

*Looking Toward Lower Manhattan, Over the New Double-Deck Pier*

# Erie Builds Large Modern Pier in New York Harbor

*Location over vehicular tunnels of the Hudson river involves the use of 845,000 feet of piling in special substructure construction*

ONE of the major improvements completed by the Erie during the last year is a modern steamship and lighterage pier on the Hudson river water front in Jersey City, N. J. This pier, which is known as pier No. 9, is worthy of special notice for a number of reasons, including its size and the effectiveness of its arrangement, its favorable location, the permanent type of construction employed and the special problems encountered in its construction.

The pier is a two-story steel structure, 1250 ft. long by 150 ft. wide, with berth space and cargo beams along the full lengths of both sides for the loading and unloading of steamships and lighters. The main deck of the pier, which is served throughout its length by two standard gage railroad tracks, is used primarily for the storage and transfer of rail-water shipments, while the loft is used for the storage and handling of import and export cargo which is brought to or taken from the pier by drays or trucks, and also, for the loading and unloading of steamship passengers. The new pier has been made readily accessible for automobiles, trucks and drays through the construction of a 20-ft. concrete driveway extending westward approximately 1100 ft. from its shore end to a connection with 12th street in one of the industrial sections of Jersey City. The loft of the pier is reached over an inclined concrete roadway which branches off from the main roadway and extends to the loft level on a grade of about 4 per cent. This roadway is approximately 625 ft. long, the first 180 ft. being on a fill maintained be-

tween concrete retaining walls, while the remainder is a concrete deck structure supported on structural steel framing.

## Pier Has Unusually Favorable Location

From the standpoint of the Erie railroad and water shippers, the new pier has one of the most advantageous positions along the Jersey water front. Located almost directly opposite the center of Manhattan island, the pier lies within the passenger and freight terminal area of the Erie in Jersey City, approximately 400 ft. north of the Erie's passenger station. The most significant feature of the pier's location is the further fact that it lies directly over the new Holland vehicular tunnels which have recently been completed, connecting New York and Jersey City. So located, the entrance to the new pier is in close proximity to the New Jersey entrance of the tunnels, which gives the pier a most favorable position owing to the readily accessible traffic connection with the heart of the metropolitan district.

From the standpoint of construction, the location of the pier over the tunnels necessitated a radical departure from the common design of pier foundations, requiring the use of unusually long piles, spaced closely together in three tiers in order to clear the tunnels beneath, and at the same time provide adequate support for the superstructure. In the particular location chosen, the off-shore end of the pier protects one of the large blower towers of the ventilation system provided for the vehicular tubes.

