

## SECTION 05502

### METAL SHEET PILING, WALERS AND STRUTS

#### PART 1 GENERAL

##### 1.1 SCOPE

The work covered by this section includes furnishing all plant, equipment, labor and materials and performing all operations in connection with the installation and protection of metal sheet piling wall system, including walers and/or bolted or structural connections, in accordance with these specifications and applicable drawings.

##### 1.2 REFERENCES

The following publications listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto. Reference to standard specifications, guides, reports, and practices stated herein shall be interpreted to mean the latest version or revision as of the date noted in the footer of this section.

###### 1.2.1 AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC                      Steel Construction Manual

###### 1.2.2 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6                General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

ASTM A 36              Carbon Structural Steel

ASTM A 325            Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 328            Steel Sheet Piling

ASTM A 490            Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength

ASTM A 563            Carbon and Alloy Steel Nuts

ASTM A 572            High-Strength Low-Alloy Columbian-Vanadium Structural Steel

ASTM A 615            Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A 690	High-Strength Low-Alloy Steel H-Piles and Sheet Piling for Use in Marine Environments
ASTM A 722	Uncoated High Strength Steel Bar for Prestressing Concrete
ASTM A 992	Steel for Structural Shapes for Use in Building Framing
ASTM F 436	Hardened Steel Washers

### 1.2.3 AMERICAN WELDING SOCIETY

AWS D1.1	Structural Welding Code – Steel
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## 1.3 RELATED SECTIONS

1.3.1 Section 01440 Contractor Quality Control

1.3.2 Section 02100 Site Preparation and Demolition

## 1.4 SUBMITTALS

The Contractor's Quality Control organization shall be responsible for certifying that all submittals are in compliance with the contract requirements.

### 1.4.1 Data

Manufacturer's literature, available from suppliers, which demonstrates compliance with applicable specifications for the materials listed below:

1.4.1.1 Complete descriptions of driving equipment including hammers, extractors, protection caps and other installation appurtenances shall be submitted for approval prior to commencement of work.

### 1.4.2 Reports

Test reports or certificates of compliance which show that the materials to be provided are in compliance with the applicable specifications. Testing of sheet piling and walers for mechanical properties shall be performed after the completion of all rolling and forming operations.

1.4.2.1 Materials test certificates and test reports shall be submitted for each shipment of steel sheet piling, walers, plates and structural tees and identified with specific lots prior to installing piling. Identification data should include piling type, heat analysis number, chemical composition, mechanical properties and the steel manufacturer's name.

1.4.2.2 Records of the sheet piling driving operations shall be submitted after driving is completed. These records shall provide a system of identification which shows the disposition of approved

piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations of installed piling.

1.4.2.3 Design calculations for the use of alternative pile sections shall be stamped by a Structural Engineer registered in the State of Illinois and submitted prior to installing piling.

1.4.2.4 Test calibration data for the Bolt Tension Calibrator unit via Skidmore or equal calibration testing device.

1.4.2.5 Written work plan, design calculations and drawings showing temporary support of the sheet pile wall during construction.

### 1.4.3 Shop Drawings

Shop drawings for steel sheet piling, including fabricated sections, shall show complete piling dimensions and details, driving sequence and location of installed piling. Shop drawings shall include details and dimensions of templates and other temporary guide structures for installing sheet piling. Shop drawings shall provide details of the method of handling sheet piling to prevent permanent deflection, distortion or damage to piling interlocks.

### 1.4.4 Winter Closure Design

The winter closure design as described in Paragraph 3.6 of this section shall be submitted to the Owner for approval a minimum of 30 days prior to installation of the winter closure.

## **PART 2 PRODUCTS**

### **2.1 METAL SHEET PILING**

#### 2.1.1 Steel Sheet Piling

Steel sheet piling shall be of the type shown on the drawings conforming to the requirements of ASTM A 572 Grade 50. The interlocks of the sheet piling shall be free-sliding, provide a swing angle suitable for the intended installation, but not less than four (4) degrees when interlocked, and maintain continuous interlocking when installed throughout their entire length. The sheet piling shall be homogeneous for the full thickness of the section and shall be capable of developing the structural capacity using the full section modulus. The Owner reserves the right to perform supplemental nondestructive examination of the sheet piling prior to installation of the piling. The cost of such inspection will be borne by the Owner. Any sheets determined to be defective shall be rejected and replaced as directed by the Owner and at no cost to the Owner. Sheet piling shall be provided with standard pulling holes.

