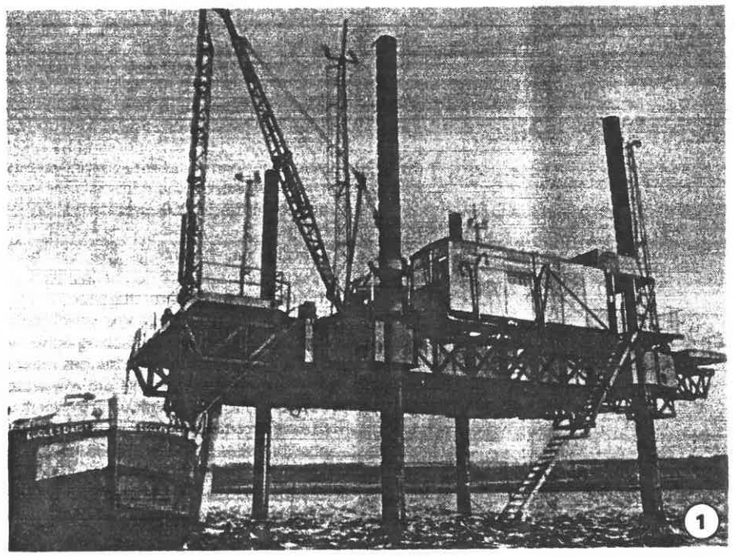
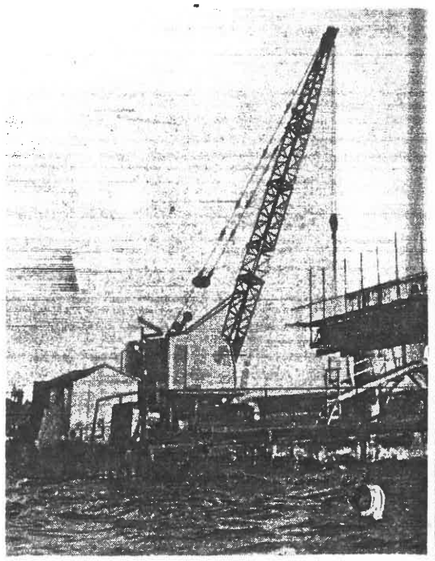
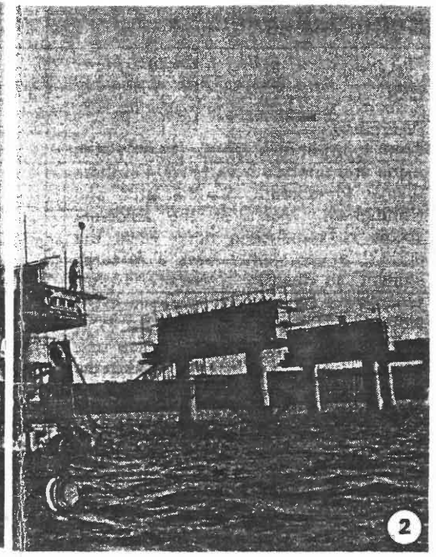
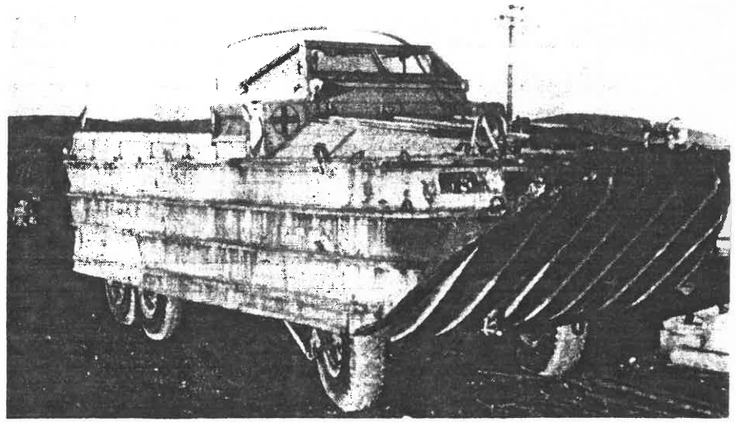
Causeway wades through Cromarty wetlands









Proof of the amphibious nature of the work on Cromarty bridge is evidenced by the two US-built ex-army DUKWs stationed at each end of the job. Both Fairclough (owner of the one above) and piling contractor Johnson find them useful for ferry work at low-water spring tides. Incredibly, Johnson's was bought from a Borders dealer two years ago with only 1,400 miles on the clock. It is surprising that these versatile vehicles, which never failed to excite the imagination of every boy with warlike intentions, did not all go to the scrap heap years ago.

Captain Andrew Postance of the Army's Ordnance depot in Nottingham answered the question many must have asked since the acronymous DUKWs came into service in 1943: the name comes from Detroit United Kaiser Works.

Supplied with a massive General Motors engine driving the double back axle and, independently, the between-hull screw, DUKWs can be a fitter's nightmare. Captain Postance told *NCE* he has a user's manual and would be glad to help the contractors.

