- When lots are at capacity, the yard inventory system will direct the equipment to different lots

- The mobile interrogator on a truck can be used to update inventory location if necessary.

Open Issues

There are several open issues that need to be resolved before a complete system of this type can be implemented:

- When a piece of equipment is lifted by a packer or crane, we need to be able to determine if that piece of equipment is entering the yard or departing the yard. When simultaneously loading and unloading, if a unit is encountered which is not in the pre-arrival inventory or the yard inventory, the computer will not be able to determine whether the unit is inbound or outbound.

- We need to determine how to handle non-tagged equipment which enters the yard. This might involve the use of magnetic serial coded transponders.

Additional opportunities can be derived from the use of a transponder/interrogator system. These include truck fuel inventory records, ramp/deramp/lift productivity records, and chassis inventory.

EXPANSION OF THE SOUTHERN PACIFIC RAILROAD'S DALLAS INTERMODAL FACILITY

BY

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Introduction

This project called for the expansion of SP's Dallas Intermodal Facility, a 30-acre freight exchange terminal a few miles south of downtown Dallas. This project can be broken down into basically three separate stages: pipeline installation and subgrade preparation, soil-cement subbase construction, and concrete pavement construction. This presentation focuses mainly on the design, the soil-cement, and concrete portions of the project.

Design

The pavement design considerations included traffic loadings and subgrade conditions. Current and projected traffic consisted of 18-wheel trucks, straddle cranes, and the side packer. Despite these heavy channelized traffic loads, we designed this intermodal paving system as a jointed plain concrete pavement using the latest Portland Cement Association design method. This method is based on non-reinforced concrete. In conjunction with the plain concrete, closer joint spacings on the order of 12 to 15 feet were used to control shrinkage cracking and to develop more efficient load transfer through tighter aggregate interlock.

Three different pavement configurations were used on the project: non-reinforced concrete over an existing crushed stone base and asphalt surface; non-reinforced concrete over 6" soil-cement subbase; and 6" soil-cement subbase with 1-1/2" asphalt wearing surface. Concrete thickness varied according to traffic loading from 6" in loaded trailer parking areas to 8" in channelized traffic lanes to 14-1/2" in straddle crane pathways. The design scheme also allowed the SP more flexibility for future expansions.

In addition to the expansion of existing facilities, the SP wished to improve its deteriorated pavements. The existing crushed stone base was utilized with asphaltic concrete surface as a subbase for a new jointed plain concrete pavement overlay. Taking advantage of the salvage value of the existing pavement permitted the use of a thinner concrete section due to greater load-transfer efficiency provided by the crushed stone. The base also served as an all-weather construction platform and prevented subgrade rutting by construction equipment, so no allowances had to be made for thickness variation. The in-situ soils in the expansion areas proved to be quite tender silty sands when tested in our laboratory, soils susceptible to deep rutting when loaded by even medium-duty construction equipment. Instead of a much thicker concrete section, we chose to take advantage of the soil conditions by designing a soil-cement subbase for the concrete pavement. The soil-cement base provided greater load-transfer efficiency, served as a solid all-weather construction platform for the slipform paver, and prevented subgrade rutting by construction equipment.

Again, this provided greater thickness control for concrete placement and resulted in a thinner concrete section because thickness variation was reduced. For the Northwest Lot, an area in which empty trailers are stored, the structural capacity requirement was less than for the other areas, so a 6" soil-cement subbase with 1-1/2" asphalt wearing course was used as the design section.

To provide uniformity of construction materials, the contractor was encouraged to have an on-site continuous feed soil-cement plant and a concrete batch plant, adding greatly to daily paving production and quality much greater than mixed-in-place soil-cement and ready-mix concrete operations could provide.

Laboratory Testing

Quality control was an essential part of this project and was instrumental in ensuring a top quality pavement. The materials testing laboratory was located on the job site. Once the quality control plan had been developed, daily inspection and testing of the contractor's performance and progress were carried on. Having the testing laboratory on site ensured maximum quality control; test results were given immediately to SP's Project Engineer, allowing for immediate remedial measures to be taken, if necessary.