#### 2.1.2 Alternative Steel Sheet Piling

Alternative steel sheet pile sections may be substituted for the section shown on the drawings. Piling substituted for the section shown on the drawings shall have as a minimum the properties listed in the following table:

Section Substituted For	Minimum Value for Substitution					
	Section Modulus In <sup>3</sup> /ft	Moment of Inertia In <sup>4</sup> /ft	Section Depth in	Flange Thickness in	Yield Strength Kips/in <sup>2</sup>	Width of Sheet In
SKZ 24	37.73	301.80	16.0	0.375	50.0	28.5

Sections substituted for those shown on the drawings shall have a “Z” profile. Substituted sections shall conform to all other requirements of this specification in addition to the requirements of this paragraph. The Contractor shall provide detailed design calculations for any alternative pile section proposed by the Contractor and accepted by the Owner. The calculations shall include, but not be limited to, battered pile design, walers and connections. Any changes to the batter pile spacing as indicated on the drawings may require revision to the batter pile tip elevations. The design calculations shall be stamped by a Structural Engineer registered in the state of Illinois and submitted to the Owner for approval. The Contractor is responsible for detailing all revisions to the layout and drawings affected by the selected alternative piling. Revised layouts and drawings shall be submitted as shop drawings for approval. Preparation of design calculations, revised drawings, and revised layouts shall be incidental to the applicable bid item.

## 2.2 APPURTENANT METAL MATERIALS

### 2.2.1 Bolts

All bolts shall conform to ASTM A 325 with threads excluded from the shear plane. All bolts shall be installed at the proper location and set straight and square with connecting members. Hardened washers conforming to ASTM F 436-93, shall be provided under the head and nut. Until final acceptance of the completed work, the Contractor shall be required to check, straighten and tighten bolts in any part of the structure. Installation shall conform to the requirements of AISC Specification for Structural Joints using ASTM A 325 bolts. The Calibrated Wrench Tightening Method or Turn of the Nut (with match marking) outlined in the AISC Steel Construction Manual shall be used for confirmation of bolt and nut tightening. No reuse of bolts will be permitted.

### 2.2.2 Bolt Holes

All holes for bolts shall be provided at the proper location or position as specified on the Plans. Holes in metal members shall be made by the applicable method for the connection being made, either drilling or torching. After drilling or torching, holes in metal which are too small or out of shape shall be reamed to the required size. Unless otherwise indicated or specified, all holes for items that are to be inserted through metal members shall not be more than one-sixteenth inch larger than the diameter of the item being installed.

### 2.2.3 Structural Tees, Miscellaneous Plates and Shapes

Structural tees, miscellaneous plates and shapes, as shown on the drawings, shall conform to Grade 50 ksi, ASTM A 572.

### **2.3 WALERS**

Walers shall be of the sections shown on the drawings and shall conform to Grade 50 ksi, ASTM A 992, unless otherwise shown on the drawings.

### **2.4 TIE RODS**

2.4.1 Tie rods shall be as shown on the drawings and shall conform to Grade 75 ksi steel, ASTM A615.

2.4.2 Tie rods shall be coated with one coat of Sherwin Williams Zinc Clad II primer (or equal) and one coat of Sherwin Williams Dura-Plate 235 epoxy paint system (or equal).

## **PART 3 EXECUTION**

### **3.1 GENERAL**

#### **3.1.1 Delivery and Storage**

Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. The manufacturer's logo and mill identification mark shall be provided on the sheet piling as required by the referenced specifications. Sheet piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage. Storage of piling should also facilitate required inspection activities.

#### **3.1.2 Field Measurements**

The Contractor shall obtain all field measurements required for proper and adequate fabrication and installation of the work. Exact measurements are the Contractor's responsibility.

