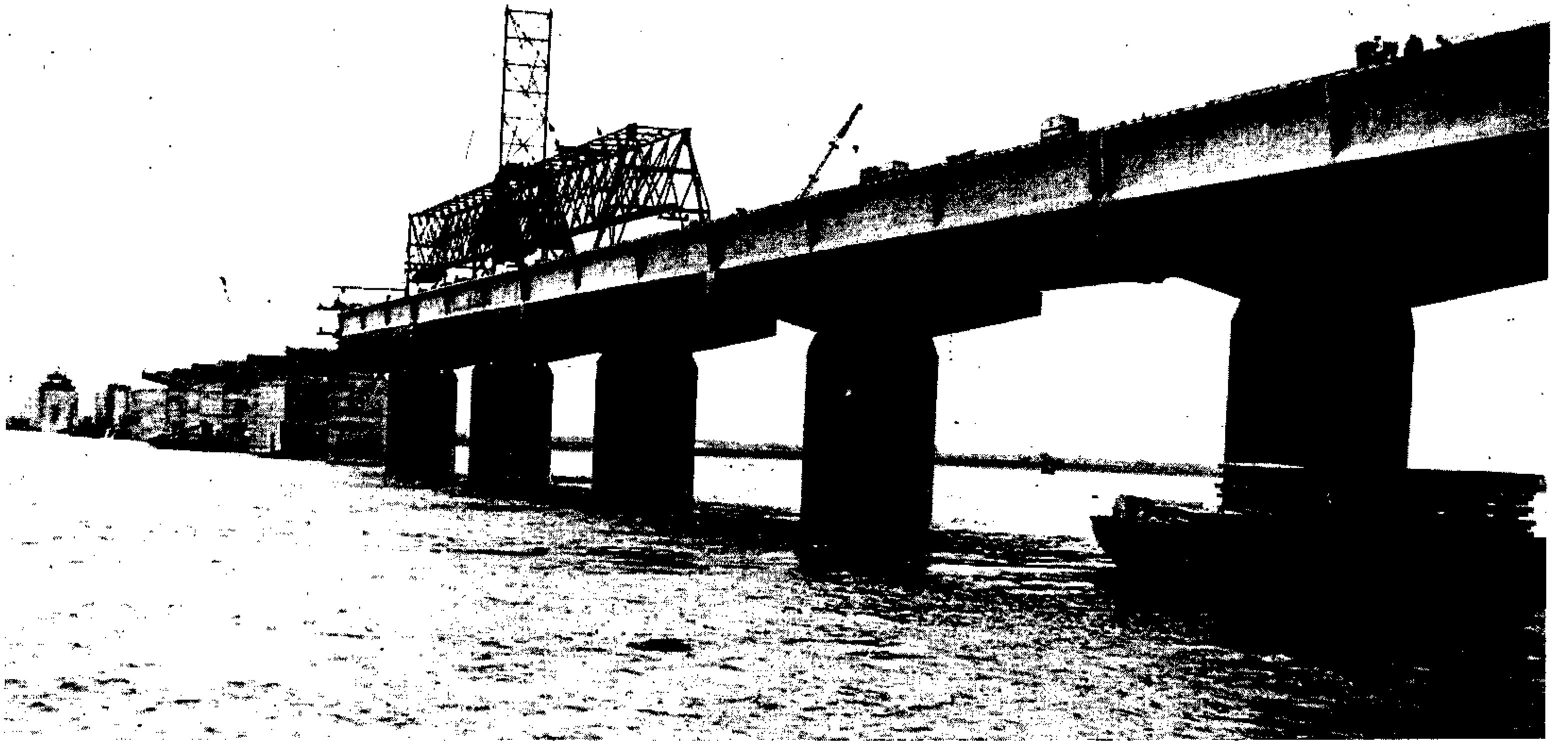


Use of Pre-Stressed Concrete Is Big Feature of Champlain Bridge

CONSTRUCTION of the mammoth Champlain Bridge, the fourth highway bridge to connect Montreal to the South Shore of the St. Lawrence River is an important milestone both for the Canadian construction industry and McNamara Quebec Limited, sponsor of the three-company joint venture group carrying out the major portion of the work. It is the first major bridge to be built in Canada using pre-stressed concrete beams rather than steel for its superstructure.

