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Overland Conveyor System at Thunder Bay Terminals

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Summary

The overland conveyor system at Thunder Bay Terminals transports lignite from the trans-shipping terminal, under a river and parkland area, before it surfaces to cross the wet low-lands to the thermal power generating station, a distance of 2 km. This paper describes the design concepts and equipment of the single flight conveyor and the slewing stacker that was commissioned in 1981 to handle 1.4 million tonnes annually.

1. Background

Thunder Bay Terminals Ltd., located on McKellar Island at Thunder Bay, Ontario, is a bulk materials terminal receiving coal by unit trains from western Canada for stockpiling and trans-shipment by self-unloading ships to markets in eastern Canada. The initial phase of the system commenced operation in 1978 with an annual capacity of $2.7 \cdot 10^6$ tonnes.

The 9,000 tonnes unit trains discharge their load in the rotary car dumper station at the rate of 3,630 t/h. From here the material is conveyed by an inclined outhaul conveyor to the 1,950 mm (78") wide x 1,071 m long yard conveyor where a travelling stacker with a 45.7 m boom discharges the coal onto the 19.8 m high stockpiles. The coal that is destined for loading into the ships is reclaimed by a bucket wheel reclaimer with a 45.7 m boom at the rate of 5,440 t/h and is then conveyed by the common yard conveyor to the surge silo and from there to the shiploader.

Stephens-Adamson supplied the majority of the bulk material handling systems comprising belt conveyors, travelling stacker, bucket wheel reclaimer, and belt feeders.

In addition to the thermal coal, Thunder Bay Terminals also receives $1.4 \cdot 10^6$ tonnes of lignite annually by unit train which is stockpiled in one area of the storage yard for further transport by an overland conveyor to the new Ontario Hydro thermal generating station located on the adjacent Mission Island. This system comprising the overland conveyor and slewing stacker was also supplied by Stephens-Adamson and commissioned in the spring of 1981.

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2. Overland Conveyor

Lignite is reclaimed from the main stockpile on the McKellar Island site by an in-ground receiving hopper, 3.96 m x 5.18 m. An electro-mechanical variable rate vibrating feeder with 3,048 mm wide x 3,657 m long (120" x 12'—0) trough at a 12° decline, feeds the lignite onto the tail end of the overland conveyor at the controlled rate up to the design capacity of 1,680 t/h for the system. The average capacity for normal operation is approximately 910 t/h.

A load cell continuous belt weigh scale with accuracy of ± 0.25 % is located in front of the conveyor loading section giving the rate of flow and the totals.

The overland conveyor extends from the loading station on McKellar Island in a concrete tunnel a distance of 218 m to the river, then 184 m through a steel tunnel under the river, into another section of concrete tunnel for 647 m under designated parkland before it surfaces above ground for the remaining 945 m. The total length of the single flight conveyor is 1,994 m. Profile of the conveyor starting from the tail end drops 7.87 m to a point under the river, then lifts 16.10 m to the long horizontal section above ground and then lifts another 16.72 m at the head end for discharge onto the Slewing Stacker. All curve radii are 1,067 m (Fig. 1).

The 1,200 mm (48") wide belt conveyor operates at a speed of 3.8 m/s. Two drive units, 447 kW (600 HP) primary and 150 kW (200 HP) secondary, are located in a dust-free drive house near the head end. Scoop type fluid couplings with electronic scoop insertion controls and actuators permit continuous running of the squirrel cage induction motors and provide accurate acceleration rate control of the belt conveyor during the starting sequence. This control is adjustable up to 64 seconds to ensure a soft-start without over stressing the belt and inducing harmful shock waves to the system. In addition, two 30 kW (40 HP) creep drives, directly connected by

Fig. 1: View of the 2 km long overland belt conveyor extending from the trans-shipping terminal to the lignite stockpiles at the thermal power generating station

over-running clutches to the high speed shafts of the parallel shaft reducers, operate the empty conveyor at 0.50 m/s as required for belt inspection and continuous cold weather operation (Fig. 2).

A low speed disc brake assembly mounted on the extended shaft of the 1,015 mm diameter brake terminal, is located in a position following the main drive terminals. The electro-hydraulic system consists of two Hagglund model BSFG-408 caliper brake units operating on a 1,520 mm diameter disc to produce the required brake torque of 41 kNm. The belt speed versus time relationship is carefully monitored in the sebra servo control system to accurately produce the required rate of deceleration in the allowed 10 seconds time period under any load condition without over stressing any of the components.