### Pier Has 188 Full-opening Cargo Doors

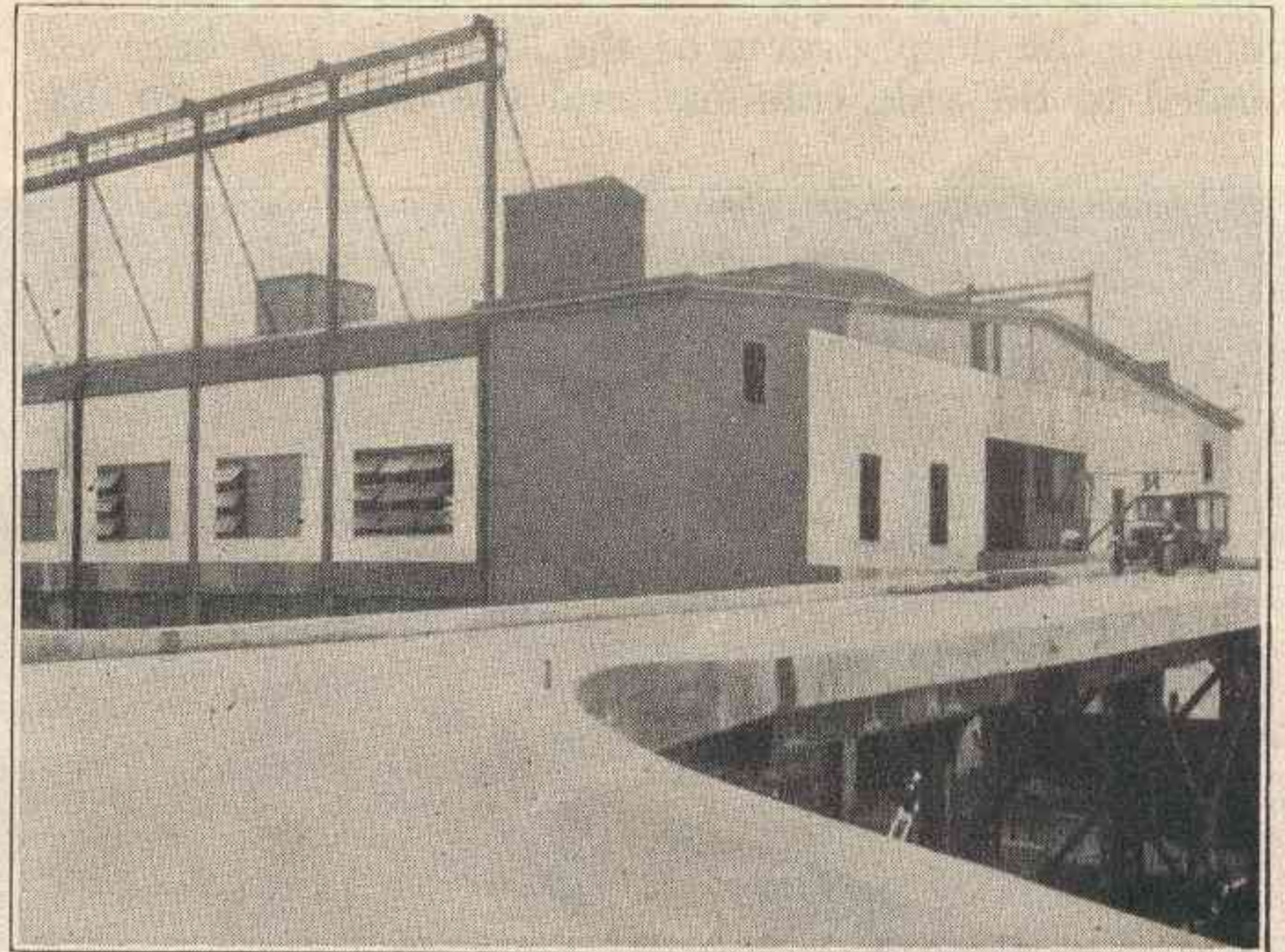
As previously mentioned, the superstructure of the pier is two stories high, 1250 ft. long and 150 ft. wide, which provides a total floor space of approximately 375,000 sq. ft. Throughout, the superstructure is of structural steel construction, steel being used for all columns, roof trusses, floor beams, and for a considerable part of the siding. The roof of the pier is of the monitor type covered with 2-in. tongue and groove pine, which in turn is protected by Barrett built-up felt and slag roofing. Both sides of the roof monitor throughout the full length of the pier are fitted with manually-operated top-hung continuous steel sash glazed with wire glass, affording adequate ventilation and daylighting within the loft section. The flooring used in both the main level and in the loft consists of 6-in. by 6-in. Douglas fir timbers supported on heavy built-up I-beam girders.

In order to make possible the loading or unloading of lighters and ships at any point along the pier, both sides of the pier at both levels, are fitted with a special type of full-opening cargo doors, separated only by the roof-supporting side wall columns. These doors, of which there are a total of 188 in the pier, are a special type of double-leaf vertical-lift, horizontal-folding doors, designed by the Erie, constructed entirely of steel except for the large area of sectional wire glass provided in the upper leaf of each door to afford daylight for the interior of the pier. In operation, the lower leaf of the doors is raised vertically and then both leaves are swung into a horizontal position within the pier, providing the full opening of each doorway with little possibility of interference with stored cargo. Through this arrangement, both sides of the pier, at both levels can be completely opened if necessary, making it possible for ships or lighters to berth at any point along the pier, regardless of the location of their hatches.