Soil-Cement Subbase

In order to save time and avoid delaying construction, the Soil-Cement Short Cut Test Procedure for Sandy Soils, as outlined by the Portland Cement Association, was used to determine a safe cement content for each type of soil used on this project. The contractor agreed to abide by these results and even voluntarily added an extra percent of cement to ensure he met the required strengths during the first couple of weeks of operations. Once his production consistently exceeded the specification requirements, he was allowed to decrease the amount of cement used as long as strength requirements were still consistently met. Based on the overall results of the field tests, the Short Cut method proved to be successful.

Once soil-cement operations commenced, several field, laboratory, and plant tests and checks were run every day to ensure good quality soil-cement. Laboratory proctors and strength cylinders were run using that day's stockpile soil and the designated cement content to give an indication of target strengths; field proctors and strength cylinders were also run using soil-cement mixture actually placed on that day to verify compliance with the specifications. Our specifications called for a minimum of 400 psi unconfined compressive strength at 7 days for these strength cylinders.

Rather than dispose of field and laboratory soil-cement Proctor cylinders, they were tested along with the strength cylinders at 7 days to illustrate the effects of moisture content and density on strength. As expected, optimum strength was attained at optimum moisture and maximum dry density. What was dramatically illustrated in the test reports was the rapid loss of strength when moisture contents deviated from optimum moisture an average of 50 psi lost for a +/-2% deviation. Because of this effect, every effort was made by the contractor and inspection team to ensure proper compaction of soil-cement at optimum moisture content.

A sieve analysis was run on the stockpile soil to monitor daily consistency and check for excessive amounts of clay and clay balls. To reduce the amount of clay balls found in the stockpile soil, the contractor placed a 2" screen at an angle over his shaker bin; this combination eliminated all objectionable clay material. To check on the effects this had in the field, we ran in-place material over a 1" and a #4 sieve to check for the amount of clay balls in the mix.

Other daily tests included in-place densities, which were run on the compacted soil-cement using a Troxler nuclear density gauge immediately after final rolling, and thickness checks to check for thickness and uniformity of mix. Cores were taken to check for thickness and laminations, an indication of built-in failure. Areas where we encountered these laminations were removed full depth and replaced. As a final quality check, 4-foot wooden poles were used to "sound" the hardened soil-cement. As areas of dull sounding soil-cement were encountered, they were marked on a map as indications of soft or failed areas. These failed areas were either removed and replaced or removed to good hard soil-cement, and additional concrete was used to make up for the deficient subbase thickness.

The plant had been stockpiling soil for processing for weeks prior to laydown operations. Each area was staked and brought to grade, then the laydown process was brought into full swing. Dump trucks were loaded with the soil-cement mixture from a hopper, then they placed the material in front of the laydown machine. The contractor started off by using an asphalt laydown machine, but his production was low and inefficient. He quickly brought in a Jersey spreader to finish the job, and this increased his production tremendously.

Because rutting was a big problem in some areas, the contractor used a rake to knock down high spots under the dump trucks, and used the roller to recompact the subgrade after each truck delivered its load. The material was then compacted using a steel wheel roller. This roller left compaction planes in the soil-cement, the source of the laminations mentioned earlier, but the amount of material used was enough to leave the compacted section 1"-2" high; the laminations were cut out using a trimming machine. The material trimmed off could then be reused if it was still less than 30 minutes old. Any laminations still in the soil-cement surface were eliminated by using a spring tooth harrow, and final compaction was achieved using a rubber tire roller.

The surface was kept wet to prevent dusting and later hardbladed to eliminate high spots. Finally, a liquid asphalt primer coat was applied as a curing coat.

