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REMR TECHNICAL NOTE EM-CR-1.6

THE USE OF A690 MARINER STEEL SHEET PILINGS

PURPOSE: The purpose of this technical note is to clarify when A690 mariner steel sheet pilings should be specified in Army Corps of Engineers Civil Works projects.

APPLICABILITY: This information is applicable to all field operating activities having civil works responsibilities.

DISCUSSION:

- a. Note 4 of the materials section of Guide Specification CW 02411 states that for applications in salt or brackish water the most economical of A690 steel sheet piling or A328 steel sheet piling with a protective coating in the splash zone should be used. It also states that a protective coating should be applied to A690 sheet pilings in the splash zone of waterway bulkheads located in salt or brackish water.
- b. The A690 sheet pilings contain 0.22 percent carbon, 0.6 to 0.9 percent manganese 0.08 to 0.15 percent phosphorus, less than 0.05 percent sulfur, less than 0.1 percent silicon, 0.4 to 0.75 percent nickel and a minimum of 0.5 percent copper in the alloys which, according to tests at different coastal locations around the United States, provide up to 2.5 times the corrosion resistance in salt water as A328 in the splash and atmospheric zones (the area from the mean high tide line to the top of the pile) for exposure periods up to 10 years. In cold water regions of the Northeast and Northwest US with exposure times up to about 3 years, A328 steel provided better corrosion resistance, but for longer exposures in these waters, A690 provided better corrosion resistance. These tests also showed that both of these steel alloys corrode at about the same rate in the submerged and soil zones.
- c. Both steel alloys have a tensile strength of 70 ksi, but the A690 steel has a yield strength of 50 ksi, whereas the A328 steel has a yield strength of 39 ksi. The A690 steel costs 25 to 27 percent more than A328 steel.
- d. A cost analysis comparing A690 sheet pilings and A328 sheet pilings was conducted by the US Army Construction Engineering Research Laboratory (USA-CERL) under REMR. In addition, coating costs and cathodic protection costs were studied.

- e. Since the benefits of using A690 steel are realized only in the splash and atmospheric zones, cathodic protection is not a part of the analysis. Cathodic protection is ineffective in these zones. The cost of cathodic protection in the submerged and soil zones is the same for both steel grades.
- f. One linear foot of steel sheet piling was used as a basis for a cost comparison of the steel sheet pilings with and without coal tar epoxy coatings. The cost values reflect the price of the steel sheet piling FOB Bethlehem, PA, and the cost of unloading, coating and reloading from railcars by the coating applicator for the second quarter FY 87.

<u>Section Designation</u>	<u>Piling Steel Grade</u>	<u>Number of Sides Coated</u>	<u>Cost Per Linear Foot</u>
PZ 22	A328	0	\$12.84
		1	21.23
		2	29.63
	A690	0	16.06
		1	24.46
		2	32.86
PZ 27	A328	0	12.90
		1	21.30
		2	29.70
	A690	0	16.14
		1	24.54
		2	32.94
PZ 35	A328	0	21.02
		1	30.93
		2	40.84
	A690	0	26.30
		1	36.21
		2	46.12
PZ 40	A328	0	20.89
		1	30.80
		2	40.72
	A690	0	26.14
		1	36.05
		2	44.96
PSA 23	A328	0	9.78
		1	16.17
		2	22.56
	A690	0	12.23
		1	18.63
		2	25.02
PS 27.5	A328	0	13.69
		1	21.30
		2	28.92
	A690	0	17.30
		1	24.91
		2	32.53

PS 31	A328	0	15.45
		1	23.06
		2	30.68
	A690	0	19.52
		1	27.14
		2	34.75

- g. If a piling requires coating, it is much more economical to specify A328 steel sheet pilings than A690. The following table can be used to determine the economics of using bare A690 steel or partially coated A328 steel sheet pilings coated with coal tar epoxy. The lengths designate the maximum coating length on A328 steel sheet pilings to the nearest 6 in. which can be economically applied and have cost savings over using bare A690 steel.

Section Designation	40-foot-long pilings		60-foot-long pilings	
	Coated	Coated	Coated	Coated
	One Side	Two Sides	One Side	Two Sides
PZ22	15'	7.5'	23'	11.5'
PZ27	15'	7.5'	23'	11.5'
PZ35	21'	10.5'	31.5'	15.5'
PZ40	21'	10.5'	31.5'	15.5'
PSA23	15'	7.5'	23'	11.5'
PS27.5	18.5'	9'	28'	14'
PS31	21'	10.5'	32'	16'

RECOMMENDATION: Unless there is a requirement for a high-yield-strength steel in construction in salt or brackish water, A328 steel sheet pilings with a protective coating in the splash and atmospheric zone should be the preferred choice in materials selection.

REFERENCE: Department of the Army. 1989. "Steel Sheet Piling," Guide Specification CW-02411, Washington, DC.