CHAPTER 7

RETAINING WALLS AND STEPS
(Minor Structures at or under 47")

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## CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

### CHAPTER 7

**RETAIING WALLS AND STEPS**  
(Minor Structures at or under 47”)

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2017 City of Lincoln Standard Specifications

CHAPTER 7 – RETAINING WALLS AND STEPS (Minor Structures at or under 47”)

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7.00  GENERAL

The Work covered in this Chapter includes the construction of both reinforced concrete retaining walls/steps and modular block concrete retaining walls/steps at or under 47” in height with or without a surcharge as per Lincoln Standard Plans except when the surcharge is caused by a building.

The Work shall include furnish and install retaining walls and all related materials required for the construction to lines and grades as shown on the plans and as specified herein. Prepare foundation soils, leveling pad, and backfill to lines and grades as required.

Examples of all products used in the work of this section, including available colors and texture, shall be provided to the City’s Project Manager, if required, for selection ahead of the Work being completed.

7.01  MATERIALS

A. CONCRETE

Unless otherwise specified, all concrete for reinforced, poured-in-place walls and steps shall be L3500 as described in Chapter 3 of these Standard Specifications.

B. REINFORCEMENT STEEL

Reinforcement steel shall be free from excess rust, scale or other substances and shall be protected at all times from damage. All reinforcements shall be placed in the exact position shown in the plans, and shall be held securely in position by suitable means so they will not displace during the process of depositing or consolidating the concrete.

1. Reinforcement Bars

   All reinforcement bars shall meet the requirements of “Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement”, ASTM Designation A 615 (A 615M), Grade 40 (300) or Grade 60 (420).

2. Reinforcement Bar Supports

   Reinforcement bar supports shall be of a satisfactory design and of sufficient strength to hold the metal reinforcement in place while the concrete is being placed.
C. PREFORMED JOINT FILLER MATERIAL


3. Synthetic rubber or neoprene water stops of approved type shall be installed as indicated on the plans.

D. WATERPROOFING

Waterproofing shall conform to the “Standard Specification for Asphalt Used in Dampproofing and Waterproofing”, ASTM Designation D 449 Type I, or other commercially produced products intended for this use and approved by the City’s Project Manager. The provisions in the above referenced Standard Specifications relating to felt, asbestos felt, and cotton fabrics shall not apply.

Primer for use with asphalt in waterproofing shall conform to the “Standard Specifications for Asphalt Primer Used in Roofing, Dampproofing and Waterproofing” ASTM Designation D 41.

E. CURING COMPOUNDS

All curing compounds shall conform to the requirements of Chapter 3 of these Standard Specifications.

F. HANDRAIL

Handrail systems shall conform to “Standard Specification for Permanent Metal Railing Systems and Rails for Buildings”, ASTM Designation E 985. Handrail shall consist of a rail element supported by metal brackets (wall type) or rail elements supported by posts (post type). Posts and rails shall be commercial quality structural steel tubing conforming to “Standard Specification for Carbon Structural Steel”, ASTM Designation A 36. Brackets, bolts, nuts, washers and other fittings shall be commercial quality structural steel, except where shown otherwise on the plans.

Handrail shall be galvanized or painted to resist corrosion as approved by the City’s Project Manager.
7.01 MATERIALS (Continued)

G. CONCRETE UNITS

Modular Block Retaining Walls shall be retaining wall units designed to create a block wall. Concrete retaining wall units shall have a minimum net 28 day compressive strength of 3,000 psi. The concrete shall have a maximum moisture absorption of 6 to 8 lbs/ft. Exterior dimensions may vary in conformance with ASTM C90 “Standard Specification for Loadbearing Concrete Masonry Units.” Unless otherwise specified, full-size units shall have a minimum of 1 square foot face area each. Partial units shall have a minimum 1/2 square foot face area each. Units shall have angled sides capable of concave and convex alignment curves with a minimum radius of 10’. NOTE: Where applicable, for straight walls use non-angled straight side cap units. Reference: ASTM C 140 – Standard Specification for Sampling and Testing Concrete Masonry Unit and Related Units and ASTM C 1372 – Standard Specification for Dry-Cast Segmental Retaining Wall Units

H. GEOGRID


I. BASE LEVELING PAD MATERIALS

Material shall consist of compacted crushed stone, 3/4” or smaller, well-compacted gravel, or coarse sand, and underdrains as required. Minimum thickness is 6”.

