Apprenticeship Manitoba

Manitoba

Bricklayer
Level 2

Rev. July 2004

Apprenticeship Manitoba

Bricklayer

Unit: B3 Blueprint Use I

Level: Two

Duration: 30 hours

Theory: 10 hours

Practical: 20 hours

Overview:

Bricklayers and stonemasons must be able to use blueprints and entire sets of blueprints with ease and accuracy. Blueprint interpretation involves learning to make sense of special symbols, codes, and conventions used to convey information to those on the bench, shopfloor, and installation jobsite. The set of blueprints required for a typical institutional or commercial project is organized like a large book. It contains hundreds of cross-referenced, dimensioned images, multiple perspectives ('elevations'), cross-sectional views, and varying degrees of detail. But even the blueprints for a simple masonry component seem complex until blueprint use is mastered. Many of the basic rules for creating and using blueprints were introduced in Unit B2 with respect to drawing and design conventions in general. The instructional content here, however, stresses the use of blueprints to provide, generate, and verify important information about masonry project requirements. The unit also describes how these indispensable documents are produced and used by specialists who are responsible for different aspects of a masonry project. The examples discussed here chiefly involve relatively simple, residential projects. Later in Technical training, bricklayer apprentices have the opportunity to use blueprints involving more complex projects in the commercial/institutional construction sector.

Objectives and Content:	**Percent of Unit Mark (%)**

1. Describe the basic taxonomy of blueprints with particular reference to masonry components. — **10%**

a. Divisions
- Architectural
- Structural
- Mechanical
- Electrical
- Other as specified by instructor

b. Other major categories
- Specifications
- Schedules
- Book (Table of Specifications)
- Addenda

2. Describe the preparation/use of construction blueprints. — **10%**

a. Detailed 'mapping' of site/site characteristics.

b. Visual representation of the construction and/or location of a built structure

c. Specification of essential details
- Shape
- Size
- Function
- Materials used
- Access
- Construction details

- Construction sequence and timetable.

d. Aid in estimating and optimizing materials
e. Aid in identifying and coordinating tasks among the trades
f. Roles and responsibilities in preparing blueprints
   - Client
   - Specification writers
   - Designer
   - Architect
   - Mechanical engineers (electrical; HVAC; plumbing)
   - General contractor
   - Subtrades
g. Sequence of blueprint preparation, distribution, and use (e.g., tendering/bidding)
h. Interpreting blueprint codes (including hierarchy of importance)

3. Describe/demonstrate the use of blueprints to derive specified information. 10%

a. Use of blueprints to perform specified take-offs
   - Costs
   - Materials
   - Quantity
   - Labour/personnel
   - Shipping
b. Use of blueprints to identify production/coordination requirements

4. Use blueprints to derive/verify information per instructor's specifications. 70%

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Apprenticeship Manitoba

Bricklayer

Unit: C3 Concrete and Reinforcement

Level: Two

Duration: 14 hours

Theory: 7 hours

Practical: 6 hours

Modern masonry practices are closely involved with the use of concrete and concrete products. One contemporary source even refers to the centuries-old designation 'mason' as 'a generic term given to a broad class of skilled workers who make final placement of shaped masonry products and concrete,' and in some contexts the term 'cement mason' is used to describe a common specialty within the trade. This close association reflects important changes in the materials and methods of the modern masonry industry which have seen the widespread adoption of such products as concrete block as a substitute for or adjunct to traditional brick and stone. Advances in architectural and engineering knowledge have also changed the ways in which brick, concrete, and other masonry materials are used in modern construction. Bricklayer apprentices thus require a through working knowledge of concrete and concrete products as used in the trade. Although concrete block is perhaps the most common of these, working bricklayers nonetheless sometimes need to estimate, mix, form, reinforce, and place batch concrete in connection with repair work and other jobs. This unit focuses on basic skills and knowledge required to prepare, place, and finish concrete in keeping with modern trade standards.

Objectives and Content: **Percent of Unit Mark (%)**

1. Describe the manufacture, selection, and use of concrete. **40%**

a. Concrete and concrete products in general
b. Trade-specific uses and requirements
   - Foundation work
   - Incorporation of pre-cast components
   - Masonry repair
   - Landscaping

a. Manufacture and supply of concrete
   - Portland cement
   - Aggregates
   - Additives/mixtures

b. Variation/rationale re: special-purpose mixtures and applications
c. Significance of estimates and other important calculations re: concrete, including:
   - Volume of excavation material required
   - Volume of base material required
   - Volume of concrete required
   - Volume of wall material required
   - Volume of drainage material required
   - Volume of backfill required
   - Estimation re: requirements for reinforcement, forming, finishing, etc.

d. Other (specified by instructor)

2. Describe/demonstrate the ordering, mixing, and testing of concrete. **20%**

a. Procurement
   - Requirements for performing estimates and calculations

- Sources and varieties
- Specifications (including transport/delivery)

b. Mixing
- Tools and equipment
- Manufacturer and other specifications
- Manual and mechanical methods of mixing concrete

c. Testing
- Variety and rationale
- Slump test
- Cylinder test, including preparation of test cylinder
- Precautions and practical tips re: modifying concrete mixtures

d. Calculations

e. Other (specified by instructor)

