<td>12.0.0</td>
<td><strong>Production and Productivity</strong></td>
</tr>
</tbody>
</table>