Concrete LB-2750 conforming to the requirements of Chapter 3 may be used also with underdrains as required. Minimum thickness is 3”.

7.02 EXCAVATION AND BACKFILL

All earthwork shall conform to the requirements of Chapter 2 of these Standard Specifications.

When called for on the Proposal, the established quantity of excavation (as provided in Chapter 2) shall include all earthwork necessary for the placement of the retaining walls and steps at the locations shown on the plans and cross sections.

When retaining walls or steps are called for on the Contract and no earthwork is bid on the proposal, all excavations and compacted backfill required for the completion of the retaining walls and steps shall be considered subsidiary to other items of Work for which direct payment is made.

Where additional fill is required, the Contractor shall submit sample to the City’s Project Manager to determine if acceptable. Backfill zone shall extend to encapsulate all Geogrids.
7.03 REINFORCED CONCRETE INSTALLATION

A. FORMS

Forms shall be of suitable material and of a type, size, shape, quality, and strength to insure construction as designed. The forms shall be true to line and grade, mortar tight, and sufficiently rigid to resist deflection during placing of the concrete. The responsibility for their adequacy shall rest with the Contractor. All dirt, chips, sawdust, nails, and other foreign matter shall be removed completely from forms before any concrete is deposited therein. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes that would deface the finished surfaces. Forms previously used shall be thoroughly cleaned of all dirt, mortar, and foreign matter before being reused. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent which will leave no objectionable film on the surface of the forms that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete.

1. BRICK FACED FORMS

Forms used for brick facing shall be cast aluminum or approved equal, unless otherwise specified by the City’s Project Manager. The forms shall have a simulated brick face and be of a size, type, shape, quality and strength to insure construction as designed.

2. SMOOTH FINISH FORMS

Forms requiring a smooth finish shall be fabricated of wood, metal or other approved materials to insure construction as designed. Wood forms shall be constructed and maintained to prevent warping and opening of joints due to shrinkage of lumber.

No direct payment will be made for forms. Forming shall be considered subsidiary to other items of Work for which direct payment is made.

B. REINFORCING STEEL

All reinforcing steel shall be furnished in full length, except where splices are indicated in the plan or permitted by the City’s Project Manager. Splices in adjacent bars shall be staggered. Unless otherwise shown in the plans, bars shall be spliced by lapping the ends. Laps shall be a minimum length of 36 bar diameters for Grade 40 (300) and 24 bar diameters for Grade 60 (420) steel. Lapped splices shall be made by securely wiring the bars in contact, maintaining alignment and clearances.

When bending is required, it shall be done accurately without the use of heat, and bars having cracks or splits at the bends shall be rejected. Stirrups and tie bars shall be bent around a pin of not less than 6 times the least dimension of the bar. Where there is a delay in depositing the concrete, the reinforcement shall be reinspected and, where necessary, cleaned.
7.03  REINFORCED CONCRETE INSTALLATION

A. CONCRETE PLACEMENT

Before placing any concrete, all dirt and other debris shall be removed from the forms. Concrete shall be handled by methods which will prevent the separation or loss of ingredients and the formation of laitance. Concrete free fall distance shall not exceed 5’. This includes free fall in a discharge pipe when using a conveyor system for placement. Pumped concrete is not considered in free fall until the concrete exits the pumper hose. The concrete shall be placed in its final position, as nearly as possible, to avoid re-handling. The concrete shall be placed and thoroughly consolidated in level layers not exceeding 12” in thickness. Suitable means shall be provided to permit concrete to be placed in a manner which will avoid accumulations of dry or hardened concrete on the forms or reinforcement.