3. Describe/demonstrate the reinforcement, forming, and placement of concrete. 20%

a. Working with reinforcing steel (rebar)
- Classification/selection
- Cutting
- Installing
- Use of ties (standards and other requirements)
- Welding

b. Concrete forms
- Construction/use of simple forms
- Preparation of forms for placement of concrete (e.g., removal of organic debris)
- Significance of subgrade materials and frost-line

c. Placement
- Techniques and equipment/accessories
- Consolidation
- Vibration

d. Calculations
- Other (specified by instructor)

4. Describe/demonstrate the finishing and curing of concrete. 20%

a. Varieties of finished concrete (e.g., exposed aggregate)

b. Factors influencing curing and hardness of concrete

c. Concrete finishing techniques
- Float finish
- Trowel finish
- Broom finish

d. Concrete curing

e. Concrete tempering

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Apprenticeship Manitoba

Bricklayer

Unit: D3 Building Envelope: Air/Moisture Control Systems

Level: Two

Duration: 21 hours

Theory: 14 hours

Practical: 7 hours

Overview:

This unit explores the theme of structural integrity in masonry practice in terms of the building envelope, including the importance of air-moisture control systems. Content includes detailed discussion of the varied products, scientific principles, trade standards, and major techniques associated with these systems.

Objectives and Content: **Percent of Unit Mark (%)**

1. Describe/explain moisture-control system concepts re: masonry structures. 20%

a. Building envelope and its contribution to structural integrity
b. Sources and impacts of moisture on masonry structures/components
   - Above grade (including precipitation and wind)
   - Below grade (including precipitation and ground-water)
   - Inside built structure (including trapped water/moisture)
c. Overview and rationale re: moisture-control methods and system components
   - Parge coats (waterproofing; damp-proofing)
   - Waterproofing: special coatings
   - Damp-proofing: membranes and sealants
   - Ventilation
   - Insulation
   - Flashings
   - Caulking
   - Weep-holes
   - Drainage
d. Overview re: air/moisture control-system products and their application
   - Air barriers
   - Building papers
   - Moisture barriers
   - Vapour barriers
e. Overview re: insulation products and their application
   - Batt insulation
   - Foil insulation
   - Loose insulation
   - Rigid insulation
f. Relevant trade standards and requirements (including National Air Barrier Association certification)
g. Other (specified by instructor)

2. Describe/demonstrate installation of membrane products. 20%

a. Hot application
   - Hazards/precautions and techniques re: use of blow-torches/propane torches
   - Use of hot asphalt or coal tar

- Embedding of fabric/felt in asphalt/tar
- Coating with mortar or Portland cement

b. 'Cold' application
- Hazards/precautions re: handling
- Lead, copper, rubber, plastic, and elastometric sheets/rolls
- Selection/use of adhesive
- Application of pressure and securement

c. Liquid membranes
- Hazards/precautions and techniques re: use of spray-gun
- Brush and trowel techniques
- Build up of layers (including curing time)

d. Other (specified by instructor)

3. Describe/demonstrate installation of insulation products. 20%

a. Comparison/contrast re: rigid and loose/granular varieties
b. Advantages/disadvantages re: selection/use
c. Installation requirements/procedure re: cavity wall
d. Installation requirements/procedure re: wythe
e. Installation requirements/procedure re: cells of concrete block
f. Other (specified by instructor)

4. Describe/demonstrate specified moisture-control techniques/products. 20%

a. Application requirements/procedure re: parging
- Portland cement/mortar coating
- Bituminous compounds/coatings

b. Application requirements/procedure re: crack repairs (above/below grade)
- Use/selection of products
- Tuckpointing
- Grout coat
- Expansion compounds
- Bentonite Clay

c. Application requirements/procedure re: caulking
- Estimating required materials
- Meteorological requirements (e.g., impact of temperature)
- Special hazards/precautions (e.g., use of mineral spirits as cleaning compound)
- Preparation of substrates (including compatibility of cleaning compounds and caulk)
- Troubleshooting large vs. small voids
- Application and spreading, including use of pressure
- Achieving smooth, finished surface

d. Application requirements/procedure re: sealants
- Use/selection and manufacturer specifications re: coverage
- Use of fibre brush, roller, and low-pressure spray equipment
- Spreading and layering

5. Complete the Building Envelope Project per instructor specifications. 20%

a. Review of all project and safety requirements with instructor
b. Preparation of substrate(s)
- Interpretation of manufacturer specifications and trade standards
- Interpretation of WHMIS materials (e.g., MSDS)
- Preparation techniques and procedure

c. Application of membrane(s) to substrate(s)
- Selection/use of PPE
- Interpretation of manufacturer specifications
- Application techniques and procedure

d. Installation of insulation products
- Interpretation of manufacturer specifications and trade standards
- Selection/use of fasteners
- Installation techniques and procedures

e. Install air/moisture barrier products
- State rationale for product selection
- Use of lock adhesive system materials, technique

- Placement of anchors and ties

f. Conduct tests and document results
   - Pull test
   - Bubble test

g. Other (specified by instructor)