Working with this company as partners are the well known and highly regarded Montreal firms of The Key Construction Inc. and Deschamps & Belanger Limitée, and the joint venture group is known as McNamara-Key-Deschamps, often abbreviated to MKD. Since July of last year the joint venture crew of up to 800 men has been engaged on this project of building Sections 5 and 7A of the bridge, 8,100 feet in length and 80 feet wide. Top supervisory men on the job are Project Manager Paul Brais, Jacques Déry, representing McNamara Quebec Limited; and Pierre Mora, representing The Key Construction Inc.

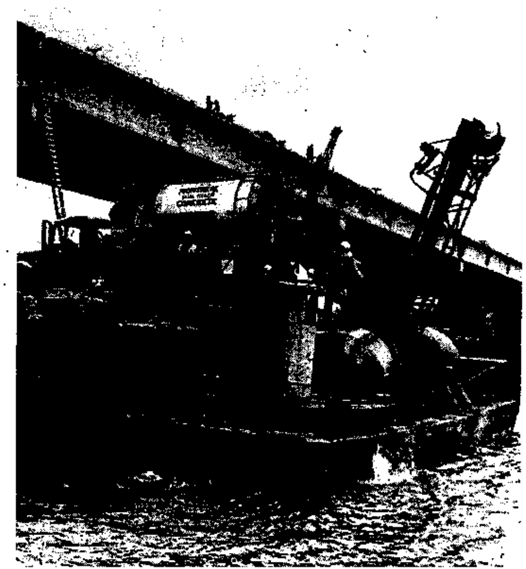
The complete crossing of the St. Lawrence River from Verdun, a western suburb of Montreal, to the South Shore of the river — all designated as the Champlain Bridge — involves the use of Nun's Island and erection of several different sections of bridge. McNamara-Key-Deschamps has the task of building Section 5, the major portion of the bridge across the main channel of the St. Lawrence from Nun's Island to the Seaway shipping channel. Also included in the MKD contract is Section 7A, beginning on the south side of the Seaway shipping channel and extending for six spans toward the South Shore. Section 7B consists of four spans between the south end of Section 7A and the South Shore.

Use Four Existing Piers

When the Seaway was built a few years ago, four large concrete piers were erected to support the future bridge crossing of the Seaway shipping channel. Dominion Bridge Limited will build the steel portion of the Champlain Bridge for 2,750 feet over this shipping channel, utilizing these existing piers.

To cross the north channel of the river between Verdun and Nun's Island, Foundation Limited put in the piers for Section 3 of the Champlain Bridge, while Creaghan & Archibald is building the superstructure. Across Nun's Island itself the traffic will move over a 226-foot-wide toll road equipped with a 14-tollgate plaza. The length of the complete river crossing known as the Champlain Bridge will be nearly four miles.

Of the total bridge, McNamara-Key-Deschamps' Sections 5 and 7A account for a bridge length of 8,100

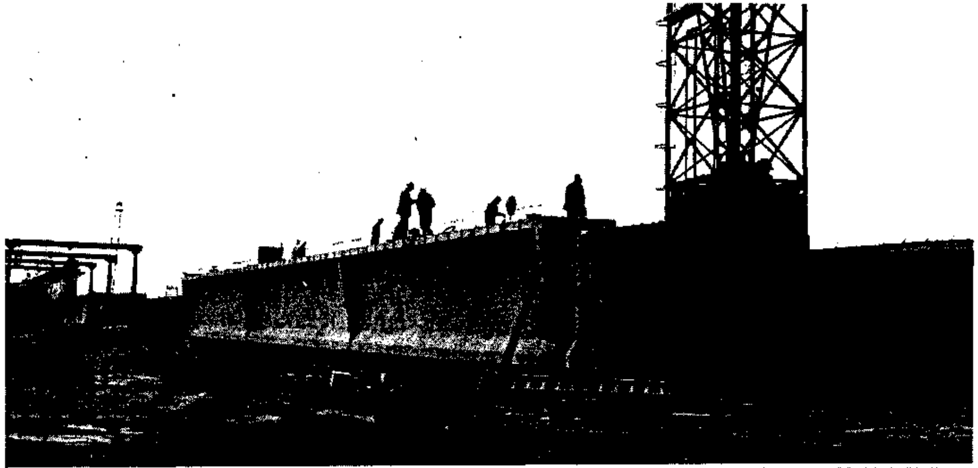


Pictured ABOVE is a view of Section 5 of the Champlain Bridge being built by McNamara-Key-Deschamps at Montreal from Nun's Island to the South Shore of the St. Lawrence River. This photo gives a good view of the shafts and pier caps which support the huge pre-stressed concrete beams that make up the superstructure of the bridge. The mammoth launching bridge used for placing these beams is shown astride the bridge, while the flat scow at right holds the forms used for pouring the concrete deck slab. Photo at RIGHT shows one of the concrete carriers used to pour the pier columns being loaded with concrete from a ready-mix truck.