1. VIBRATING

All concrete shall be thoroughly consolidated by means of approved mechanical vibrators. The vibrator shall consolidate the full depth and width of the concrete to a uniform mass without segregation. Care must be exercised to insure the coating of all surfaces of the reinforcement with concrete and the thorough consolidation of concrete around the reinforcement. Equal care shall be taken to insure that all concrete is consolidated against the face of the forms.

No direct payment will be made for vibrating. Vibrating shall be considered subsidiary to other items of Work for which direct payment is made.

2. SURFACE FINISH

After removal of the forms all smooth finished exposed surfaces of the concrete shall be rubbed starting as soon as conditions permit. Immediately before starting this Work the concrete shall be thoroughly saturated with water.

Sufficient time shall have elapsed before the wetting is done to allow the mortar used in the pointing of tie wire or tie rod holes and defects to be thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse Carborundum stone using a small quantity of mortar on its face. The grout shall be composed of cement and fine sand mixed in the proportion used in the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface finish has been obtained. The paste produced by this rubbing shall be left in place at this time.

The final finish shall be obtained by rubbing with a fine Carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color. After the final rubbing is completed and the surface dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks. Epoxy or latex sealant may be used in lieu of the above, with the approval of the City’s Project Manager.

After removal of brick-faced forms, all irregularities in the finish shall be corrected to the satisfaction of the City’s Project Manager. All tie wire and tie rod holes shall be pointed up with grout. All ridges at form joints shall be chipped off and pointed up. These and all other irregularities in the finish shall be made to match the configuration of the simulated brick surface, as nearly as possible.
7.03 REINFORCED CONCRETE INSTALLATION (Continued)

C. CONCRETE PLACEMENT (Continued)

2. SURFACE FINISH (Continued)

No direct payment will be made for surface finish. The cost of the Work required to provide the surface finish shall be considered subsidiary to other items of Work for which direct payment is made.

D. JOINTS

Joints shall be square and normal to the forms unless otherwise provided. Bulkheads shall be provided for all except horizontal joints. When shown in the plans or specified in the Special Provisions, joints shall be sealed.

1. CONSTRUCTION JOINTS

Construction joints shall consist of the joints in which no provision is made for movement of abutting surfaces. All construction joints shall be keyed and shall be made only where located in the plans, unless otherwise provided in these Standard Specifications and approved by the City’s Project Manager. When not detailed in the plans, or in case of emergency, construction joints shall be placed as directed by the City’s Project Manager.

2. SURFACE FINISH

The surface of the hardened concrete shall be roughened as required by the City’s Project Manager, in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance, and saturated with water. A thin layer of grout shall be applied to the cleaned and saturated surface immediately prior to placing the fresh concrete.

The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints which are exposed to view shall be carefully finished true to line and elevation.

3. EXPANSION JOINTS

Expansion and fixed joints shall be constructed according to the details shown in the plans. Expansion joints shall include those in which provision, in some manner or other, is made for movement by sliding or by deflection.

When preformed expansion joints are specified, the material shall be placed in correct position as the concrete on one side of the joint is placed. When the form is removed, the concrete on the other side shall be placed.
D. JOINTS (Continued)

4 WATER STOPS

Water stops shall be furnished and placed as provided in the plans. They shall be synthetic rubber or other approved material. They shall form continuous watertight joints.

No direct payment will be made for joints or water stops. The construction of joints and water stops shall be considered subsidiary to other items of Work for which direct payment is made.

E. WATERPROOFING

The back face of all retaining walls over 2’ high shall be damp-proofed above the top of the footing. The surfaces to be damp-proofed shall be free from dust, sand, mud, mortar and other loose particles, all grease spots or marks of soil shall be removed by washing with an approved solvent.