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Bricklayer

Unit: D4 Structural Walls and Columns

Level: Two
Duration: 63 hours
Theory: 28 hours
Practical: 35 hours

Overview:

This unit helps extend the apprentice Bricklayer's knowledge and practical skills in building structural walls and columns. The unit includes a review of major concepts concerned with the long-term structural integrity of these components and their function within structural masonry systems. Equally important, however, is the opportunity to become more familiar with the techniques that apply these concepts and principles in everyday trade practice. The major aim of this unit is to encourage deeper appreciation of particular techniques and components of structural wall-column systems, both individually *and* as a sequence of interlocked, interdependent practices. It thus provides an opportunity to learn about and apply specific trade techniques, while achieving a deeper grasp of how these are connected within the building of a structural wall/column system as a whole. Some of these techniques – such as levelling, plumbing, and gauging - apply first of all to the monitoring of a masonry job as it progresses. Others – such as reinforcement, insulation, and parging – have significance long after the masonry crew has left the site. None can be dispensed with if a structural wall/column system is to satisfy modern trade standards.

Objectives and Content: **Percent of Unit Mark (%)**

1. Review specified considerations re: integrity of structural walls/columns. **5%**

a. Recap concept/principles re: structural integrity of systems
b. Recap re: varieties and components of masonry wall/column systems
   - Masonry structural walls (including foundation walls and reinforced walls)
   - Columns (including pilasters and piers)
   - Beams, lintels, and sills
   - Wall/column systems
   - Hollow vs. solid walls
   - Loadbearing vs. nonloadbearing
   - Exterior vs. interior masonry walls/columns
   - Single vs. multi-storey walls
   - Above-grade vs. below-grade walls
   - Faced walls vs. back-up walls
c. Other (specified by instructor)

2. Describe/demonstrate preparations for constructing structural walls/columns. **20%**

a. On-site use of documentation and job specifications
   - Interpreting technical documents re: job specifications
   - Physical inspection/verification re: jobsite characteristics and requirements
   - Clarification of roles/responsibilities and expectations
   - Personal 'plan of attack', including rate of production, deadlines, coordination, etc.)
b. Laying out jobsite
   - Transfer of all measurements, dimensions as specified from documentation
   - Use of levels, transit, lines, batter-boards, storey-poles, etc.
   - Other (specified by instructor)
c. Preparing and organizing personal work area
   - Selection and arrangement of all required tools/equipment
   - Use of aids/accessories for handling materials
   - Arrangement of masonry units and required materials

- Selection/use of cleaning agents re: substrates/materials
- Identifying, analyzing, and solving structural problems

d. Other (specified by instructor)

3. Describe/demonstrate specified techniques re: building structural walls. 25%

a. Coursing
   - Mixing/application of mortar to specifications
   - Maintaining measurements and bonds
   - Tooling and finishing of joints
   - Weepers

b. Gauging
c. Frame-setting
d. Levelling and plumbing
e. Bracing and other reinforcement techniques
   - Installation of lateral and horizontal bracing
   - Embedding of plates
   - Installation of anchors, clips and specified accessories

f. Shoring
   - Regulatory and other requirements
   - Practical techniques

g. Verification re: job specifications and quality assurance requirements
h. Other (specified by instructor)

4. Describe/demonstrate incorporation of other system components. 25%

a. Placement and other requirements re: piers, columns, and pilasters
b. Bearing of roof and floor joists
c. Installation of beams, lintels, and sills
d. Verification re: component specifications
e. Stabilization of system and system components
f. Other (specified by instructor)

5. Describe/demonstrate provisions for long-term structural integrity. 25%

a. Installation of all barriers, membranes, and accessories per instructor specifications (e.g., compartmentalization strips)
b. Air barriers and ventilation
c. Waterproofing and damp-proofing
   - Drainage systems/components for structural wall-column systems
   - Installation of flashing
   - Application of grouts, caulking, and water-repellent products
   - Parging techniques

d. Fireproofing and firestops
e. Insulation products and techniques
f. Selecting and installing special membranes, including tests (e.g., pull test; bubble test)
g. Laying of units
h. Application of reinforcement
   - Vertical
   - Horizontal

i. Other (specified by instructor)

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Apprenticeship Manitoba

Bricklayer

Unit: D5 Masonry Veneers and Cladding

Level: Two

Duration: 21 hours

Theory: 7 hours

Practical: 14 hours

Overview:

This unit concerns the most visible component of masonry wall and column systems: nonstructural veneers and claddings that require the working bricklayer to integrate several distinct kinds of skill and knowledge. Many clients will judge the quality of a brick, stone, or cladded masonry wall on the basis of its outermost appearance. This means masonry veneer work necessarily requires the ability to install units with a special crispness of execution, and a keen appreciation for aesthetic or design-related concerns. However, building durable, nonstructural walls involves much more than just 'what meets the eye.' Although such walls are themselves 'nonstructural' by definition, it is increasingly recognized that they nonetheless play a key role in determining the integrity of built structures as a whole. They are in fact part of the building envelope, and therefore require the bricklayer to build not just attractively but also with due attention to the characteristics of specific materials, while anticipating the likely impact of natural and other forces. The subject's scope and complexity is noteworthy in itself. Masonry veneers and cladding include some of the oldest trade materials still in use such as clay or terra cotta tiles, as well as new products that represent leading-edge knowledge in construction engineering and prefabricated component systems.