feet built 80 feet wide to carry six lanes of traffic. The crown of the roadway on the bridge deck will be roughly 100 feet above water level. The slope is .85 per cent out from Nun's Island to the Seaway shipping channel and 3 per cent from the south Seaway dyke to the South Shore.

Section 5 comprises 40 spans, each consisting of 7 pre-stressed concrete beams 176 feet long. Section 7A is made up of 4 spans using pre-stressed beams 176 feet long and 2 shorter spans using beams of this type 168 feet long. Supporting the 46 spans of these two sections will be 45 piers of a special type designed for the McNamara-Key-Deschamps project. These piers are 176 feet apart, centre to centre, and consist of a footing, shaft and pier cap on which the pre-stressed beams rest.

This large bridge-building project of MKD will require the impressive total of 100,000 cubic yards of concrete. Of this total, approximately 30,000 yards will go into the 322 giant pre-stressed concrete beams, while the remaining 70,000 yards will be used in



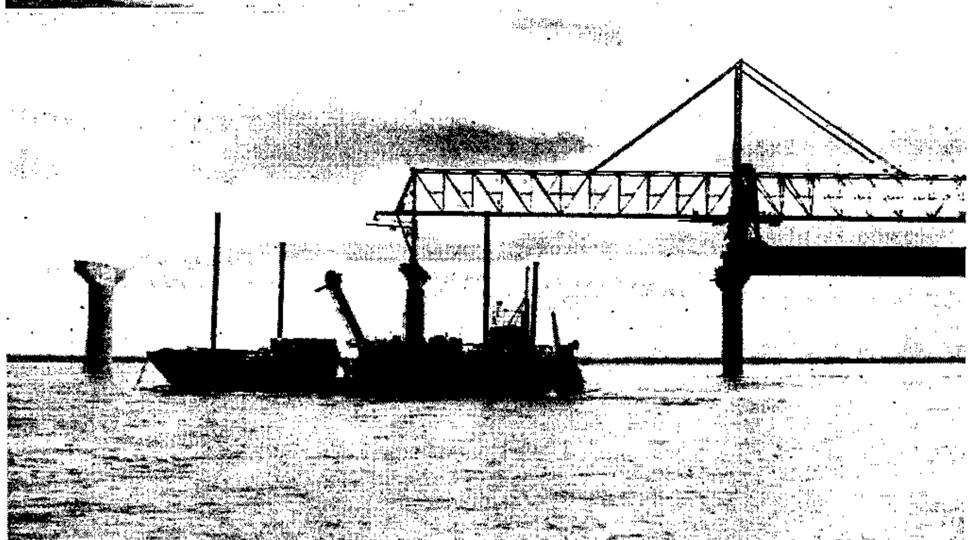


Photo TOP, RIGHT shows some of the 176-foot pre-stressed concrete beams used for the bridge superstructure in the yard where they are cast. Each span requires seven of these beams. Second picture shows most of the MKD engineering staff on the project. From left to right are Benoit Boivin, Gabriel Lascorz, Albert Langlois, Raymond Pessayre, Graham Earle, Michel Fontaine and Louis Revert. In the third photo the McNamara vessel "Black Carrier" is shown taking two concrete trucks out to pour the footing for one of the piers. The launching bridge in the background is in position to place the pre-stressed beams for the next span. Pictured BELOW and RIGHT, BELOW are the top supervisory men on the project. From left to right across the two photos are Project Manager Paul Brais, Project Engineer Maurice Berthault, Jacques Dery, representing McNamara Quebec Limited, Assistant Project Manager Emeric Leonard and Pierra Mora, representing Key Construction Limited.

