HEAD, WRIGHTSON & COMPANY LIMITED,
TEESDALE IRON WORKS,
THORNABY-ON-TEES.

PRESS NOTICE RELEASE

OPENING OF THE FIRST ALUMINIUM ALLOY BASCULE BRIDGE IN SCOTLAND AT THE VICTORIA DOCK ABERDEEN

On Wednesday, 30th. September, 1953, at 11 a.m., Her Majesty the Queen Mother officially opened the New Bridges at the entrance to the Victoria Dock, Aberdeen.

The new bridges consist of a Bascule Bridge, employing aluminium alloys in the moving spans, and a steel Removable Bridge. Although the bridges are of no great size, they represent a pioneering achievement. The bascule bridge of unorthodox design is of an entirely new type and is the first bascule bridge in Scotland to employ aluminium alloys in its construction. Novel methods of fabrication, of operation and counterbalancing are used in the bascule bridge, which is the subject of a patent by the Aberdeen Harbour Engineer, Mr. John Anderson, M.I.C.E., M.I.Struct.E., M. Inst. T.

The bridges form a modern traffic link between the north and south sides of the Victoria Dock. They serve the nearby deep water berth and will greatly facilitate the rapid turn-round of shipping and relieve road congestion elsewhere. The opening ceremony marks the completion of the first stage in the Aberdeen Harbour Commissioners' long term plans for the development of the port. To date, nearly £1,000,000 has been spent on various improvement schemes.

The Harbour Engineer had a number of problems to face before deciding the types of the bridges to be adopted. For example; The north lock is permanently sealed off at its seaward end with a concrete dam. This was rendered necessary due to the poor condition of the lock dock gates. However, the north lock is used by vessels being fitted with engines and boilers at the nearby sheer poles. In order to extend this service to large vessels requiring the full length of the lockway - the new bridge spanning the 57'0" north lock has been made removable. A simple steel deck span was chosen for the north lock, which may be removed from its concrete abutments by lifting on a buoyancy pontoon. The pontoon is built up from 14 "beetles" which were previously used for the support of the floating roadway of the D-Day"Mulberry Harbour."

Further problems arose when dealing with the type of movable bridge for the south entrance to the Victoria Dock. It is the principal commercial dock and communicates with the Upper Dock. Thus, the construction of a new movable bridge should not interfere with the passage of shipping through the dock from the start to finish of operations. The limited space available at the site, dictated that the bridge should occupy the minimum ground space. Concentrations of weights should be reduced to a minimum so that the foundation costs could be kept low. The bridge must be speedy in operation, driven by simple machinery with low operating costs. It should present a pleasing appearance if possible and should be immune from damage by shipping when in the fully open position. In order to meet all these requirements, Mr. John Anderson developed his new type of double leaf heel trunnion bridge employing aluminium alloys in the moving spans. Each moving leaf rotates about a trunnion at the landward end, the trunnion being set at 100-ft. centres.

The contract for the design, construction and erection of the new bridges was entrusted to the Head Wrightson organisation whose aluminium subsidiary company have had a wide experience in the design and fabrication of the heavier type aluminium alloy structures. It may be recalled that in 1948, Head, Wrightson & Co. Ltd. built the first aluminium alloy bascule bridge in the world at the entrance to the Hendon Docks, Sunderland.

DESCRIPTION OF BASCULE BRIDGE

Structural Details.

The bridge is of double leaf trunnion type, designed to carry road and rail traffic. A 22'0" wide roadway is provided between the trusses, whilst outside the trusses walkways 5'0" wide are provided to cope with the peak hour pedestrian traffic. The total weight of aluminium alloy used in the movable spans is 48 tons. The flooring system employed is that of cross girders carrying troughs, the wells of the troughs being unfilled. To the tops of the troughs are bolted Rhodesian Teak Underlay Timbers, some 3" thick tongued and grooved and laid diagonally. The rails of standard gauge are set to one side of the bridge and are bolted through the teak underlay to the tops of the troughs.

Douglas Fir Dowelled Paving Blocks 5¼" deep form the road surfacing and they are coach screwed to the teak underlay. In the two leaves there are approximately 25½ tons of timber. The principal dimensions of the bridge are:

Clear opening to Dock:- 70'0"
Span between centre line of trunnions:- 100'0"
Length of moving span:- 69'11½"
Approximate overall length of Bridge:- 198'0"
Clear height under machinery portal:- 16'0"
Angle of opening of Bridge:- 87°
Overall width of Bridge:- 37'1"
Centres of trusses of moving span:- 25'0"

The maximum loads for which the bridge is designed are those specified in the B.S.S.153, for the highway load 15 Units plus 50% impact, whilst the rail loads consist of an "Austerity" type shunting locomotive of T.48 3.c 3.q 0. total weight, followed by a train of 16-tons axle loads, with 20% impact allowance. The footways are rated at 84lbs./sq.ft. The bridge has been designed to take two-way road traffic or one line of road vehicles plus one line of rail vehicles.