This unit builds on earlier content concerning structural walls/column systems, the building envelope, and practical masonry skills. It describes the varieties of masonry veneers and cladding, with special reference to building brick veneer walls. The unit also offers apprentices an opportunity to practice techniques associated with veneer and cladding jobs, including the selection and use of appropriate fasteners, membranes and allied products. The unit includes content that is further developed elsewhere in Bricklayer technical training. A sound understanding of nonstructural wall construction involving veneers and cladding is a prerequisite for further learning in such areas as proprietary masonry products, restoration work, stonemasonry, and ornamental specialties.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Describe masonry veneer walls and cladding components.	**25%**

a. Recap relevant content re: structural integrity of wall/column systems
b. Function of masonry veneer and cladding components
   - Architectural/historical contexts and variation re: materials and techniques
   - Decorative and ornamental factors
   - Insulation factors, including soundproofing
   - Cost factors
c. Engineering requirements and considerations
   - Lateral/horizontal stability – independent, and re: specified structural components
   - Bearing support/capacity and other characteristics of structural frame
   - Drift due to lateral forces (in-plane and out-of-plane)
   - Compartmentalization
   - Ventilation (including air-flow and evaporation rates)
   - Moisture-related impacts

- Seismic impacts
- Solar impacts (moisture absorption: interior vs. exterior)
- Wind impacts (including 'wind-pumping')
- Thermal impacts (expansion/contraction; extreme heat and cold)
- Technological impacts (technical knowledge; product development)
- Tradeworker impacts (e.g., faulty application of mortar around shelf angle)
- Noncombustible anchors/fasteners (safety of firefighters and others)
- Other (specified by instructor)

d. Common types, including relevant points of comparison/contrast
   - Brick
   - Clays and terra cotta
   - Stone (including facings, panels, sheets, terrazzo, tiles, and flooring)
   - Concrete and precast products (including re: prefabricated/engineered systems)
   - Non-traditional claddings (including re: prefabricated/engineered systems)
   - Exterior vs. interior
   - Adhered vs. anchored
   - High vs. low structures
   - New vs. old construction
   - Relative weight and thickness

e. Major components of masonry veneer walls
   - Bearing support
   - Substrates (steel-frame; wood-frame; masonry; concrete; other)
   - Fastening/anchoring systems and accessories – selection, use and rationale (including shelf angle/plate, metal pins, tabs, clips, ties, wire, screws, specialty/proprietary hardware)
   - Cavity, including rationale for standards
   - Insulation products (including re: EIFS and GFRC panels)
   - Membranes
   - Mortars
   - Provisions for ventilation
   - Provisions for moisture control (e.g., weepers, flashings, etc.)
   - Provisions for movement (e.g., cladding joints)

f. Other (specified by instructor)

2. Describe/demonstrate preparations for constructing nonstructural walls. 25%

a. On-site use of documentation and job specifications
   - Interpreting technical documents re: job specifications
   - Timetabling/scheduling veneer/cladding -work re: structural wall completion
   - Physical inspection/verification re: jobsite characteristics and requirements
   - Coordination with other jobsite personnel
   - Personal 'plan of attack' – communication and negotiation

b. Laying out jobsite
   - Transfer of all measurements, dimensions as specified from documentation
   - Use of levels, transit, lines, batter-boards, storey-poles, etc.
   - Other (specified by instructor)

c. Preparing and organizing personal work area
   - Selection and arrangement of all required tools/equipment
   - Use of aids/accessories for handling materials
   - Arrangement of masonry units and required materials
   - Selection/use of cleaning agents re: substrates/materials
   - Identifying, analyzing, and solving structural problems

d. Other (specified by instructor)

3. Describe/demonstrate techniques re: building nonstructural masonry walls. 25%

a. Cleaning and preparation of footing
b. Inspection of substrates
c. Coursing
   - Mixing/application of mortar to specifications
   - Maintaining measurements
   - Maintaining patterns and bonds
   - Tooling and finishing of joints

d. Gauging

e. Facings around openings and frames
f. Levelling and plumbing
g. Bracing and other reinforcement techniques
   - Installation of lateral and horizontal bracing
   - Embedding of plates
   - Installation of anchors, ties, shelf angles, and specified accessories
h. Shoring
   - Regulatory and other requirements
   - Practical techniques
i. Verification re: job specifications and quality assurance requirements
j. Other (specified by instructor)

4. Describe/demonstrate incorporation of specified veneer-wall accessories. 25%

a. Selection and use of accessories for reinforcement
   - Vertical
   - Horizontal
b. Trade standards and requirements re: fasteners and accessories
c. Inspection of substrates
d. Selection/placement/installation of brick-ties.
e. Selection/placement/installation of anchors/anchor plates.
f. Selection/placement/installation of shelf angles.
g. Selection/placement/installation of flashings
   - Water efficiency for flashing
h. Selection/placement/installation of weepers
i. Selection/placement/installation of insulation to specifications
j. Inspection of anchors and flashings
k. Application of grouts, caulking, and water-repellent products
l. Other (specified by instructor)

