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Inland and estuaral navigation safety system for small craft based on the SGNI/CEVNI standards

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If you have seen photographs or have visited Swansea Marina and the associated Tawe Barrage in South Wales, you may have observed the buoys and booms landward of this. You would then have noticed a signing system giving direction to yachtsmen, advising of the change of course required to avoid the dangers ahead.

This signing system was developed after two fatal accidents had occured at the same weir on the River Trent, in Nottinghamshire, England.

In 1975, a night accident claimed the lives of 10 soldiers when their craft was driven over Cromwell weir. Power failure had extinguished the adjacent lock lights and this was believed to have been the primary cause. Following this accident, standby generators were installed at the lock, in the event of any future power failure.

Two further deaths occurred at the same weir, in June, 1981, when a hired pleasure craft with 4 people on board went over. Two children were rescued from the boil of the weir by helicopter, and two adults drowned.

It was a fine day and the river was only 0.5m above normal, which was considered to be acceptable for this type of craft. The boat was heading downstream to Cromwell Lock, where the lock-keeper had been signalled of an approaching boat by the upstream lock-keeper. The journey should have taken approximately 45 minutes. After 1 hour, there was

no sign of the craft. The lock-keeper became concerned and went into his elevated control cabin, only to see the craft already over the weir.

The lOOm long weir at Cromwell (Figure l), is curved in plan and has a fall of 3m. The crest of the weir is sharp with a steep apron, ending in a submerged toe wall. Objects passing over the crest are generally retained in the turbulance, giving rise to the local name of the weir, Witches Cauldron.

Obviously something was drastically wrong with the way in which craft were directed on the approach to the lock, even though the Police claimed the weir was well signed.

An immediate investigation was undertaken using our own small motor boat, at this and other similar weirs on the River Trent. The object of this exercise was to simulate the perspective of all such hazards by a similar craft.

Inquest - 1981 Accident

The Coroner returned his verdict of accidental death on the basis of the evidence given by the survivors, a Report from the Coastguards, the view of the Royal Society for the Prevention of Accidents (ROSPA) commissioned by the Local Authority, and by members of the general public. This resulted in the Coroner making four recommendations

1. Better signing at the approach to the lock.

2. That British Waterways and the Land Drainage Authority agree on the installation of booms above weirs.

3. Voice communication to be established between locks in order that craft could be passed safely between them.

4. Emergency Procedures i.e., summoning Police, Fire Service, Ambulance, etc., be improved, together with means to provide assistance.

It was revealed during the inquest that contrary to regulations covering the conditions of Hire Craft, there was a boy alone at the helm of

the boat who said he could not see anything which indicated to him there was a weir ahead.

Results of British Waterways Investigations revealed that due to the construction of the weir at Cromwell, under certain conditions, there did not appear to be any visible break in the surface of the river at the position of the weir which could be seen clearly from a small craft. Furthermore, many of the signs on the river were misleading either by their positioning, or the fact that they were not prominent enough and had insufficient directional arrows (Figure 2). There was also evidence that British Waterways presumed that those using the river would be aware of the local dangers.

A report was presented to the Board and accepted.

Installation of Features Recommended in the Report

Signing

The signing improvements followed ROSPAs contention that 90% of the danger was removed if davanced warning was given of the hazard and its nature. Fortunately at this time draft copies of SIGNI (produced by the United Nations Economic Commission for Europe) "Signalisation des Voies de Navigation Intérieure" (SIGNI, 1982) were available and we decided to adopt the principles of this system, and adapt it to suit our purposes.

The Department of Transport's Traffic Signing Manual had previously been used to sign a junction of 3 navigations on the River Trent in a similar manner to class A trunk road (white on a green background), (Figure 3). During our investigations I spoke with a French family who were holidaying on a hire boat, and they commented on how clear these signs were.

The main modification we made was to produce composite signs with a white background on which, by way of broad black lines, (Figure 4), the change of course necessary was shown. Legends were added to give the distance from the hazard and other information. Plates roughly conforming to those contained in sections 5.1 in SIGNI for Mandatory signs, 5.3 for Restrictive signs and 5.4 for Information were added. The Weir 5.4.10 sign

was modified to show a craft about to go over the crest of a weir for easier recognition, (Figure 5). The 'No Entry' sign consisted of a square red background with a horizontal white bar.

Plate sizes of 600mm and 1000mm square were used with legends of up to 200mm. The largest sign was 3.5m x 4.5m with a height above bank of 2.5m.