#### **3.1.3 Preparation**

The Contractor shall relocate/remove all pilings, stone, concrete, submerged timbers, and other materials interfering with the proper alignment and performance of the work. See Section 02100 SITE PREPARATION AND DEMOLITION for further direction on site preparation.

### **3.2 PILING DRIVING EQUIPMENT - HAMMER**

Driving Hammers. Hammers shall be steam, air, or diesel drop, single-acting, double-acting, differential-acting type, or vibratory type. The driving energy of the hammers shall be as

recommended by the manufacturer for the piling weights and subsurface materials to be encountered.

### 3.3 PLACING AND DRIVING

#### 3.3.1 Driving Line

The driving line shall be cleared of any debris or stone prior to the placing of the sheet piling.

#### 3.3.2 Placing

Any excavation required within the area where piling is to be installed shall be completed prior to placing sheet piling. Piling shall be carefully located as shown on the drawings or directed by the Owner. Piling shall be placed plumb with out-of-plumbness not exceeding one-eighth inch per foot of length and true to line. Permanent walers, templates, or temporary guide structures shall be provided to ensure that the piling is placed and driven to the correct alignment. At least two templates in the vertical direction shall be used in placing each piling, and the maximum spacing of templates shall not exceed 20 feet. Sheet pile shall be placed and driven with the interlock ball leading in the direction of driving. Properly placed and driven sheet piling shall be interlocked throughout its entire length with the adjacent piling to form a continuous diaphragm throughout the length or run of piling wall.

#### 3.3.3 Driving

Piling shall be driven with the proper size hammer and by approved methods so as not to subject the piling to damage and to insure proper sheet pile interlock throughout its length. Piles shall be driven to the depths shown on the plans, or until refusal is encountered. Driving resistance in excess of 10 blows per inch per single pile unit shall be considered practical refusal for impact hammers. The Contractor is restricted to impact hammers having a rated capacity less than 24,450 foot-pounds of energy. For vibratory hammers, a pile penetration rate less than six (6) inches per minute for a period of 5 minutes shall be considered practical refusal. If a pile fails to reach the design tip elevation using a vibratory hammer, the Contractor shall attempt to drive a single sheet pile unit using an appropriate impact hammer as discussed above. Driving hammers shall be maintained in proper alignment during driving operations by use of leads or guides attached to the hammer. A protecting cap shall be employed in driving when using impact hammers to prevent damage to the top of piling. Piling damaged during driving or driven out of interlock shall be removed and replaced at the Contractor's expense. Adequate precautions shall be taken to insure that piling is driven plumb. If at any time the forward or leading edge of the sheet piling wall is found to be out-of-plumb in the plane of the wall, the piling being driven shall be driven to the required depth and tapered piling shall be provided and driven to interlock with the out-of-plumb leading edge or other approved corrective measures shall be taken to insure the plumbness of succeeding piling. The maximum permissible taper for any tapered piling shall be one-eighth inch per foot of length. The horizontal alignment of the steel sheet pile wall shall be within one inch of required location after completion of driving and after assembly and tightening of wales. Piling in each run or continuous length wall shall be driven alternately in increments of depth to the required depth or elevation. No piling shall be driven to a lower elevation than those behind it in

the same run except when those behind it cannot be driven deeper. If the sheet piling next to the one being driven tends to follow below final elevation it may be pinned to the next adjacent piling. If obstructions restrict driving a piling to the specified penetration, the obstructions shall be removed or penetrated with chisel beam by means of pre-drilling through the obstructions. If the Contractor demonstrates that removal or penetration is impractical, the Contractor shall make changes in the design alignment of the piling structure as directed by the Owner to insure the adequacy and stability of the structure. Piling shall be driven to depths shown on the drawings and shall extend up to the elevation shown on the drawings for the top of pilings. A tolerance of one inch above the required top elevations will be permitted. Piling shall not be driven within 100 feet of cast-in-place concrete or grouted earth anchors less than seven days old.