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Apprenticeship Manitoba

Bricklayer

Unit: E1 Principles of Refractory Work and Heat Dynamics

Level: Two

Duration: 14 hours

Theory: 14 hours

Practical: 0 hours

Overview:

This unit introduces Bricklayer apprentices to the special challenges and opportunities regarding work on heat-resistant masonry structures and linings of many kinds. In broad terms, refractory work encompasses such trade specialties as fireplaces, ovens, and chimneys that have become synonymous with the meaning of 'hearth and home.' The masonry worker's unique expertise in crafting these durable structures to help harness fire and heat for a wide range of essential human purposes has been time-honoured in many cultures and contexts. In some settings, the communal oven built of clay or fire-brick is as central a focus of community life as the village well. However, trade practice also has long since extended refractory work to include leading-edge techniques and special materials involving more sophisticated projects. Modern refractory installations include the use of special-purpose brick, tile, plastic, concrete, and mortar products to build, line, and repair smokestacks, furnaces, kilns, boilers, ladles, and other required components of high-temperature industrial activity. In some sectors, such as mining and steel-milling, specialists known as 'refractory masons' or 'refractory bricklayers' have become indispensable. Bricklayer Technical training includes content on most of these aspects of refractory work. The present unit offers an overview of basic considerations involving the interplay of heat and fire with masonry elements. Other units extend this theme to the theoretical and practical requirements of more specific refractory projects, including chimneys, fireplaces, masonry heaters, furnaces, and kilns.

Objectives and Content: **Percent of Unit Mark (%)**

1. Describe the significance and scope of refractory work. **20%**

a. Significance of refractory work
- Definitions and important trade terminology
- Historical and technological dimensions
- Rationale for refractory work
- Refractory work re: the Bricklayer trade generalist
- Refractory work re: specialization (including career ladders and opportunities)

b. Explain principles/dynamics of heat energy re: masonry structures and materials
- General scientific concepts re: properties of fire and heat (e.g., combustion, convection/diffusion, etc.
- Engineering considerations (e.g., heat/fire-resistance, expansion/contraction, insulation/containment; stability of structures, materials, etc.)
- Interplay of fire/heat with physical properties of common masonry materials

c. Major categories and applications of refractory work
- New structures
- Existing structures
- Structural vs. nonstructural refractory work
- Plastic vs. castable refractories
- Fireplaces
- Masonry heaters/stoves
- Chimneys and smokestacks

- Furnaces
- Kilns
- Ladles
- Vessels
- Tanks
- Substrates (including brick, metal, concrete, wood, insulation boards)
- Relevant specifications and standards – source(s); criteria
- Other (specified by instructor)

2. Describe refractory materials, including special hazards/precautions. 40%

a. Refractory products – descriptions; major types, shapes/sizes, grades, etc.
   - Bricks (Fireclay; High Alumina; Silica; Chrome; Magnesite; Forsterite)
   - Blocks
   - Tile
   - Monolithics
   - Plastics (ramming mixtures)
   - Castables
   - Mortars
   - Cements, clays, and sprays (including
   - Guniting materials
   - Chemical products (e.g., epoxies)
   - Insulation (major types, uses)
   - Hardware (e.g., anchors and brackets)
   - Miscellaneous products (e.g., ceramic fibre/rope/paper; wool; blankets modules; cartons, etc.)

b. Important physical/chemical properties of refractory products, and their relevance
   - Adhesion and cohesion
   - Composition and weight
   - Consistency
   - Ratings re: heat-resistance and combustion point
   - Melting point, fusion, and vitrification
   - Air-setting vs. heat-setting
   - Stability (expansion/contraction)
   - Rigidity vs. malleability
   - Modulus of rupture (transverse resistance to 'cross-breaking')
   - Resistance to abrasion
   - Resistance to oxidation
   - Resistance to acidity
   - Slagging
   - Spalling
   - Setting time
   - 'Shelf-life' (e.g., re: mouldables)

c. Special hazards/precautions, e.g., re: harmful dusts, fibres, etc.
d. Other (specified by instructor)

3. Describe important tools, tasks, and techniques re: refractory work. 40%

a. Precautions re: special hazards (including lockout; confined-space entry)
b. Removal of compromised material (e.g., lining)
c. Cleaning and preparation of substrate
d. Selection and use of required tools, equipment, and accessories, including:
   - Guniting equipment
   - Mechanical mixers/vibrators
   - Tamping tool and/or pneumatic rammer
   - Bolster-surface roughener
   - Pneumatic rammers/tamping tool
   - Wet blankets and/or plastic sheets
   - Scutch hammer
   - Other (specified by instructor)

e. Refractory materials handling
f. Cutting refractory materials (e.g., lining)
g. Mixing and vibrating of castables
h. Ramming (of plastic)

i. Formwork
j. Dipping and laying of firebrick
k. Placement of refractory products
l. Use of expansion joints
m. Use of control joints
n. Anchorage and stabilization of refractory materials (including welding of brackets)
o. Curing and thermal drying of refractory systems
p. Inspection and verification of job re: standards
q. Other (specified by instructor)

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Apprenticeship Manitoba

Bricklayer

Unit: E2 Chimneys

Level: Two

Duration: 21 hours

Theory: 7 hours

Practical: 14 hours

Overview:

This unit is intended to assist Bricklayer apprentices to integrate their practical skills as builders with a deepened understanding of heat-resistant masonry structures. Chimneys are perhaps one of the most familiar of these structures, and perform a relatively simple function. But it can be a challenging job to build them so that they are stable, safe, and fully functional, while satisfying regulatory and trade requirements. Unit content presents an overview of chimney variations and functions, including the contribution that major components make to ensure the safe and efficient operation of combustion systems. Also, because chimneys are by definition so closely associated with fire, heat, and hazardous gases, the unit includes content concerning the many important safety-related construction and functional requirements as these are reflected in project blueprints, the *National Building Code*, and hands-on practice. The unit also offers apprentices the chance to apply their practical skills directly to the production of several kinds of chimney. This material is supplemented by other Technical training units which are included to round out the apprentice's exposure to other varieties of heat-resistant masonry work, including fireplaces, heaters, furnaces, and kilns.

Objectives and Content:	**Percent of Unit Mark (%)**

1. Describe chimney systems, components, and applicable standards. **30%**

a. Functions
- Review characteristics/requirements of refractory materials
- Historical, technological, and environmental considerations
- Venting of heat, fumes, and gases generated by combustion
- Enables draught of oxygen into combustion chamber
- Fire-protection for adjacent materials *via* voiding and heat-shielding

b. Major categories, including criteria, contrasts, and rationale
- Number of flues: Single Flue; Double Flue, Multiple Flue
- Use of associated structure(s): Residential; Commercial; Industrial
- Temperature of combustion products vented through chimney
- Type of connected appliance and/or combustion chamber (e.g., stove, furnace, fireplace)
- Type of fuel source associated with appliance and/or combustion chamber
- Brick chimneys vs. chimneys lined with refractory materials

c. Chimney-system components and their relation to combustion systems
- Anchorage
- Cap(s): Chimney; Rain
- Cleanout door
- Clearances and fire-stops
- Connection
- Flashing
- Flue
- Flue Lining
- Foundation

- Hood
- Reinforcement
- Spark arrester
- Stack
- Stem
- Thimble
- Other (specified by instructor)

d. *National Building Code* standards and related trade practices
- Liners
- Wall thickness
- Hearth
- Smoke chamber
- Clearances
- Termination height
- Anchorage and anchoring methods
- Reinforcement
- Hoods
- Clearances/firestops
- Thimbles
- Smoke test
- Down draught

e. Examination of typical blueprints for various chimneys
- Identify/compare significant features (e.g., industrial vs. residential)
- Derivation of sketches, dimensions, from technical drawings
- Recognition of *NBC*-related provisions and specifications

2. Describe/demonstrate single-flue chimney construction. 30%

a. Interpret provided blueprint and *National Building Code* requirements
- Derivation of sketches, dimensions, etc. from technical drawings
- Use of *NBC* to verify compliance of specifications with standards

b. Locate chimney and place foundation
c. Layout chimney and lower section of stem
d. Construct cleanout opening and set cleanout
e. Anchor chimney
f. Install flue liner and lay up units
- Calculation of offsets
- Placement of supports and achievement of air-tightness
- Verification of measurements re: flue opening, height, and angle

g. Install flashing
- Cutting of flashing as required by slope of roof
- Placement of flashing, counter-flashing, and base flashing
- Proper execution of all laps, edges, bonds, and joints

h. Finished height of chimney
i. Lay up chimney cap
- Placement of cap on cast-concrete top course
- Offset masonry course
- Placement of cap form and placement of concrete
- Sloping of top and stripping of cap form
- Finish of cap sides and sealing of liner joint

j. Install spark arrester
- Anchoring
- Selection of fasteners

k. Other (specified by instructor)

3. Produce the Multiple-Flue Chimney Project per instructor specifications. 40%

a. Interpret provided blueprint and *National Building Code* requirements
- Derivation of sketches, dimensions, etc. from technical drawings
- Use of *NBC* to verify compliance of specifications with standards

b. Locate chimney and place foundation
c. Identification and observance of all relevant safety considerations
d. Understanding of Project rationale and specifications

e. Project requirements re: tool selection and technique
f. Major criteria
    - Cut offset flue liners
    - Execute corbel brickwork
    - Set liners
    - Install chimney tops: brick; concrete
    - Top out and flash as for flat-roof structure with projected masonry cap
    - Incorporate offsets in chimney
    - Compliance with Project Specifications
    - General finished appearance
    - Organization and time-management
g. Other (specified by instructor)

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Apprenticeship Manitoba

Bricklayer

Unit: F2 Stonework and Stone Ornament

Level: Two

Duration: 35 hours

Theory: 10 hours

Practical: 25 hours

Overview:

This instructional unit concentrates on the knowledge and time-honoured practical skills associated with stonemasonry in the context of Bricklayer trade requirements. Content includes essential information about the many varieties of building stone and their preferred use in a variety of applications. Important comparisons and contrasts with other kind of trade practice -- such as satisfying requirements for achieving durable bonds – are noted, as are the special techniques and equipment which make stonemasonry a distinct realm of trade expertise. The unit also offers Bricklayer apprentices the chance to try their hand at practical stone-cutting, installation, and estimating.