In the general design and layout of the pier, every effort was made to provide a maximum of unobstructed floor space, the only obstruction permitted being the fire walls, columns and track pits on the main deck, all of which were essential to the construction of the pier. The fire walls are three in number, extending across the full width of the pier in both the main deck and the loft, and dividing the pier into four sections of approximately equal length. These walls are constructed entirely of concrete, 12 in. thick, and extend from the substructure well above the top of the roof. Each fire

by a twin installation of sliding tin-clad, automatically-operated fire doors.

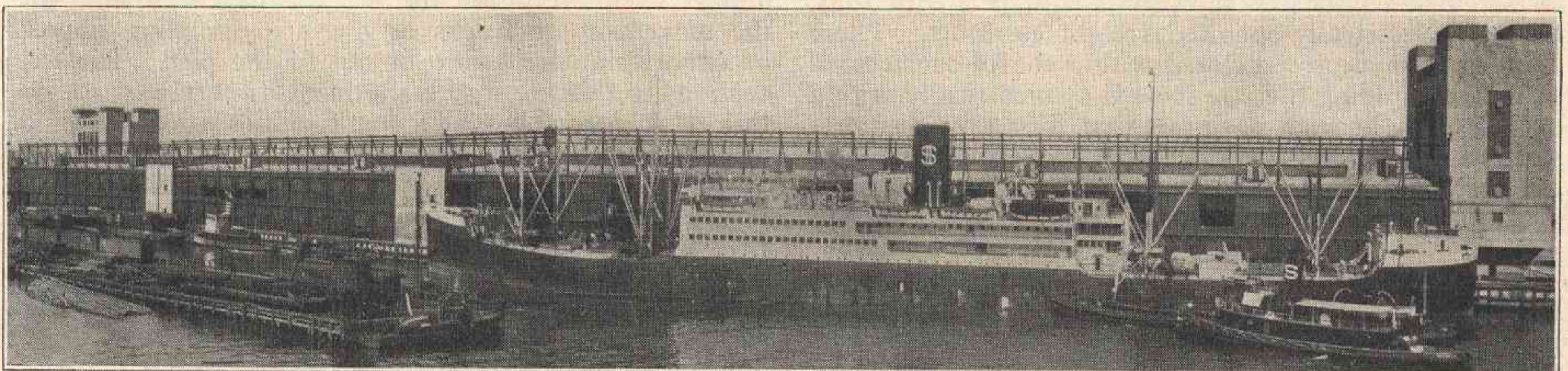
In addition to these fire doors to close off the truck passageways through the fire walls in case of fire, the track openings through the walls on the lower deck are also protected with fire doors which will lower automatically in case of fire, completely closing off the individual sections of the pier. These latter doors operate in a vertical plane and when opened extend up along the solid portion of the fire wall in the loft where they are entirely out of the way. All of the fire doors within the pier are of the tin-clad type.



The Rear of the Pier Showing the Steel and Concrete Approach Ramp to the Upper Deck Level

Other features about the pier which reduce the hazard of fire are the metal fire curtains provided over two of the roof trusses in each section of the pier, and the complete installation of a dry pipe automatic sprinkler system. This sprinkler system is connected to a 100,000-gal. fresh water supply tank and has auxiliary connection with a battery of electrically-driven fire pumps for use in emergency.

The only other obstructions within the pier on each deck other than the fire walls, are the stairways, elevators and columns, which have been so located as to minimize interference with trucking. For example, the stairways from the main deck to the loft and from the



The New Erie Pier, With One of the Holland Tunnel Ventilating Towers at the Off-Shore End

wall has two large openings on each floor to provide for the free passage of trucks throughout the entire length of the pier. These openings lie on either side of the center of the pier, about midway between the center and the side walls, and in each case are protected

loft to the roof, of which there are two in each section of the pier, are located adjacent to the side walls and close to the fire walls. In the loft the only columns throughout the entire floor area lie in a single row longitudinally through the center of the pier, these being

spaced 20 ft. center to center and supporting the roof trusses.

On the main deck three intermediate rows of columns extend longitudinally through the pier, each with a column spacing of 20 ft. The center row of columns however, does not interfere in any way with operations within the pier as it lies between the two railroad tracks in the track pit. The other rows of columns lie along both sides of the pier, 12 ft. 6 in. from the side wall columns which support the outer ends of the roof trusses. These columns support the floor structure of the loft, and were provided mainly for two reasons. One of these was to make possible a maximum height of side door openings, which could not have been secured if the deep girders of the loft deck had been extended to the side columns, and the other was to dis-

pier, beyond the ends of the pier tracks, that it can be approached from either side of the pier on both levels.