Conveyor idlers are Stephens-Adamson's model 3206 factory sealed ball bearing units with 150 mm dia. rolls on fixed frames. The 35° troughed carriers have graduated spacings up to 2.23 m centres depending on the belt tensions along the length. The returns are two roll 15° troughed rubber disc units that are spaced at 4.57 m centres (Fig. 3).

The conveyor belting is Goodyear's Flexsteel 1000 steelcord type with 7 mm x 6 mm low temperature oil resistant rubber covers. An electronic rip detection system, Goodyear's Sensor Guard model 79, protects the belt from possible extensive damage due to slitting. Sensors made up of relatively small wire loops near one edge of the belt and circuit wires extending across the width of the belt are vulcanized into the bottom cover at 15 m centres. Electronic detectors are mounted at potential damaging locations (e.g., loading sections) to monitor the electro-magnetic field generated in

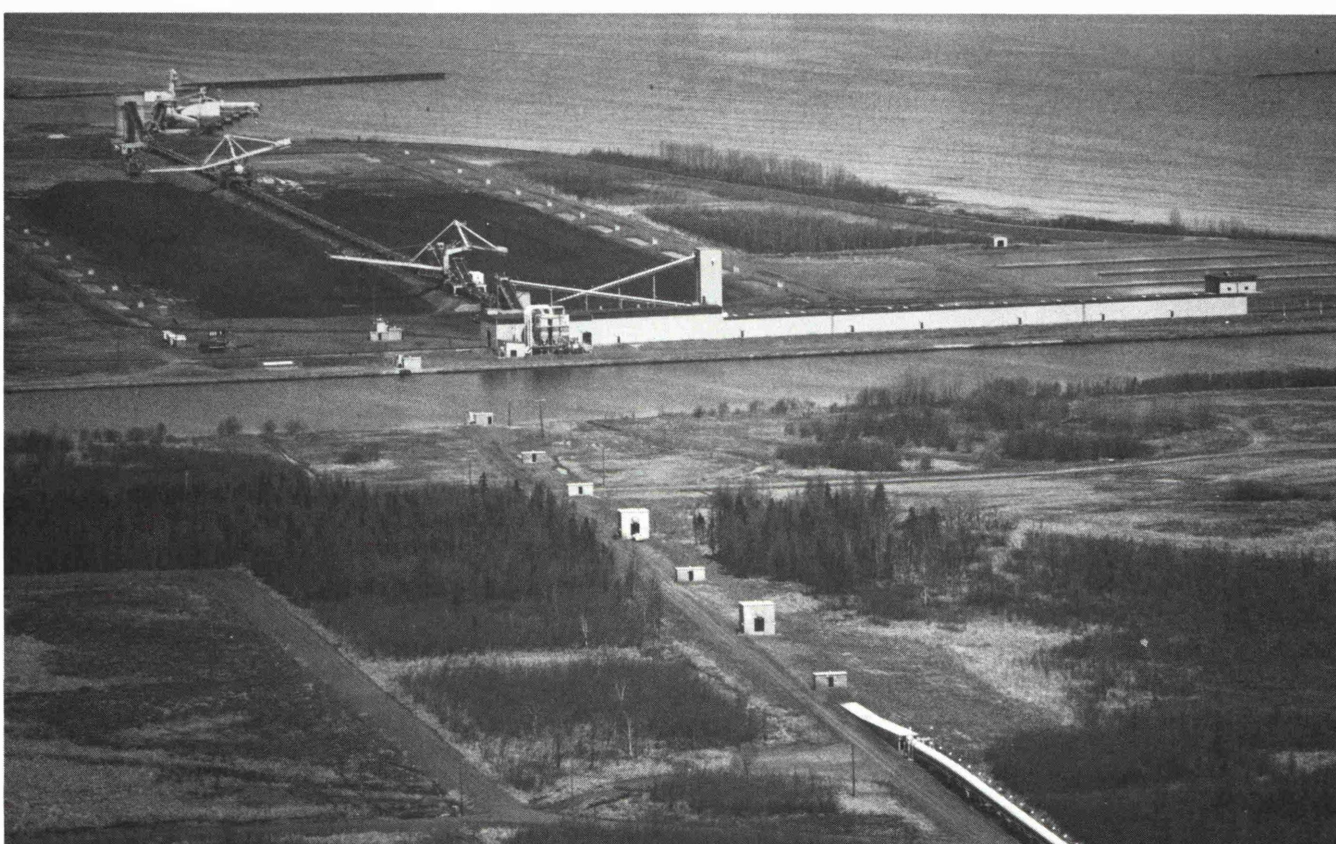

Fig. 2: Trans-shipping terminal and the tail end of the overland conveyor that extends in concrete and steel tunnels from the in-ground receiving hopper under the river and designated parkland for a distance of 1 km

