REMR TECHNICAL NOTE CS-MR-1.13

LOCK WALL REHABILITATION

PURPOSE: To provide additional guidance to that given in EM 1110-2-2002 (Ref a) on the use of cast-in-place concrete and precast concrete stay-in-place forms for lock wall rehabilitation.

BACKGROUND: The general approach in lock wall resurfacing has been to remove 1 to 2 ft of concrete from the face of the lock wall and to replace it with air-entrained concrete with the use of conventional forming and placing procedures. One of the most persistent problems with this approach is cracking in the replacement concrete (Ref b). These cracks are attributed primarily to restraint of volume changes resulting from drying shrinkage, thermal gradients, and autogenous volume changes within the replacement concrete. The restraint is provided through bond of the relatively thin layer of resurfacing concrete to the stable mass of existing concrete. In most cases, such cracking will not cause structural deficiencies; however, the cracks are unsightly and may require additional maintenance to minimize deterioration.

SUMMARY OF REMR RESEARCH:

a. A general purpose heat transfer and structural analysis finite element computer program was used to predict the response of concrete overlays with varying thicknesses and placement conditions (Ref c). In all of the analyses, shrinkage had a dominant effect on cracking. Ambient temperature, thickness of overlay, and use of a bond breaker between the replacement concrete and the existing wall also significantly affected cracking.

b. In addition to the finite element analyses, a precast concrete stay-in-place forming system was developed and the constructibility of the system was demonstrated. Results of this work indicate that the precast concrete stay-in-place forming system is a viable method for lock wall rehabilitation. In addition to providing a concrete surface of superior durability with minimal cracking, the estimated construction cost is very competitive with the cost of conventional forming and concrete placement. Also, this system has the potential for eliminating the extended periods of time a lock must be closed to traffic for conventional lock wall resurfacing and could eliminate the need for dewatering the lock chamber during wall rehabilitation.

RECOMMENDED PROCEDURE: Both the cast-in-place concrete and precast stay-in-place forming system should be considered for lock wall resurfacing projects. Final selection of the method should take into account criteria such as the total cost, access to the structure, operating schedule of the lock, weather condition, available material, labor skill, and equipment.

a. Cast-in-Place Concrete. If cast-in-place concrete is to be used for resurfacing a lock wall, considerations should be made as to the selection of concrete materials, mixture proportions, and construction procedures to obtain the lowest possible shrinkage and thermal gradients in the concrete. Excellent information on factors influencing shrinkage and volume change in concrete can be found in Ref d and e. It should be emphasized that concrete curing and protection are of paramount importance in minimizing concrete cracking. Therefore, close attention to timely application of appropriate curing and protection methods (Ref e) is an absolute necessity.

b. Precast Stay-in-Place Forming System. If the precast stay-in-place forming system is to be used, a precast quality concrete, conventionally reinforced flat panel, which is horizontally oriented and tied to the lock wall, as shown in Figure 1, should be considered. Detailed design of the precast panels, tie details, and lock hardware details can be found in Ref f and g. A similar system was recently used to resurface the walls at Lock 22, Mississippi River. Also, concepts have been developed for installation of the stay-in-place forming system in an operational lock (Ref h).

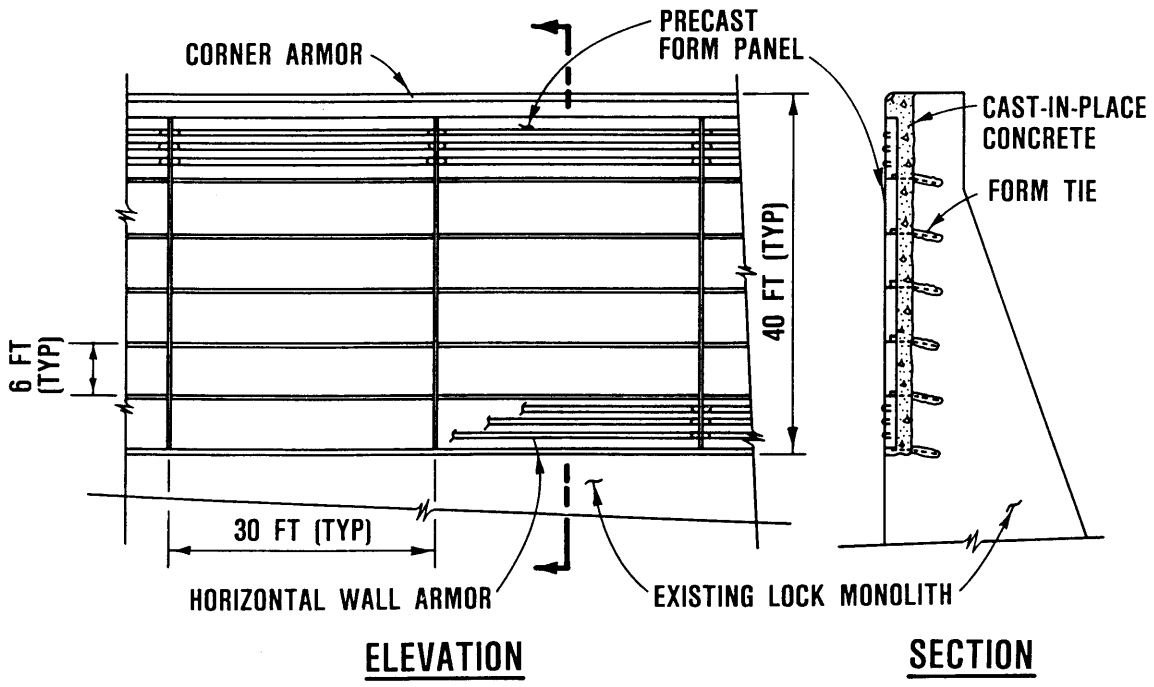

Figure 1. Precast concrete stay-in-place forming system for lock wall rehabilitation.

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