The plates and extruded sections for the bridge were supplied by two of the leading producers of aluminium alloys in the United Kingdom,- British Aluminium Co. Limited, with works in many parts of Scotland and Northern England and Northern Aluminium Co. Ltd. of Banbury, Rogerstone and Birmingham. Two types of aluminium alloys were used, namely the duralumin type alloys for the flooring system and the aluminium-magnesium-silicon alloys for the main trusses and the main operating machinery portal. These heat treated alloys are designated in the B.S.S.1470 Series as follows, and the mechanical properties are also listed.

ALLOY	TYPE	0.1% PROOF STRESS	U.T.S.	% ELONGATION (2" g.l.)
HE10WP)	Al-Mg-Si	15 tons/sq.in.	18/tons/sq.in.	10
HP10WP)	Al-Mg-Si	14 " "	18 " "	8
HE15W)	Duralumin	15 " "	25 " "	15
HPC15W)	Type	20 " "	26 " "	8

To ensure maximum protection against the acid bearing teak underlay, the whole of the flooring system has been metal sprayed with 99.5% pure aluminium. Throughout the fabrication and erection of the bridge, precautions have been taken to insulate all dissimilar metals to prevent any possible electrolytic action.

An outstanding advance in the technique of aluminium fabrication, has been the successful cold driving of large size aluminium alloy rivets up to ⅞" nominal diameter both in the shops and at site. The rivets have special heads to facilitate their driving. Rivet test pieces driven on the site were subsequently tested at the University of Aberdeen with highly satisfactory results.

METHOD OF COUNTERBALANCE

The dead weight of each moving leaf is counterbalanced by the use of a fixed amount of counterweight contained in a welded steel box, hanging from a $1\frac{3}{4}$" diameter locked coil rope and passing over a special cam, bolted to the main truss of the moving leaf. The cam provides the necessary variation in "lever arm" to the counterbalance pull, which is required as the moving leaf is being opened or closed. There are two counterbalance weights to each leaf, one to each side of the truss and the counterbalance weights run into suitable pits provided in the rear of the mass concrete foundation as the moving leaf opens. The shore steel fixed structure has an "A" frame at its rear which carries a 7'6" diameter pulley, over which passes the counterbalance weight rope.

Each balance box weighs approximately 24-tons, the weight being made up of cast iron blocks suitably bedded in lead.

OPERATING MACHINERY.

All the operating machinery is neatly housed within an aluminium alloy portal girder some 5'0" square, forming part of the moving leaf. The machinery, driving the bridge up and down,,operates on the twin fluidrive system. Two electric motors ($13\frac{1}{3}$ h.p. and 10.h.p.) running at different speeds, drive into a differential via fluid couplings and this permits the slower motor to be reversed when a "creeping" speed is required. This twin fluidrive system is a recent development and enables the bridge to operate at a very fast speed or a "creeping" speed, in conjunction with electric control equipment. When the bridge is fully open, this portal girder forms a further barrier to any road traffic which may have over-run the outer gates. The steel pin type rack quadrant is embodied in the shore fixed structure and forms part of the "operating machinery". The rack comprising 78 pins positioned to a close tolerance, meshes with a pinion extending from the moving leaf.

THE STEEL FIXED STRUCTURE ON THE SHORE.

This fixed structure on the shore performs the dual function of carrying the counterbalance weight pulley and also helps to transit a portion of the live load on the moving bridge well away from the quay face. The live load is transferred from the moving span via "stop arms" on the trusses, which engage with a stop girder of the shore fixed structure. A pit is provided in the foundations for the truss stop arm when the bridge is fully open.

CONTROL MECHANISM.

Electrical control equipment is installed so that the bridge is controlled by a Master Drum Controller, operating relays, and beyond this, everything is automatic. The bridge operator may control the bridge from the Control House on the South Approach to the Movable Bridge or from a remote control panel on the other side of the dock entrance. Luminous indicators are provided which show all positions of the bridge and navigation lights are fitted for both road and shipping traffic. Interlocks are provided to render the electrical operation fool-proof.

CENTRE LOCK MACHINERY.

When in the down position, the leaves are locked to each other by two robust steel bolts which ensure that the leaves deflect together as a load passes over the bridge. The bolts are driven by a motor through gears and are controlled from the Master Controller through a limit switch. The longitudinal camber in the movable bridge is $4\frac{1}{2}$" between trunnions.

SAFETY AND EMERGENCY EQUIPMENT.

In the event of an electrical power supply failure, hand operation of the bridge may be carried out. Further if one motor goes out of commission it is possible to operate the bridge on one motor. Protective fencing is provided to prevent any entry to the various pits etc, whilst flashing light and Klaxon horns give warning signals.

ERECTION OF THE BASCULE BRIDGE.

The Shore Steel fixed structure was positioned first and subsequently the moving spans were mated at site. The steel and aluminium portions were made in different parts of the Head Wrightson works and the accuracy of the workmanship may be gleaned when it is noted that the moving spans were successfully erected at site in 90 days. A trial erection of the aluminium alloy moving spans at Thornaby, enabled the flooring contractors to obtain actual dimensions of the spans and prefabricated the wood decking.

The lightness of the aluminium, meant that large pieces could be shipped direct to site and heavy cranage was not required. A Coaster S.S. "Ardgantock" took the whole of the moving spans and two steel quadrants direct to Aberdeen from Head Wrightson's Wharf.