Having an on-site batch plant greatly improved concrete quality and allowed for greater control of the concrete. The contractor used a slipform paver, which also resulted in higher concrete quality because of the lower slumps necessary for efficient operation. While our specifications called for a maximum slump of 4", the contractor preferred a much lower slump and, indeed, their slumps typically ranged from 1-1/2" to 2-1/2", even when doing hand pours using the Clary machine. This improved the quality of the pavement in both strength and durability resulting in a dense, durable wearing surface of high strength and no problems with scaling.

Specifications called for a maximum 4" slump, entrained air content of 5%, and a 7 day flexural strength of 600 psi at third point loading.

During placement, the subbase was first cleaned off well, then wet down to prevent the subbase from absorbing water from the concrete mix. For finishing, the contractor used 3-foot bull floats and 10-foot straightedges, which produced a much smoother riding surface. For surface texture, wet burlap was dragged along the new concrete, then the white curing compound was applied. The contractor's equipment train was set up so efficiently that the amount of time involved from concrete placement to application of the curing compound was usually less than 30 minutes, thereby preventing plastic shrinkage cracking from occurring during the hot, dry Texas summer days.

Joints were sawed later the same day, as soon as possible without ravelling the green concrete. After inserting a backer rod, these joints were sealed with a cold-poured asphalt emulsion sealer before the pavement was opened to traffic. After all concrete had been placed, cores were taken to check for thickness.

Problems that were encountered during the concrete operations did not come from materials, but from weather. The concrete work was started at the end of the spring rains and although the contractor usually had enough warning before a storm, once he got caught. However, all concrete poured that day was covered with plastic and we did not lose any of that concrete, but the contractor was more cautious from that point on. Concrete operations continued on into July and August, and temperatures soared into the 100's. We became concerned with plastic shrinkage, cracking and flash sets at this point which could result from high mix temperatures. As mentioned earlier, the curing compound was applied immediately after finishing, which eliminated the occurrence of plastic shrinkage cracks. To avoid flash sets, the contractor watered down his coarse aggregate pile to keep it cool and reduce the mix temperature of the concrete. We experienced no problems with flash sets.

The concrete operations were very successful and produced a concrete pavement of exceptionally high quality.

Asphalt

Asphalt had a very limited use on this project. It was used as a level-up to fill in low spots in the existing crushed stone base with asphalt surface which was to be overlaid. It was also used between the railroad tracks to allow crossing the tracks at any point. Finally, and primarily, it was used as the wearing surface over the soil-cement in the Northwest Lot, on which empty trailers were stored.

ASPHALT CONCRETE PAVED YARD FOR THE UNION PACIFIC IN SEATTLE

BY
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The Union Pacific Railroad Company's Seattle Intermodal Facility is located a short distance south of Spokane Street, roughly between 1st and 5th Avenues. A portion south of the 5th Avenue viaduct has been used as an intermodal facility for several years, but the yard needed to be expanded. The expanded area is about 3,300 feet long and up to about 500 feet wide, and extends from 6000 feet northerly from the 1st Avenue viaduct to 700 feet southerly from the 5th Avenue South viaduct. The expanded area has been used for tracks, but did not carry heavy vehicular traffic.

The facility is on the old Duwamish River floodplain. About 80 years ago, to improve the area for development, the river was channeled to its present location, leaving old meanders in the developed area. The old meanders cut through the northerly portion of the intermodal facility and were about 18 feet deep below the present ground surface. In addition, the floodplain was from 2 to 12 feet below the present ground surface.

Initial site investigations consisted of 19 hollow-stem auger borings with Standard Penetration Tests followed by 15 backhoe test pits and 53 Falling Weight Deflectometer tests. Fourteen field California Bearing Ratio (CBR) tests were conducted at selected locations and two plate-bearing tests were performed. Subsurface materials were found to be extremely variable. Until the early 1950's, the old river meanders had been used for disposing of trash consisting of cinders and ashes, glass, various kinds of metals, and chunks of concrete. The rest of the area had been filled with highly variable materials ranging from sand and gravelly sand to very soft clay. The water table was generally only 2 to 3 feet below the ground surface. The old meanders filled