Objectives and Content: **Percent of Unit Mark (%)**

1. Review the scope and substance of stonework specialties. 25%

a. Major varieties and applications of stonemasonry work
b. Classification and procurement/manufacture of building stone
c. Key terms and concepts
d. Varieties of stone and their functional characteristics as a construction material
e. Stonework bonds and patterns
   - Ashlar
   - Coursed stone
   - Uncoursed stone (random)
   - Dimensioned stone
f. Relevant code requirements and industry standards
g. Other (specified by instructor)

2. Describe/demonstrate the use of stonemasonry techniques and materials. 15%

a. Tools and equipment.
   - Hand tools for tough shaping vs. dressing tools
   - Axes
   - Banker (bench)
   - Chisels (pitching; pneumatic; splitting; tooth)
   - Compressed air tools (drills; saws; hammers; chisels)
   - Hammers (including bush; cavil [pyramidal pointer]; crandall; face/double-face; patent; peen; pick)
   - Hand polisher
   - Lewis pin
   - Mallets
   - Pitching chisel
   - Pitching tool
   - Plug and feather
   - Point(s)
   - Saws (circular; diamond; gang; gantry; wire)

- Splitting chisel and plug
- Wooden mallet

b. Cutting and trimming of stone
c. Facing, polishing, and finishing of stone
d. Selection and cleaning of stone
e. Procedure re: mortars and caulking
f. Forming mortar joints
g. Pointing
h. Stonemasonry layouts and estimation
i. Receiving, handling, and storage of stonemasonry materials
   - Special precautions
   - Coding of stonework components

j. Other (specified by instructor)

3. Describe/demonstrate the laying of specified stone facings. 15%

a. Laying of artificial/cut stone facings
   - Working with drawings and specifications
   - Substrate requirements
   - Cutting of stone with hand tools
   - Cutting of stone with saw and hydraulic splitter
   - Establishment of horizontal coursing patterns
   - Installing accessories (e.g., corrugated metal ties)
   - Pointing, jointing
   - Cleaning artificial/cut stone facings

b. Laying of fieldstone facings
   - Working with drawings and specifications
   - Substrate requirements
   - Providing a masonry backup
   - Splitting stone with feathers and plugs
   - Cutting of stone with hand tools
   - Pointing and jointing
   - Cleaning fieldstone facings

4. Describe/demonstrate the installation of stonework floors and ornamentation. 15%

a. Floors
   - Laying out centre-lines
   - Installing concrete bed
   - Installing floor-covering
   - Grouting of joints
   - Cleaning floor

b. Ornamental stonework components
   - Coping
   - Sills
   - Steps
   - Jambs
   - Lintels

c. Other (specified by instructor)

5. Describe/demonstrate the erection and dismantling of needles. 15%

a. Working with drawings and specifications
b. Safety assessment re: wall
c. Locating and laying out for opening
d. Locating and layout for needles
e. Installation of needles
   - Punching of holes
   - Cutting and installation of needles

f. Erection of support for needles
g. Knocking off brick opening
h. Building of jambs
i. Installation of lintel
j. Removal of needles

k. Filling-in of brickwork
l. Other (specified by instructor)

6. Describe/demonstrate calculations re: estimating/ordering for stonework. 15%

m. Typical division of labour re: roles/responsibilities (architect/contractor/stonemason)
n. Significance re: variations in types of stone and stone quarrying/milling
o. Estimation factors
    - Dimensions of stones (length, width, etc.)
    - Number of finished faces
    - Type of finish (e.g., deep; shallow)
    - Corners (pre-formed or defined on jobsite)
    - Special component (e.g., sill)
    - Fasteners, anchors, and other hardware/accessories
    - Mortars, caulks, cleaning products, and other materials
    - Tools/equipment (e.g., edge tools; mixers; washers)
    - Pattern and bond specifications (formulas)
p. Use of technical drawings and specifications when estimating stonemasonry jobs
q. Other (specified by instructor)

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Apprenticeship Manitoba

Bricklayer

Unit: F3 Archwork Theory and Practice

Level: Two

Duration: 69 hours

Theory: 20 hours

Practical: 49 hours

Overview:

Masonry archwork is among the most visible and most widely admired of Bricklayer trade specialties. Even those who are not privileged to ply the trade can sense the ingenuity and precise technical skills required to form curved work from materials that otherwise would seem to limit builders to straight lines, flat planes, and box-like shapes. The sheer variety of masonry archwork – whether purely decorative or robustly structural in design – would be remarkable if it existed only in the imagination of builders. Instead, working masons have applied their arch-building expertise to architectural as well as infrastructural achievements upon which entire social systems have depended. Examples include the famous corbelled arches of pre-Columbian indigenous people in the Americas, the aqueducts of ancient Rome, as well as such vaulted structures as cathedral domes, bridges, and subway tunnels of more recent vintage. The apprentice Bricklayer who puzzles through the challenges of laying out and building even a simple archwork project has a direct practical connection with these historic achievements. Contemporary archwork typically involves many of the same materials and purposes, as well as the ability to use the tools of math and geometry to solve relatively complex problems in design, template use, and execution. This instructional unit introduces these essential elements of masonry archwork. Content includes the special terminology, calculations, structural requirements, and techniques associated with this important trade specialty, as well as several opportunities to use them in practice.