#### Each Deck of the Pier is Used for Specific Purposes

In the utilization of the extensive area supplied in the new pier, the main floor, which is located at an elevation of approximately eight feet above high tide level, is used primarily in connection with the transferring of cargo from lighters to ships, and vice versa, and for the interchanging of shipments between ships and freight cars. For each of these classes of work, special provision has been made within the pier. For handling lighterage freight into and out of the main deck, most of which is done toward the shore end of the pier, five ramps have been provided along each side of the pier in the two sections near this end, these ramps leading



The Three Tiers of the Pier Sub-Structure at Various Stages of Construction. Note the Precast Concrete Blocks in Place Above the Piling

tribute the weight of the loft deck over different areas of the foundation piling than those supporting the side walls and the roof structure. As these columns are spaced 20 ft. apart and about 12½ ft. back of the doors, they do not afford obstruction to storage or trucking operations.

#### 17 Freight Elevators Connect the Pier Decks

For handling cargo between decks of the pier, each of the four sections of the pier is equipped with four, two-ton, electrically-operated freight elevators. These elevators, which are enclosed within shafts constructed of hollow building tile, are located symmetrically within each section in such positions that they provide unrestricted storage and trucking space on all four sides. In each case the elevator shafts are protected against damage by vehicles or hand trucks, by heavy timber wheel guards.

In addition to these 16 general service elevators at the pier, the offshore end section of the pier is equipped with a 15-ton heavy duty elevator for the transferring of exceptionally heavy shipments, or entire truck loads, from one deck to the other. The principal advantage of this special unit is through the fact that drays or trucks with shipments to be handled out of each deck, can be transferred from one deck to the other without the necessity of making a long run through the pier to the loft level approach ramp. As with the smaller elevators, this larger unit is electrically operated and is so located at the extreme end of the

down to openings at a suitable level for handling shipments to and from lighters. These ramps are approximately 25 ft. long and 15 ft. wide, and rise on an easy grade to the floor level of the pier. To facilitate the handling of rail-ship cargo or vice versa, the two standard gage railroad tracks extending through the center of the pier have been depressed within a pit so that car floors are at the same level as the deck of the pier.

The loft of the new pier affords space that is used almost exclusively for the storage of cargo and for the movement of trucks or drays in handling import or export shipments into or out of the pier. The exceptions to this are in the allotment of certain space on this deck for offices and for facilities for steamship passengers. In the layout of the floor area of the loft, which is obstructed only by the fire walls, columns and elevators as previously mentioned, the outer end of the rear section, or that furthest from the shore, is used for the storage of the gear used in working the ships. Here also is provided a segregated area for the storage of ship engine parts and an area for the storage of dunnage.

The passenger and office facilities at the new pier are located entirely in the loft, these being confined within two separate enclosures at the front of the pier, on either side of the loft level entrance and exit driveway. These enclosures, which are approximately 100 ft. long by 52 ft. wide, are built-in units, entirely enclosed with side walls and a roof, the latter lying immediately below the lower chords of the roof trusses of the pier

proper. So constructed, both of these units might be considered as separate buildings in themselves, placed in position on the loft floor and divided into suitable areas for passenger and office facilities.

The principal passenger facilities within these units are a well appointed waiting room, approximately 50 ft. long by 46 ft. wide, a small women's rest room, and wash and lavatory facilities. These are not intended to be spacious as they are used only upon the arrival of passenger-carrying ships and then primarily by friends or relatives of passengers who come to the pier to see them off or to welcome them home.