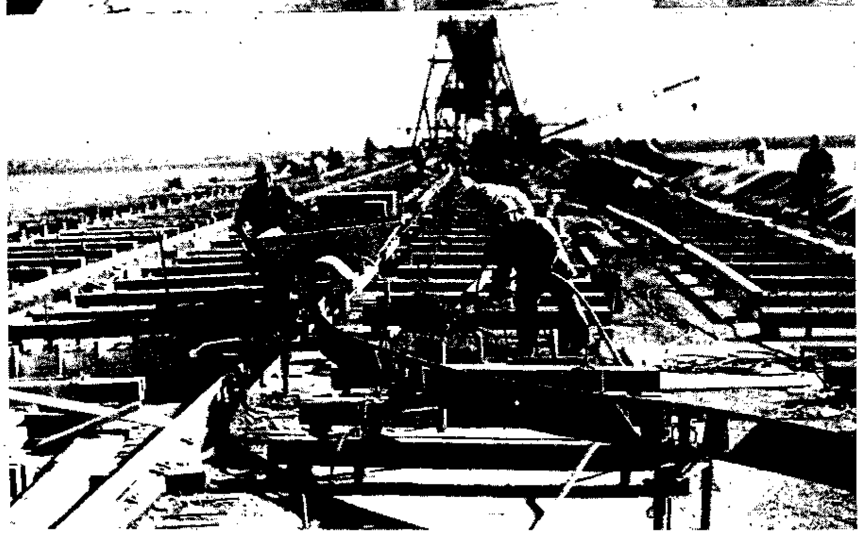
the slab, pier footings, shafts and pier caps.

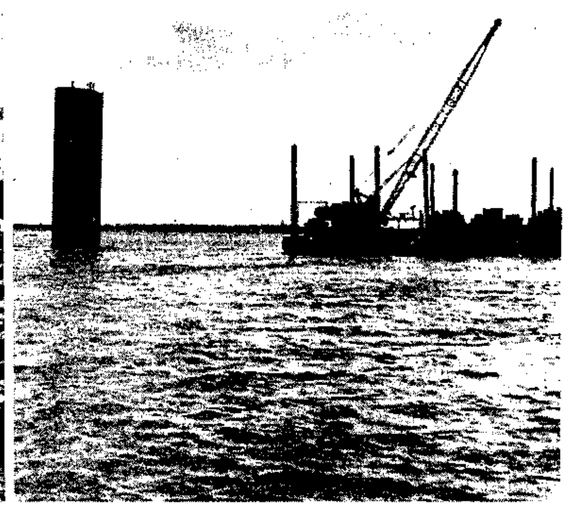
In building the piers the joint venture crews are pouring reinforced concrete footings 34 feet in diameter and varying from 8 to 18 feet in height. The shafts are elliptical in shape, 31½ feet wide and 10 feet thick at the centre, tapering off to 7 feet in thickness at the ends. On the upstream side they have a nosing of stainless steel plate to protect the piers from ice coming downriver. The shafts vary in height from 17 to 92 feet.

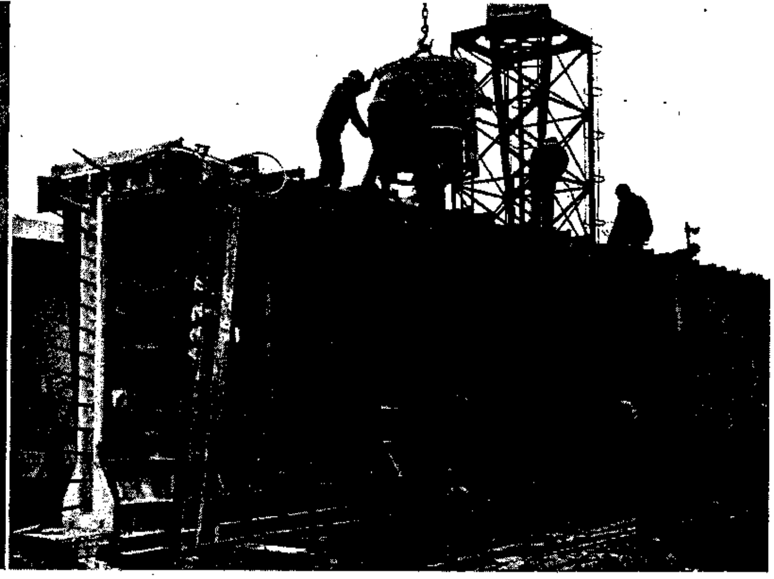
The third component of each pier, the pier caps, are 79 feet long, 11 feet high at the centre tapering off to 5 feet in height at the ends. They are 6 feet 4 inches thick. These caps are poured in place by use of cantilever steel forms consisting of four parts. The forms are mounted on two steel beams on top of the columns, with pouring done from the centre out. Each pier cap requires approximately 175 yards of concrete.