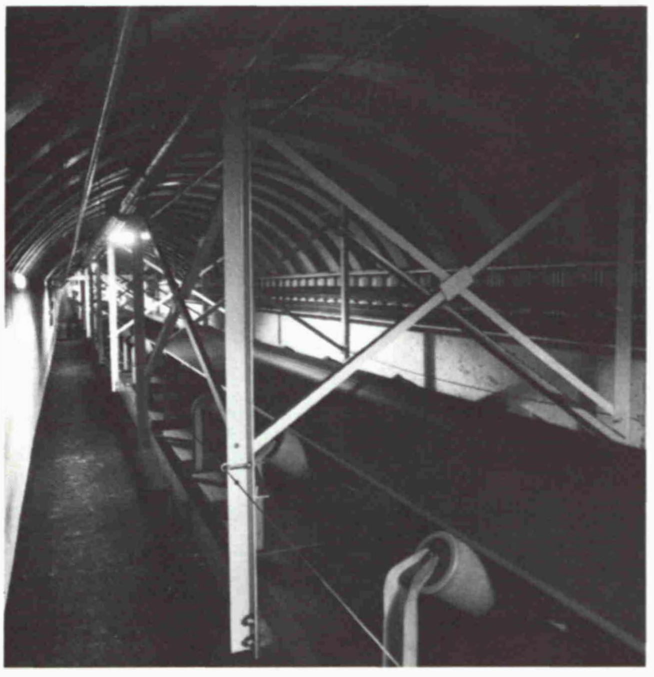

Fig. 3: Section of the 1,200 mm wide conveyor in the tunnel under the river

each sensor loop as the belt passes over the detector providing the wire loop is continuous. Should a wire fail the resulting lack of an induced current will be observed by the detector and the signal causes an emergency shut down of the conveyor. A loop skip switch is provided to permit 0, 1 or 2 sequential loops to be missed before the stop signal is given by the detector. This allows for possible random wire failure other than a belt rip.

The conveyor stringer frames for the main length, except for the structural steel trusses at the head end, are modular cold formed channels 203 mm depth made of # 12 gauge galvanized steel. The sections outside of the tunnels are fitted with coloured corrugated weather covers with removable panels on one side for access to the conveyor idlers.

Prestressed concrete double tees, each 812 mm depth by 18.24 m long with a 2.74 m deck, are the supporting beams for the 823 m section of the conveyor that extends horizontally from the end of the concrete tunnel over the wet low lands. The conveyor frames are supported above the deck level by structural steel legs at 3.66 m centres. A walkway, 890 mm wide, extends along one side of the conveyor on the concrete deck. Structural piles with concrete caps provide the base support for the tees. One end of each tee is fixed while the other end is free for sliding on bearing pads (Fig. 4).

Fig. 4: Section of the conveyor mounted on prestress concrete double tee slabs

3. Stacker

The overland conveyor discharges onto a slewing/luffing Stacker with a 40 m boom that automatically builds 18.3 m high surge piles in a 240° arc on the property of the power generating station. This stacker is mounted on top of an 8.53 m dia. concrete base pedestal. Many of the mechanical components including the high capacity cross roller bearing slewing ring approximately 5.25 m diameter and the 15 kW (20 HP) DC shunt wound variable speed slewing drive are interchangeable with the equipment used on the other machines at Thunder Bay Terminals. The stacker is a counterbalanced design with a straight through boom and jib mast. Boom luffing ranges from —6° to + 14° angles of inclination with a hydraulic cylinder providing the motion (Fig. 5).

From these surge piles, the lignite is reclaimed by three in-ground hoppers and is conveyed directly to the bunkers for feed to the boilers in the generating station.

4. Design Criteria

All the equipment at Thunder Bay Terminals is designed to provide trouble-free operations through the wide variations in climatic conditions with temperatures ranging from a minimum of —40°C in winter to a maximum of +35°C in summer without any loss in the system capacities. Special attention in the engineering stage was given to the design of the structures and the selection of the equipment. In addition, protection of the environment is of major importance to the area around the site.

Fig. 5: View of the head end of the overland conveyor and the 40 m boom slewing stacker at the thermal power generating station