After the surfaces have been thoroughly cleaned and dried, and if asphalt is the intended waterproofing, they shall be uniformly coated with one coat of primer and two coats of hot waterproofing asphalt.

The primer may be applied cold, but the asphalt shall be applied at a temperature of at least 250° Fahrenheit. Each coating shall be allowed to dry before the next coating is applied.

The primer shall be applied in quantities sufficient to thoroughly cover the surfaces to be treated. The waterproofing asphalt shall be applied at a rate of not less than 5 gallons per 100 square feet of surface.

If using other approved commercially produced products, the waterproofing shall be applied as per manufacturers’ Specifications and directions.

Care shall be exercised to confine all damp-proofing materials to the area being treated and to prevent disfigurement of any exposed part of the structure by dripping or spreading of asphalt.

No direct payment for waterproofing will be made. Waterproofing shall be considered subsidiary to other items of Work for which direct payment is made.

F. WEEP-HOLE / DRAINAGE COLLECTION PIPE

Weep-holes shall be constructed in all retaining walls as shown on the plans or as directed by the City’s Project Manager.

No direct payment for the placement of weep-holes will be made. Placement of weep-holes shall be considered subsidiary to other items of Work for which direct payment is made.
7.03 REINFORCED CONCRETE INSTALLATION (Continued)

G. CURING AND PROTECTION

1. CURING

As soon after the completion of the specified finishing operation as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surface shall be cured by the water method, the form-in-place method, or by the membrane curing compound method.

a. Water Method

The concrete shall be kept continuously wet by application of water for a minimum period of 72 hours after the concrete has been placed. Burlap, earth, or sand may be used as a curing medium to retain the moisture. The entire surface of the concrete shall be kept damp such that the concrete is covered with the curing medium.

b. Form-In-Place Method

Formed surfaces of concrete may be cured by retaining the forms in place. The forms shall remain in place for a minimum period of 72 hours after the concrete has been placed.

c. Membrane Curing Compound Method

All surfaces which are exposed to the air shall be sealed with a uniform application of a membrane curing compound applied at a rate of 1 gallon per 200 square feet of surface area. The curing compound shall be applied using an approved mechanical power sprayer of a size and capacity to complete the Work. The curing compound shall meet the requirements of Chapter 3 of these Standard Specifications.

2. PROTECTION

The Contractor shall provide protective measures at their own expense to prevent damage to the Work. The Contractor shall be responsible for any damage caused by the construction operation. Any concrete showing injury from vandalism shall be repaired or removed and replaced at the Contractor's expense.

No direct payment will be made for curing and protection. The cost of curing and protection shall be considered subsidiary to other items of Work for which direct payment is made.

H. HOT AND COLD WEATHER CONSTRUCTION

Concrete Work on retaining walls and steps shall not be performed during inclement weather except with specific permission of the City’s Project Manager. During hot or cold weather the Work may proceed in conformance with Chapter 3 of these Standard Specifications.
Installation shall be according to the latest edition of manufacturer’s Specifications for methods of installation. Contractor shall arrange a meeting with the authorized technical representative, the Contractor, and the City’s Project Manager to review the manufacturer’s recommendation prior to construction. In-lieu of this meeting the authorized technical representative and Contractor shall sign off agreement to the following Standard Specifications:

A. PREPARATION

Contractor shall excavate to the lines and grades shown on the construction drawings. Over excavation shall not be paid for and replacement with compacted fill and/or wall system components will be required at contractor expense. Contractor shall be careful not to disturb embankment materials beyond lines shown.

B. FOUNDATION SOIL PREPARATION

Foundation soil shall be excavated as required for footing dimensions shown on the construction drawings or as directed by the City’s Project Manager. Foundation soil shall be examined by the City’s Project Manager to assure that the actual foundation soil strength meets or exceeds assumed design strength. Soils not meeting required strength shall be removed and replaced with acceptable material. Over-excavated areas shall be filled with approved compacted granular fill backfill material. Foundation shall be proof rolled prior to fill and geogrid placement.