**Substructure Presented Interesting Piling Problems**

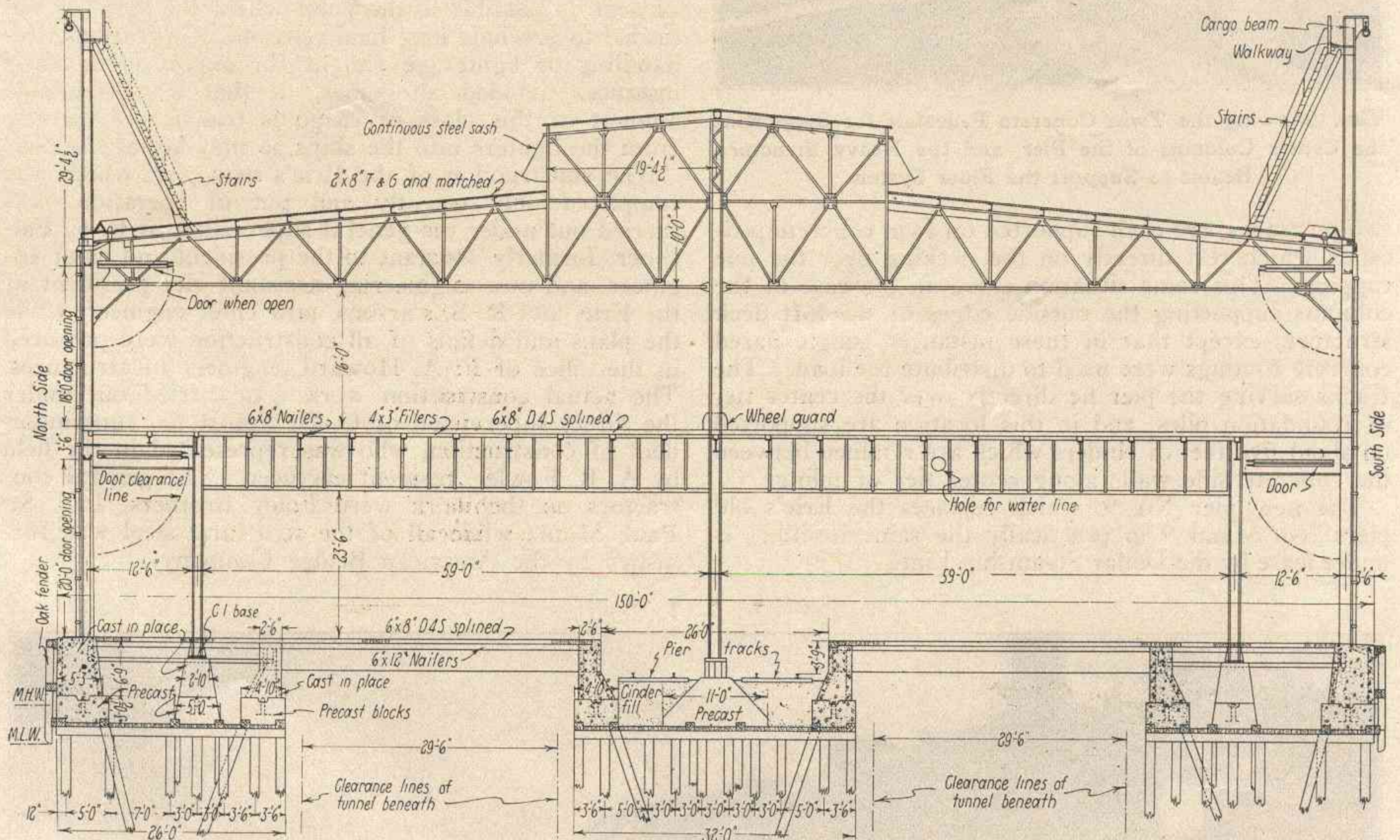
The most interesting work, from an engineering standpoint, in connection with the building of the new pier was involved in the construction of the foundation and the first deck. This was due to the location of the vehicular tunnels directly beneath the site of the pier, which would not permit a more or less regular spacing of the foundation piles throughout the area covered by the pier.

Reference to the accompanying cross sectional view of the pier and its foundation will make evident the

pile spacing was increased or decreased, as was found necessary or advisable, the spacing in each direction varying from about 3 ft. to 8 ft.

The length of the piles as specified ranged from 85 ft. to 110 ft., although in some instances piles were driven as long as 128 feet. The distribution of the longer piles throughout the foundation varied somewhat with the location of the more concentrated loads, although in the main they were used throughout to form the two outside rows of piles in the outside tiers, to support the loads of the wall columns, and toward the rear end of the pier in deep water, where increased length was required to secure the proper penetration.