### 3.4 CUTTING OFF AND SPLICING

Piling driven to refusal or to the point where additional penetration cannot be attained and are extending above the required top elevation shall be cut off to the required elevation, as directed by the Owner. Piling driven below the required top elevation and piling damaged by driving and cut off to permit further driving shall be extended as required to reach the top elevation by splicing when directed by the Owner at no additional cost to the Owner. If directed by the Owner, piling shall be spliced as required to drive them to depths greater than shown on the drawings and extend them up to the required top elevation. Splices shall be made by an approved butt weld, making full penetration of the pile section, or as otherwise directed or approved by the Owner. Piling adjoining spliced pilings shall be full length unless otherwise approved. Piling ends to be spliced shall be squared before splicing to eliminate dips or camber. Concentric alignment of the spliced piling interlocks shall be provided so that there are no discontinuities, dips or camber at the abutting interlocks. Spliced piling shall be free sliding and able to obtain the maximum swing with contiguous piling. The tops of excessively battered piling shall be trimmed when directed at no cost to the Owner. Piling cutoffs shall become the property of the Contractor and shall be removed from the site. The Contractor shall cut necessary holes in piling for bolts, rods, drains, or utilities as shown on the drawings or as directed. All cutting shall be done in a neat and workmanlike manner. A straight edge shall be used in cuts made by burning to avoid abrupt nicks. Bolt holes in steel piling shall be drilled or may be burned and reamed by approved methods that will not damage the surrounding metal. Driven sheeting shall have no handling holes left in place after piles have been driven to the minimum pile tip elevation.

#### 3.4.1 Inspection of Driven Piling

The Contractor shall inspect the interlocked joints of driven sheet piling extending above ground. Piling found to be out of interlock shall be removed and replaced at the Contractor's expense.

#### 3.4.2 Pulling and Redriving

The Contractor shall pull selected piling after driving to determine the condition of the underground portions of pilings, when directed by the Owner. The Owner shall approve the Contractor's method for pulling piling. Any piling so pulled and found to be damaged to the extent that its usefulness in the structure is impaired shall be removed and replaced at the Contractor's

expense. Piling pulled and found to be in satisfactory condition shall be redriven, when directed by the Owner.

### **3.5 REMOVAL**

The removal of pilings shall consist of pulling, sorting, cleaning, inventorying and storing previously installed piling as shown on the drawings and directed by the Owner.

#### **3.5.1 Pulling**

The method of pulling piling must be approved by the Owner. Pulling holes shall be provided as required. Extractors shall be of suitable type and size. Care shall be exercised during pulling to avoid damaging piling interlocks and adjacent construction. If the Owner determines that adjacent permanent construction has been damaged during pulling, the Contractor will be required to repair this construction at no cost to the Owner. Piling shall be pulled one sheet at a time. Piling fused together shall be separated prior to pulling unless the Contractor demonstrates to the satisfaction of the Owner that the piling cannot be separated. The Contractor will not be paid for the removal of piling damaged beyond structural use due to proper care not being exercised during pulling.

#### **3.5.2 Sorting, Cleaning, Inventorying and Storing**

Pulled piling shall be sorted, cleaned, inventoried and stored, by type, into groups as:

- a. Piling usable without reconditioning;
- b. Piling requiring reconditioning; and
- c. Piling damaged beyond structural use.

### **3.6 WINTER CLOSURE**

At the time of cessation of work for an extended period, be it winter conditions, or other reasons, details described herein, as winter closure shall apply. No rubble removal or site preparation shall be done beyond the limits of the anticipated winter closure until work resumes after the shutdown. The new structure shall be complete, including concrete placement and Toe Stone, up to the winter closure. The Contractor shall provide a winter closure design for approval by the Owner. The winter closure shall be designed, as a minimum, to contain the stone fill within the new portions of the structure, protect the new structure from storm, wind, wave and other damage, and provide a method for preserving the continuity of the structure after work resumes.