C. BASE LEVELING PAD

Leveling pad materials shall be placed upon undisturbed in-situ soil. Material shall be compacted so as to provide a level hard surface on which to place the first course of units. Mechanical Compaction shall be to 95% of standard proctor. Leveling pad shall be prepared to insure complete contact of retaining wall unit with base. Leveling pad materials shall be to the depths and widths required. Well-graded sand can be used to smooth the top 1/4” to 1/2” of the leveling pad. In no case shall the compacted leveling pad shall be less than a minimum 6” thick if well-compacted gravel, crushed stone or coarse sand or 3” thick if LB-2750 Concrete.

D. UNIT INSTALLATION

First course of concrete wall units shall be placed on the base leveling pad. The units shall be checked for level and alignment. The first course is the most important to insure accurate and acceptable results. Insure that units are in full contact with base. Units are placed side by side for full length of wall alignment. Alignment may be done by means of a string line or offset from base line. Install connecting devices and fill all voids at units with unit fill material. Tamp fill. Sweep all excess material from top of units and install next course. Insure each course is completely unit filled, backfilled and compacted prior to proceeding to next course. Lay up each course insuring that connectors protrude into adjoining courses above a minimum of 1”. Pull each unit forward, away from the embankment, against connectors in the previous course and backfill as the course is completed. Repeat procedure to the extent of wall height. The top two courses of wall units below the cap shall also have an adhesive or epoxy to provide a permanent bond of the upper blocks. As appropriate where the wall changes elevation, units can be stepped with grade or turned into the embankment with a convex return end. Provide appropriate buried units on compacted leveling pad in area of convex return end.
E. CAP INSTALLATION

Place Modular Block Cap units over projecting connectors from units below. Pull forward to set back position. Back fill and compact to finished grade. As required, provide permanent mechanical connection to wall units with construction adhesive or epoxy. Apply adhesive or epoxy bottom surface of cap units and install on units below.

F. GEOGRID INSTALLATION

The geogrid soil reinforcement shall be laid horizontally on compacted backfill. Connect to the concrete wall units by hooding geogrid over connector units. Pull taut, and anchor before backfill is placed on the geogrid. Slack in the geogrid at the wall unit connections shall be removed. Geogrid shall be laid at the proper elevation and orientation as shown on the construction drawings or as directed by the City’s Project Manager. Correct orientation (roll direction) of the geogrid shall be verified by the contractor. To pretension geogrid, pull pinned geogrid taut to eliminate loose folds. Stake or secure back edge of geogrid prior to and during backfill and compaction. The Contractor shall follow manufacturer’s guideline relative to overlap requirement of uniaxial and biaxial geogrids.

G. FILL PLACEMENT

Backfill material shall be placed in 8” lifts and compacted to 95% of Standard Proctor. Backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack or loss of pretension of the geogrid. Only hand-operated compaction equipment shall be allowed within 3’ of the back surface of the Modular Block units. Backfill shall be placed from the wall rearward into the embankment to insure that the geogrid remains taut. Tracked construction equipment shall not be operated directly on the geogrid. A minimum backfill thickness of 6” is required prior to operation of tracked vehicles over geogrid. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid. Rubber-tired equipment may pass over the geogrid reinforcement at slow speeds, less than 10 MPH. Sudden braking and sharp turning shall be avoided. Fill placed 1’ behind the geogrid units shall be wrapped in filter fabric as shown on the plans. A 6” overlap of the filter fabric shall be provided at the top of each layer of stone backfill. The fill placement shall be coordinated with the installation of handrails, fences, or guiderails. There shall be 12” of topsoil on the surface.