Pouring of the footings, columns and pier caps during the past season has constituted a large marine operation on which a big fleet of McNamara and rented vessels has been hard at work. Making up this fleet were the McNamara vessels "Black Carrier", "No. 6", "No. 27", "No. 29", "Levis", "Flora M", "Florence M" and

Photo TOP, LEFT shows the skeleton of one of the huge pre-stressed beams in the casting yard before the forms are erected around it and the concrete poured. The 14 cables which arc downward through the concrete are subjected to 180,000 pounds pressure per square inch after the beam is made. Second photo shows the office staff on the project. Third photo from the top was taken on the bridge itself under the launching bridge and looking out from Nun's Island. The rail runs down the centre of one of the pre-stressed beams and two of the six additional beams in the span can be seen at left and right. The operation of pouring the deck slab between the beams is shown BELOW, LEFT. Photo BELOW shows one of the cofferdams in which construction of a pier footing is going forward, while one of the completed pier shafts can be seen at left.







Pictured LEFT, ABOVE are some of the men on the marine phase of the Champlain Bridge construction work. In the usual order are Omer Bailey, who is responsible for operation of the floating equipment; Percy Pollard, foreman of the "No. 27", George St. Louis, Bert Villafana and Gilles Laplante. Photo RIGHT, ABOVE shows the pouring operation for one of the pre-stressed concrete beams. The ends of the 14 cables used for stressing can be seen jutting out of the end of the massive steel form at the left. The view at BOTTOM OF PAGE shows the extensive marine operation required to build the 45 piers required for the McNamara-Key-Deschamps portion of the bridge. Three completed shafts and the cofferdams for two more are visible, while workmen have started to place the steel forms used for pouring the pier caps on the shaft at centre.

the concrete carrier "Federal", plus the McNamara-owned or rented "Federal" and "Pentagon Adair" concrete carriers, seven flat scows, and several smaller craft.

Six extra-heavy floating templates have been used for building the cofferdams needed for the pier construction. These templates are 50 feet in diameter and incorporate steel drums which float them. When one of them has been floated into position, a flat scow mounting a crane and pile-driving hammer comes alongside to drive the steel piles for the cofferdam around the outer circumference of the template.

Footings Go Into Bedrock

When the cofferdam has been completed a front-end loader is lowered inside to excavate overburden. There must also be a minimum excavation of two inches into bedrock. The forms are then placed and the concrete poured. After the footing has been completed, work begins on the shaft. Sliding steel forms are used for pouring the shaft and after it has been brought above water level, the template, which is hinged, is opened and floated out to be used for building another cofferdam.

The concrete for the footings has largely been poured by the "Black Carrier" which takes out two ready-mix trucks a trip. For pouring the shafts, the concrete carriers "Federal" and "Pentagon Adair" have been used. They each mount two mixers of the type used on ready-mix trucks which unload onto a conveyor belt. The pier caps have been poured by a crane mounted on a flat scow which hoists the buckets up over the steel forms. The footings have required from 300 to 800 yards of concrete each, the caps about 175 yards each and the shafts some 9 cubic yards per foot of height. This has meant that the taller columns, ranging up to 92 feet in height, have required up to 828 yards of concrete.

With the large number of marine craft of various types working on the project it has been possible to carry out the many different operations required for building the piers at several locations simultaneously. During the past season the MKD men have been driving the pilings needed for each cofferdam in from three to four days and pouring about 20 feet of column in 24 hours. Pouring of footings has been proceeding so well it is hoped they can all be finished by the time the marine operations close down for the winter.

Paul Brais and his assistant, Emeric Leonard, are in charge of the pier work, while Omer Bailey of McNamara Marine Limited is responsible for the operation of the floating equipment. Among the 89 men on the marine end of job late in October were such familiar names as Percy Pollard, Mike Keogh, Capt. Garfield Young, Capt. Cliff Pennington, Garth Wasson, H. Hawks, J. Simard, J. E. Dufour, J. Provencher, A. Romkey and J. L. Cowan.