In driving the piling for the pier foundation, all of which was done with steam hammers, every precaution was taken to preclude distortion of, or damage to, the tunnels. This was necessary particularly when driving the rows of piles nearest to the tunnels, as these rows were placed as close as 1 3/4 ft. to 2 ft. from the tunnel casings. As a precaution in this work, men were stationed within the tunnels at all times during driving operations, and were equipped with telephone connections to the pile drivers so that they could warn the operators of any adverse effects the driving was having upon the tunnels. That this was advisable was evidenced by the



**Sectional View Across the Pier Showing Its Unusual Foundation Construction**

unusual problem which was encountered. With the two circular tubes, 29 ft. 6 in. in diameter and spaced approximately 65 ft. center to center, directly under the pier site, it was necessary to group the foundation piles in three tiers, suitably spaced, and extending parallel with the tunnels and the length of the pier. In so doing, one of these tiers was placed along the north side of the north tunnel, one tier immediately south of the south tunnel, and the third tier between the two tunnels. Confined to such a layout, unusually long piles and close spacing were required in order to provide adequate supporting power for the superstructure. The

fact that in spite of the tendency of the driving to distort the alinement of the tunnels, this distortion was kept to a negligible amount through the direct contact maintained between the pile driver operators and the men stationed within the tunnels.

All of the piling used in the pier substructure was untreated timber, but as it is all cut off and capped well below high tide level, no trouble is anticipated from decay. All of the 85-ft. piles and approximately 50 per cent of the 90-ft. piles used were long leaf yellow pine, while the remainder of the 90-ft. piles and all of those of greater length were Douglas fir. The

magnitude of the pile-driving operations in connection with the substructure of the pier is better appreciated when it is understood that in all, approximately 845,000 lin. ft., or about 160 miles of piling was put in place.

### The Substructure

Above the piling and capping, the substructure of the pier consists of a six-inch timber deck over each of the three tiers of piling, and along the sides of each of these tiers is a row of massive, interlocked, precast concrete blocks which in turn supports a poured-in-place concrete foundation wall. These latter walls, which extend throughout the length of the pier support the side wall columns and the heavy structural steel beams of the main deck floor system. The columns in the center row, extending throughout the length of the pier between the



View Showing the Twin Concrete Pedestals for Supporting the Center Columns of the Pier, and the Heavy Structural Beams to Support the Floor System

two pit tracks, are each supported on twin concrete pedestals which rest directly on the decking over the pile capping. This same situation exists in the case of the columns supporting the outside edges of the loft deck structure, except that in these instances, single flared concrete footings were used to distribute the load. The tracks serving the pier lie directly over the center tier of foundation piles, and in this location are supported on about five feet of cinders which are retained between the concrete side walls along center tier of piling.

The new pier No. 9, which replaces the Erie's old piers No. 8 and 9 in practically the same location, is under lease by the Dollar Steamship Line.