H. WEEPHOLE / DRAINAGE COLLECTION PIPE

Weep-holes shall be constructed in all retaining walls as shown on the plans or as directed by the City’s Project Manager. No direct payment for the placement of weep-holes will be made. Placement of weep-holes shall be considered subsidiary to other items of Work for which direct payment is made.

7.05 FENCE PLACEMENT

Fences shall placed along the tops of retaining walls where shown on the plans. These fences shall be constructed in conformance with the provisions of Chapter 8 of these Standard Specifications.
7.06 HANDRAIL PLACEMENT

Handrails shall be placed at the locations and in conformance with the details shown on the plans, and as specified in these Standard Specifications and the Special Provisions, and as directed by the City’s Project Manager. The type of railing to be constructed shall be specified in the special provisions or shown on the plans. All handrails, posts, and paint shall be of the size and materials as shown on the plans, Standard Specifications, or as directed by the City’s Project Manager.

The railing shall be erected true to line and grade. Posts shall be set vertical. All welds shall conform to the latest requirements of the American Welding Society. All welds on exposed surfaces shall be ground flush with the adjacent surfaces.

Primer paint shall be applied to a dry thickness of 2.0 to 3.5 mils and 2 coats of enamel shall be applied to a dry thickness of 1.5 to 2.5 mils for each coat.

7.07 SUBSTANTIAL COMPLETION

Retaining walls and steps will be considered substantially complete when all elements of the wall are placed and finished, backfill completed, and handrail completed.
A. CONCRETE FOR STEPS AND RETAINING WALLS, IN PLACE

Payment for CONCRETE FOR STEPS AND RETAINING WALLS, IN PLACE, shall be based on the contract unit price bid per cubic yard, based upon the quantity of concrete required for the Design Section, unless otherwise specified. No actual measurement of the volume of concrete will be made. Such payment shall be full compensation for furnishing, preparing, transporting, delivering and placing all materials, except those for which the contract provides that direct payment shall be made, for work and materials for forms, falsework, bracing, etc.; incidental excavation and compacted backfill; and for all labor, equipment, tools and incidentals necessary to complete the Work.

B. REINFORCING STEEL FOR RETAINING WALLS AND STEPS

Payment for REINFORCING STEEL FOR RETAINING WALLS AND STEPS, IN PLACE, constructed in conformance with the plans and Standard Specifications, and accepted by the City’s Project Manager, shall be based on the contract unit price bid per pound, based upon the quantity of reinforcing steel required for the Design Section, unless otherwise specified. No actual weighing of steel will be made. Such payment shall be full compensation for furnishing, bending, fabricating and placing the reinforcements; for all clips, spacers, ties, wire or other material used for fastening reinforcement, in place; and for all tools, labor, equipment and incidentals necessary to complete the Work.

C. MODULAR BLOCK RETAINING WALL

MODULAR BLOCK RETAINING WALL constructed in conformance with the manufacturer’s Specifications and installation instructions, and accepted by the City’s Project Manager, shall be measured and paid for at the contract unit price bid per square foot, based on the total area of the retaining wall installed. Such payment shall be full compensation for furnishing, preparing, transporting, delivering, placing and installing all materials including retaining wall units, geogrid reinforcement, fill, backfill, foundation preparation, and furnishing/installing leveling pad except those for which the contract provides that direct payment shall be made, incidental excavation and compacted backfill; and for all labor, equipment, tools and incidentals necessary to complete the Work. Modular Block Retaining Wall Systems shall be constructed according to the manufacturer’s specifications.

D. HANDRAILS, COMPLETE

HANDRAILS, COMPLETE, constructed in conformance with the plans and Standard Specifications and accepted by the City’s Project Manager, shall be measured and paid for at the contract unit price bid per foot, based on the total length of the top rail. Said payment shall be full compensation for the top rail, post or mounting brackets, erection, paint and all other tools, materials, labor and incidentals necessary to complete the Work.