One of the most important phases of the McNamara-Key-Deschamps operation is the casting of the huge pre-stressed concrete beams which is done in a yard on Nun's Island near the bridge. This casting yard also has a concrete batching plant and is near the mechanical shops, yard and office of the MKD joint venture group. Eight casting beds 180 feet long and 27 inches wide, and four huge sets of steel forms have been used for this work.

Giant Beams Used

The great majority of the 322 pre-stressed concrete beams required for the project are 176 feet long and 10 feet high. They are "T" shaped, with the top 6 feet wide, the centre portion, or web, 7 inches wide, and the bottom 2 feet, 3 inches wide. There are also four diaphragms on each beam. The beams require about 87 cubic yards of 5,000-pound concrete and weigh 180 tons each.

There are 24 cables in each beam, with each cable consisting of 12 steel wires .276 inches in diameter. The cables arc downward from the ends of the beam and the concrete is poured around them. After the concrete

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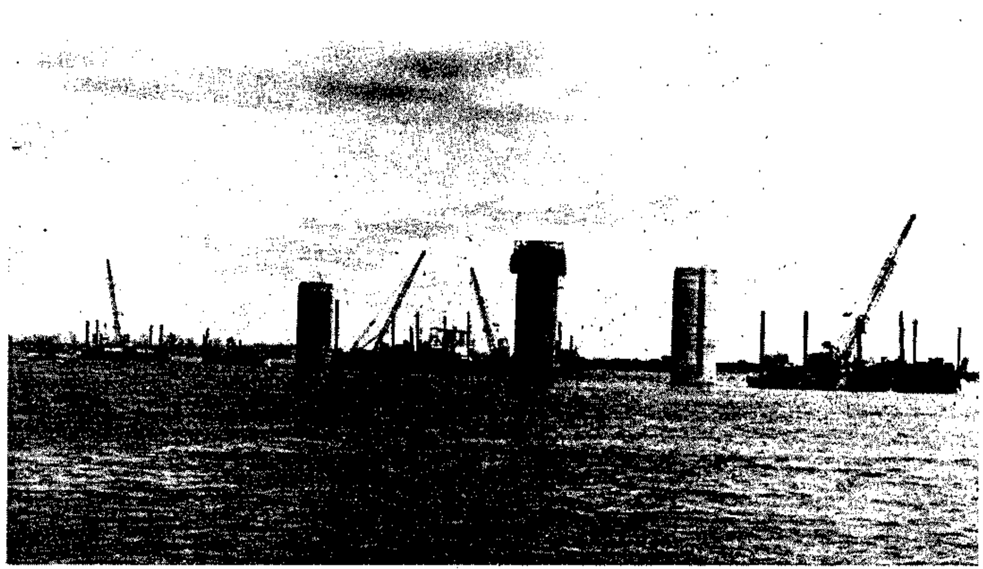

Champlain Bridge

(Continued from Page 7)

hardens the cables are then tightened, or stressed.

To manufacture these beams the steel forms for the bottom of each one are placed on the wooden platform of the casting bed, with some sections resting on concrete blocks to facilitate handling after they are poured. The 24 cables are carefully fitted in their downward arc pattern in special jigs at each end and the skeleton is brought into place over the casting bed by chain blocks. A pre-fabricated concrete jig form placed behind the form ends receives the cables in anchoring cones for tensioning.

The form is closed and the concrete poured in from buckets hoisted by a 1½-ton gantry crane positioned in the casting yard so it can reach four forms on the beds without being moved. It takes four hours to pour each beam, and as many as 14 beams have been fabricated in a six-day week.

When the concrete has set, the beams are moved from the casting yard to the stock yard by large self-propelled straddle trucks on rails. The wheels of these straddle trucks can be moved at right angles to allow them to run sideways as well as forward.

The stressing of the beams is carried out in three stages. Under summer weather conditions 14 of the 24 cables are stressed two days after pouring, six more are stressed 10 days after pouring, and the final four are stressed after the beams have been placed on the bridge piers and the deck slab poured. This final stressing can be carried out any time after 28 days have elapsed since the beam was poured.

Freyssinet Method Used

The Freyssinet method of stressing is being used by McNamara-Key-Deschamps and in this process hydraulic jacks are used on each end of the cables to apply a pressure of 180,000 pounds per square inch. Losses which occur result in a final permanent tension of 122,000 pounds per square inch. It takes about 20 minutes to apply the stress with the hydraulic jacks.