### **3.7 TEMPORARY CONSTRUCTION**

The Contractor is responsible for temporary bracing and support of the structure during construction and shall protect all exposed partially complete work against damage. The Contractor shall take precautions to assure that the structure is adequately braced to avoid damage from wave action during construction. Any structural component damaged during construction shall be replaced by the Contractor at no cost to the Owner. The Contractor's means and methods of providing temporary protection shall be as included in the work plan as approved by the Owner.



The Contractor is fully responsible to maintain sheet pile alignment and stability during construction. The Contractor should place toe stone and the deck slab as soon as practical after the backfill is in place to avoid storm or water overtopping damage.

### **3.8 QUALITY CONTROL**

3.8.1 The Contractor shall establish and maintain quality control for work under this section to assure compliance with contract requirements and maintain records of his quality control for all construction operations including, but not limited to, the following:

- a. Materials;
- b. Sheet piling driving operations, including type and rating of hammer; and
- c. Driving depth or depth of refusal.

3.8.2 A copy of the records of inspections, as well as the records of corrective actions taken, shall be furnished to the Owner as directed by the Owner in accordance with the "Section 01440 CONTRACTOR QUALITY CONTROL" section of this document.

## **MEASUREMENT AND PAYMENT**

### **4.1 MEASUREMENT**

Steel sheet pile shall be measured for payment by using the area of 2-dimensional projection of the wall area. Projected wall area shall be computed by multiplying the horizontal length of wall measured along the top of the pile centerline multiplied by the length of piles, measured from the tip elevation to the cut-off elevation. For installed pilings directed to be cut off before reaching the penetration depth shown on drawings, the portion cut off will be measured for payment as the difference between the total length of piling shown on the plans for that location and the length of piling installed below the point of cut-off. This will equal the square footage of sheet pile.

### **4.2 PAYMENT**

Payment shall cover all costs of furnishing, handling, storing and installing the steel sheet piling and wales including clearing the drive line, placing, driving, cutting holes, connections and other appurtenant materials and work incident thereto. Payment for steel sheet piling in-place shall be made at the contract unit price per square foot of sheet pile as described in Paragraph 4.1 above for Bid Item 6.0 (Steel Sheet Piles). Payment for design and installation of the winter closure shall be incidental to the cost of the steel sheet pile. Payment for steel walers, braces, tie rods, bolts, plates and angles, and associated items shall be made at the contract Lump Sum price for Bid Item 7.0 (Steel Walers). Payment for weldments, drilling, cutting and installing bolts and tie rods shall be incidental to the cost of the Steel Walers.

4.2.1 Pilings not driven to the penetration depths shown on the drawings, which are directed by the Owner to be cutoff, except for those cutoffs necessitated by natural subsurface obstructions,

will be paid by each square foot of sheet pile for the portion cut off. Payment will be as stipulated in Paragraph 4.1 at the rate of 50 percent of the applicable contract unit price.

4.2.3 The cost of each splice made shall be incidental to the cost of the square foot area of the pile extension. An additional sum will be paid for each square foot of piling extension at the contract unit price per square foot of Bid Item 6.0 (Steel Sheet Piles). Payment will be made for each piling spliced, at the direction of the Owner, to drive the piling to a depth greater than shown on the drawings and extend the piling up to the required top elevation.

4.2.4 Contractor-furnished pilings, which have been installed and are pulled at the direction of the Owner and found to be in good condition, will be paid for at the applicable contract unit price for furnishing and installing the pilings in their initial position plus an equal amount for the cost of pulling. When such pulled pilings are redriven, an additional amount equal to 50 percent of the applicable contract unit price for furnishing and driving the pilings will be paid for redriving pilings. This additional price constitutes payment for redriving only. The cost of furnishing, initial driving and pulling the pilings is to be paid for as specified herein. When pilings are pulled and found to be damaged no payment will be made for the initial furnishing and driving or for the pulling of such pilings. Pilings replacing damaged pilings will be paid for at the applicable contract unit prices.

4.2.5 Bidding schedule items applicable to this section are as follows:

<b>Item No.</b>	<b>Description</b>	<b>Unit</b>
6.0	Steel Sheet Piles	Square Foot
7.0	Steel Walers	Lump Sum

**END OF SECTION**