Signs were installed on the banks nearest the channel using our General Development Order powers with surprisingly little objection. The only difficulties were when an angling club demanded £1,000 compensation for loss of 2 fishing stations, and the owner of a Café complained that a large sign would obscure all the sunlight from his building.

After trials, it was decided that at 4mph (6.4km/hr), the impact of the signs was lost if sited 400m and 800m from the hazard due to a travelling time of 4 minutes between signs. These distances were altered to 200m and 400m.

As further emphasis, the final marker on the bullnose was to be an arrow, as suggested by Plate 5.1.5. of SIGNI. This was not considered to have sufficient impact, and a chevron sign in the same colours was devised (Figure 6).

It was important that the distances of 200m and 400m for advanced signs were not measured from the hazard, but from the point by which the change of course was felt necessary to safely clear the hazard.

All signs were produced using reflective materials for night visibility, as few sites had power available.

Buoyage

This was introduced to back up the signs to both emphasise the lead-in, and to adopt IALA convention found internationally. The buoys provided the second line of defence and dominated the less obtrusive boom, thus being more environmentally acceptable. Because of difficulties of maintenance, vertical reflective panels of the appropriate colour were attached to the buoys for night navigation.

Protective Booms
These were found to have been installed on the Great Ouse between Bedford and Peterborough by the Anglian Water Authority. Proposals were put forward by British Waterways to Severn Trent Water Authority for a trial installation on the basis of the success of those on the Ouse, as these did not cause attenuation of flood flows.

The trial booms consisted of expanded polystyrene cylinders 1m in diameter and 3m long, clad in olive green fibreglass and threaded on to a continuous rope to freely rotate. Spacers incorporating hand-holds were clamped to the rope between the units. The booms were tested by a 150 h.p. (139 k.w.) tug, and a 15m steel narrowboat being driwen into them.

It was concluded that such an installation would primarily satisfy the Water Authority, and also be strong enough to restrain the majority of boats using the river. Only light craft, and those with a very low freeboard, would be unlikely to be arrested, due to the requirement of the Water Authority, that floating debris should be allowed to pass under the booms.

On New Years Day, 1982, the river was in full flood and the booms were seen in action, rotating freely with no debris being held back. As a result of the observations of this trial, the Water Authority gave Consent for the booms to be put into operation by British Waterways. If was decided that booms would be placed at only the most dangerous weirs.

Voice Communication
This was introduced by extending the Operational Private Mobile Radio (PMR) System. This was quickly superseded by the installation of VHF marine band radios, using Channel 74, for which an operating licence was obtained.

Lock Traffic Lights
These were renewed and repositioned to act as lead-in markers on both sides of the lock approaches and automatic emergency standby generators were installed at all the locks.

Emergency Equipment
This was provided in the form of rocket lines at all locks with an adjacent weir hazard. Telephones with direct connection to the Emergency Services were installed on all lock sides. Emergency Aid Training was undertaken through ROSPA for all operational staff, and our Emergency Procedures were amended so that the Police, Fire and Ambulance Services were designated as the first point of contact.

Subsequent Work
Since the original installation in 1982, not only have there been no other fatalities, but the use of the river, once regarded as dangerous, has become more popular with pleasure craft.

To add to the measures previously introduced, by 1988, an agreement for continuous manning of locks during peak daylight hours had been concluded. Up to then some mechanised locks were manned from 0600 hrs to 2200 hrs, and the non-mechanised were unmanned most weekends. This was a relic of commercial days, and not conducive to recreational use.

In 1984 numbered kilometre marker posts were installed along the length of the River Trent to aid the location of any emergency.

At the time of the accident, charts for the meandering river channel, and particularly the tidal section, were inadequate for the newer and larger cruisers then beginning to use the river.

A hydropraphic survey of 88km of the main river was undertaken during 1994, primarily to provide economies in maintenance dredging by identifying the channel. The kilometre markers were used to identify the distance along the river and all other salient features are shown i.e., bridges and structures. It is intended to produce charts for sale, with regular updates to these. Future plans include the marking of the channel in accordance with CEVNI, ongoing checks on the width and depth of the channel, and repositioning of markers as necessary, resulting from the survey updates.

The system has since been adopted for the River Severn, major navigations in the North East

of England, and at the Tawe Barrage, Swansea, following the Author's recommendations, which were commissioned by Swansea City Council.

In 1988, SIGNI was superseded by CEVNI, (Code European des voies de Navigation Interieure"), an extension and update of SIGNI.