To maintain this pressure in the completed beams special concrete plugs which look something like blunt ice cream cones with 12 grooves and ridges around the outside circumference are used. Each of the 12 wires making up the cable fit in one of these grooves and while the hydraulic jack is applying tension outward on the wires it is also forcing this plug into the hole in the end of the beam where the cable comes out. This pressure on the plug jams the wires so tightly between the plug and the walls of the duct that the tremendous tension on the wires is maintained. A grout of two parts sand and one part cement and aluminum is then injected into the duct through a hole in the centre of the plug. This grout solidifies to fuse the wires, grout and the beam itself into one solid mass.

The special pre-stressing equipment was obtained from the Freyssinet company in collaboration with the Society Technique pour l'Utilization des Precontraintes of Paris, France. It was this latter company working in collaboration with Enterprise Fougerolle (the parent company of Key Construction) and Warycka & Skortecky, consulting engineers for McNamara-Key-Deschamps, which worked out the design for the pre-stressed beams, concrete piers and special equipment for Sections 5 and 7A of the Champlain Bridge. The bridge is being built for the National Harbours Board, and H. H. L. Pratley of Montreal is consulting engineer for this body. The consulting engineering firm of Lalonde & Valois are inspectors.

After the beams have gone through two of the three stages of stressing in the fabrication yard and the stock yard they are taken out on the bridge for placing. They are transported by a self-propelled low-bed truck on rails which delivers them to the mammoth steel launching bridge for placing in position on the pier caps. This launching bridge advances on rails of the same size used by the low-bed and straddle trucks. It is 350 feet long, has a lifting capacity of 250 tons, and is the largest of its type ever used on a Canadian bridge construction project.

The launching bridge stands over one span on which beams have already been laid and also extends out over the water to the pier cap which will receive the next beams. These are picked up by the launching bridge's monorails and carried out over the water to the top of the next pier cap. Since the bridge can move sideways on steel rails as well as forward, it can place the beams needed for the new span in their proper position on the pier caps, except for the side beams which are shifted into their final position.

When the last span that the launching bridge has placed reaches the stage of completion that the bridge can travel over it, it is moved ahead to launch the seven beams needed for the next span.

A large crew of McNamara-Key-Deschamps men is kept busy behind the launching bridge doing the jobs needed to finish off the deck. These include the insertion of the cables across the deck by which it is stressed transversely, pouring of the diaphragms between the beams, pouring of the deck slab, transverse stressing of the bridge and the final longitudinal stressing of the last four cables in the beams. The same type of cables and jacks are used in stressing the slab except that stress is applied from one end only.

Concrete pouring of the four diaphragms is carried out at the same time as the 8½-inch deck slab is poured.

In addition to those already mentioned, other supervisory men on the job this fall included Project Engineer Maurice Berthault, Raymond Pessayre, who was in charge of superstructure engineering; Graham Earle and Paul Dorval, who were in charge of beam and slab casting; Master Mechanic Rene Charron and Office Manager Jean-Louis Lefebvre.

Among the superintendents on the job were Gaston Dorion, Arthur Tessier, Bob Coltart, Louis-Phillipe Babin and Yvon Desmeules.

The MKD foremen included Paul Gionet, Raoul Bilodeau, Marcel Boyer, Louis Auger, Jean Darcel, Arsene Desjardin, Honore Desrosiers, Eulethere Dunn, Raymond Dusseault, Arthur Duval, Roger Pelchat, Maurice Fournier, Phillipe Fournier, Emile Jasmin, Marcel Lavoie, Belisle Magloire, Romeo Montpetit, Roland Pelchat, Marcel Perron, Pierre Rolland, Aurele Rozon, Paul Savary, Raymond Theoret and Marcel Vertefeuille.

Executive Appointments Announced

Bill White

Robert Grant

Joseph LaBine

Mr. Paul McNamara, on behalf of the Board of Directors of the McNamara Holding Corporation, is pleased to announce the appointment of Mr. Bill White as Vice-President of Federal Equipment of Canada Limited, and Mr. Robert Grant, General Manager of Harbour Brick Company Limited.

The Board is also pleased to announce the election of Mr. Joseph S. LaBine to the Board of Directors of the Northgate Hotel Limited, and his appointment as Treasurer of the Company.