Their big disadvantage is their weight; they can make heavy going of a mudflat if they break the crust. Also it can be difficult to get sufficient purchase at the back when hitting the transition between soft ground and a steep side bank. It is not possible, either, to water ski behind them.

(1) The piling subcontractor is using a jack-up barge as a workbase. (2) Bridge supports are simple and identical. (3) On average the gantry moves forward once every 10 days.

Blizzards and bitter weather may have brought parts of northern Scotland to its knees of late, but the hiatus has not seriously affected progress on the A9 Cromarty Firth bridge, which should be open to traffic by this time next year.

First vehicle over will celebrate a considerable achievement by contractor Fairclough Civil Engineering — not because this low-level bridge is a sophisticated technological marvel but because it is being built over 1.5km of estuarial wetland.

The 1,462m bridge will connect the Black Isle with the north shore of the Cromarty Firth. It is the most northerly extension of the Scottish Development Department's 220km A9 trunk road reconstruction programme which starts at Perth — 'the gateway to the Highlands' — and eventually by-passes Inverness with a spur to the Kessock bridge.

Meanwhile at Cromarty bridge, the £4.45M construction is being carried out along production-line methods that require a steady working rhythm to meet a 10-day cycle of 2-span deck beam emplacement. Working out from the south, and ever further from base, 67 piers have to be established in the Firth at 21.5m centres. Each pier comprises two insitu concrete columns 5.34m apart, founded on precast Herkules piles driven into a silty clay bed.

Installing the 400mm nominal dia, H1300 bayonet-joined hexagonal piles — 4 or 5 to each column base — is the Herkules piling division of A Johnson Construction, Glasgow, working under a £1.3M subcontract. Johnson invested in a Dutch Flexifloat four-leg jack-up barge for the contract, in order to ensure a stable base from which to drive the vertical and raking piles at all states of the tide. Foot plates at the bottom of the legs were enlarged to eliminate the possibility of settlement into the mudflat and Johnson is extremely pleased with the performance of the barge as a working platform, and also with the fact that piles can be driven off both ends.

Pre-contract borehole data led consulting engineer Crouch & Hogg to believe that mid-stream piles would have to be driven 75m to obtain the required skin friction. But subsequent 400t insitu pile tests along the line of the bridge gave better results, allowing installed friction lengths to be reduced by 10m to 65m.

Bridge columns and column bases are cast separately within 3m-dia bell-ended caisson 'cans' surrounding a group of piles. Fairclough is using a submersible sand pump, lowered from a Uniflote working barge, to remove about a metre of silt and make way for a tremie concrete plug to seal the caisson. Working in the dry, concrete is broken away from the extruding piles at cut-off level before casting a 3m-dia reinforced concrete pile cap.

Steel column shuttering split lengthwise is used to raise the columns full height above the water — about 3m at high tide.

A follow-up crew, working from another Uniflote barge, shutter and concrete the capping beams after the columns are stripped and the caisson removed. Low tide leaves craft marooned so the concreting barge is restocked by towing it back at high water to Fairclough's south end base.

Prestressed concrete deck beams are manufactured in Fairclough's Accrington precast factory and cured for three months before delivery by road. They are installed from a double-double Bailey gantry that is launched over the water to span across two piers at a time. Beams are run out on tyred bogies over completed bridge deck sections and fed onto side-hung tackle blocks which run on rails for the length of the gantry.

The gantry itself can be traversed on rails across the width of the bridge, enabling each beam to be lowered directly into place on its bearing. Ten beams are placed in each double span, and the cycle calls for the gantry to be advanced northwards every ten days.

It is a complex cycle of work that would seem to be under constant threat of breakdowns, shortages, bad weather and inconvenient tides. But according to Fairclough agent John Timmins the job has got far enough now — most major operations but blacktopping are under way — to prove that basic concepts adopted at the tender stage have worked out in practice.

Articulation of the bridge is on a three-span system with laminated rubber bearings occuring every third pier. Intermediate piers carry floating piston bearings and absorb expansion forces from the beams through stainless steel dowels.

The bridge is built to a curve of nearly 4,000m radius, and a 2.5% super-elevation.

Deck beams are straight but the curvature is expressed along the outer edge of the insitu concrete footpath cantilevers which are cast in the wake of the main deck concreting.

Although the curve and the cross fall can only add to construction problems, it is becoming apparent — as the bridge snakes further out into the Firth — that the sweep adds sufficient drama to transform the bridge beyond a merely workaday solution to the problem of throwing a road across a mudflat.

Not so long ago, setting out and maintaining the line of a curved and lengthy marine structure would have required almost constant attendance from a team of hardy surveyors. But, as Crouch & Hogg resident engineer Ken Wilson points out, the arrival of surveying instruments embodying electronic wizardry has changed all that. Both contractor and engineer use Wild Distomats to keep the bridge on course, working from a triangulated grid of six survey stations on shore and two set on piles in the Firth.

Sam Wade