Objectives and Content: **Percent of Unit Mark (%)**

1. Describe the major concepts and requirements of masonry archwork. 25%

a. Historical scope and significance of archwork
b. Contemporary applications (e.g., doorways, windows, walkways, etc.)
c. Key terms and concepts
   - Arch Ring, including: apex [crown]; arch brick [voussoir]; haunch; keystone; soffit; springer.
   - Arch Abutment: including: creepers; jamb; spandrel; skewback
   - Dimensions, including span; rise; radius; depth; centreline; extrados (outer ring)/ intrados (inner ring); skewback angle
   - Support base (centre/templates)
d. Considerations re: structural and load-bearing characteristics, including:
   - Explanation of structural and load-bearing features
   - Requirements re: anchorage/reinforcement and temporary support
   - Relevant code requirements and industry standards
e. Considerations re: design and ornamental characteristics
f. Compare/contrast Major Arches (parabolic), Minor Arches (Elliptical; Gothic; Jack/Flat; Rampant; Roman; Saracen; Segmental), and Vaults/Domes (e.g., pendentive)
   - Arch geometry: shapes and centres
   - Span of openings
   - Loadbearing characteristics
   - Applications (e.g., light/residential vs. heavy construction)
   - Bonding patterns

- Thickness of joints
- Location/mode of representation in blueprints and other technical documents
- Special considerations re: vaults and domes

g. Archwork materials and their preferred use
- Brick
- Stone
- Ceramics
- Anchors, fasteners, and reinforcement
- Mortars and grouts
- Archwork cladding and ornament
- Wood/wood products (e.g., templates construction, temporary support) support)

h. Transitions between archwork and other components of the built structure
i. Other (specified by instructor)

2. Describe/demonstrate technical drawing, layout, and calculations re: archwork. 25%

a. Review relevant math and geometry concepts/operations
b. Review of electronic calculator functions re: arcs, circles, etc.
c. Working with archwork blueprints/specifications
d. Requirements and rationale re: archwork centres/templates
e. Outline of procedure re: archwork centres/templates
- Review plans re: dimensions of span, rise, radius, depth, and centreline
- Draw span line on plywood
- Draw rise and locate radius point
- Draw arc of inner ring

f. Lay-outs and calculations for Roman, Segmental, Elliptical, and Gothic arches
- Determine span and rise
- Determine radial lines
- Determine skewback angle
- Determine bonding methods (e.g., rowlock, soldier, etc.)
- Determine spacing and gauging
- Determine cuts required
- Determine number of bricks/courses required
- Determine size of joint required
- Laying centre on side and place brick around arch

g. Perform assigned calculations re: radius of arch
- Dimension of arch
- Span
- Rise
- Curvature
- Angle/orientation of units

h. Other (specified by instructor)

3. Describe/demonstrate archwork construction procedures and techniques. 15%

a. Overview of archwork construction
- General procedure and techniques
- Variations in procedure/techniques re: specific projects

b. Special safety precautions and hazards – e.g., removal of template
c. Planning and organizing archwork project
d. Selection/use of tools, equipment, and accessories
e. Building and placing templates
- Determining type/location of arc, span, rise, and depth
- Selection of materials
- Construction techniques
- Requirements re: structural strength of templates
- Setting out arch to full size
- Laying out timber components for support
- Cutting timber parts for support
- Assembling templates from full-size layouts
- Placement of template, including supports and bracing as required

f. Building arches
- Dimensioning and shaping of masonry units

- Laying masonry units
- Use of reinforcement materials
- Forming of spandrels
- Removal of template, including safety check(s)
- Jointing with jointer or trowel
- Pointing of bricks in arch

4. Perform archwork calculations as assigned by instructor. 10%

a. Calculations re: archwork geometry
b. Calculations re: interpreting archwork blueprints and specifications
c. Calculations re: estimation/preparation of materials (e.g., cutting of brick)
d. Calculations re: jobsite sequencing/scheduling of archwork projects
e. Other (specified by instructor)

5. Complete the Archwork Project per instructor specifications. 25%

a. Review of all drawings and project specifications with instructor
b. Segmental Arch
   - Lay up abutment to skewback height
   - Position centre/template
   - Perform dry lay-out of brick
   - Construct skewback
   - Lay up arch ring and abutment
   - Remove centre
   - Tool and finish
c. Jack Arch
   - Dry lay-out abutment
   - Lay up abutment to lintel height
   - Install lintel
   - {lace centre
   - Construct skewbacks
   - Perform dry lay-out of arch brick
   - Lay up arch brick
   - Lay up abutment over arch brick
   - Tool and finish
d. Gothic Arch
   - Use of two different radius points
   - Establishing right and left opening of spanline
   - Marking of points on abutment
   - Use of reference point to lay up arch brick on opposite side
e. Elliptical Arch
   - Position centre
   - Lay-out of arch ring (height/angle of course; radius points)
   - Lay up arch ring and abutment
   - Remove centre
f. Other (specified by instructor)

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