Lessons to be Learned

Comprehensive uniformally recognised signing of hazards on navigations such as the River Trent can dramatically reduce accidents. Personally, I believe CEVNI, either as set out, or in composite form, should be adopted universally, (except for size variations for smaller navigations), on all Inland Waters, Channels not in open sea, and Marinas where craft manoeuvre at close quarters.

It is incumbent on those responsible for the operation or engineering of navigations not to presume the familiarity of boaters with the navigation, and to make an effort to understand the needs, particularly with regard to the safety of pleasure craft.

Figure 1: The weir at Cromwell (The Witches Cauldron).

Figure 2: One of the old style warning signs - Averham Weir.

Figure 3: Route signing at Trent Lock.

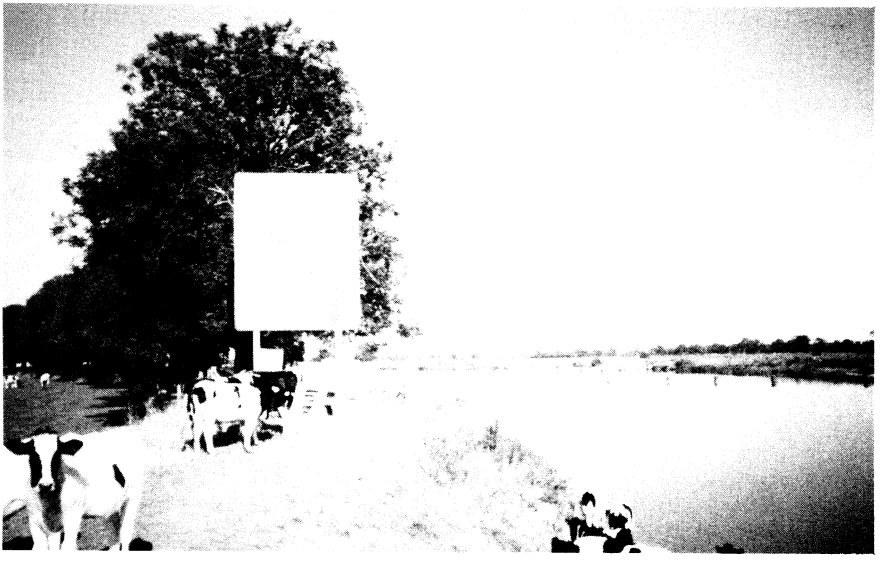

Figure 4: New warning sign at Cromwell Lock, also showing the buoys and boom in position on the right.

Figure 5: Sign at exit to Cromwell Lock heading upstream. Note modified pictogram for "Weir".

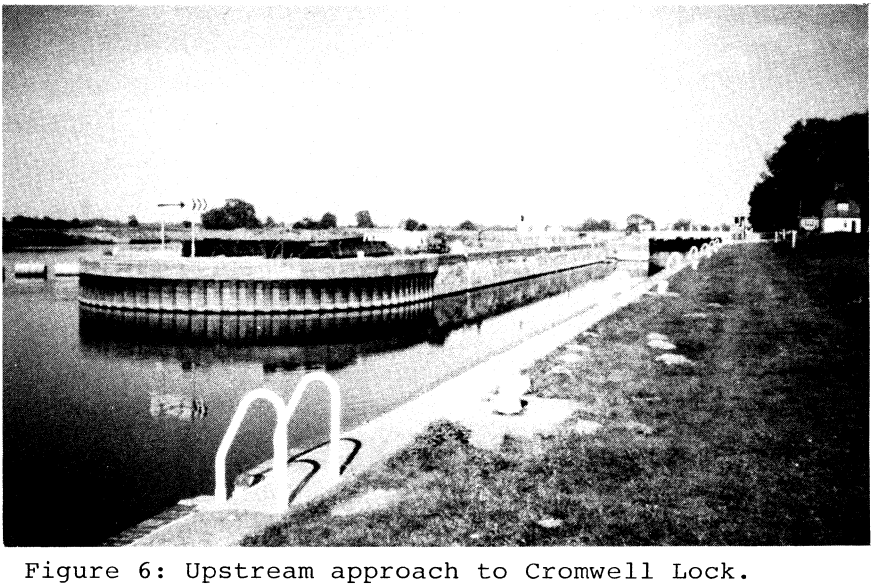

Figure 6: Upstream approach to Cromwell Lock. Note chevron on bullnose between weir and lock.