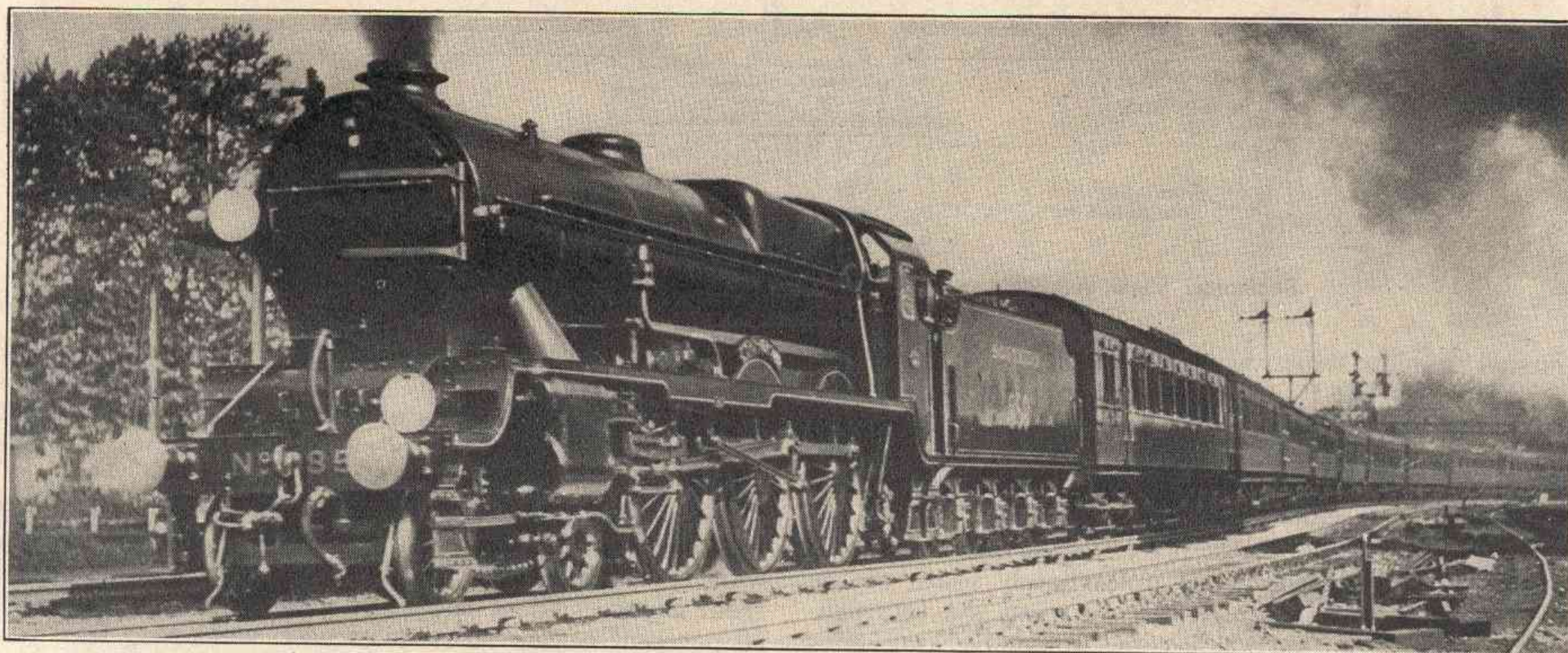
In the operation of the pier, practically all cargo on the main deck level is trucked manually into and out of the holds of the ships, while at the loft level the freight is handled through the use of gear in connection with the cargo beams extending along both sides of the pier above the roof structure. Some of the cargo handled over the main deck of the pier is trucked direct from ships to cars or vice versa, although more frequently cargo is accumulated and stored according to destination, either along the pier tracks for subsequent loading into cars, or near a designated pier door for subsequent stowing in ships.

In the loft the same principle of operation is carried out except that truck cargo alone is handled on this level. If an interchange or cargo is necessary between the pier decks, the elevators at frequent intervals make this readily possible. Little mechanical hoisting or conveying equipment of any kind is used in the operations at the pier, the large area provided making it possible in almost every case for car or truck shipments to be placed in close proximity to the proper outbound doorway.

This is also the situation with respect to inbound cargo which usually arrives in large shipments, with specific destinations to be reached either by rail or truck. In such cases trucks or freight cars are spotted as near as possible to the point where the cargo is unloaded to preclude long haul rehandling operations. Rehandling of lighterage freight for export is in many instances avoided altogether, in that a considerable amount of this class of cargo is transferred directly from the lighters into the ships as they lay at the pier.

The construction of the Erie's new pier, which was completed only recently and put in operation, was carried out under the general supervision of R. C. Falconer, formerly assistant to the president and chief engineer, and now engineering assistant vice-president of the Erie, and R. S. Parsons, now chief engineer, while the plans and details of all construction were prepared in the office of F. A. Howard, engineer of structures. The actual construction work was carried out under the direct supervision of C. H. Splitstone, superintendent of construction, who was represented in the field by A. B. Fowler, resident engineer. The general contractors on the work were Foley Brothers, Inc., St. Paul, Minn., while all of the structural steel was furnished by the American Bridge Company.

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Continental Express, Southern Railway (England)—Drawn by the New "Lord Nelson"