

Case study: refurbishment of Anchor Lock, Gargrave, Leeds & Liverpool Canal

The project

1. Anchor Lock is situated on the Leeds & Liverpool Canal to the west of the village of Gargrave, near Skipton in North Yorkshire: it falls within the responsibilities of BWB's North West Region. It was probably built in the late 1700s and has one of the highest usages on the busiest length of this canal at some 5,000 lockages per year. There is also a high non-boating interest due to the proximity of a popular tourist inn and the attractive surrounding countryside.

2. The lock was constructed of large, dressed stone masonry, blockwork. The original timber gates at each end had been replaced with steel gates in the 1960s but the local authority had registered the lock as a listed structure in 1990 and it was decided to rebuild using the original design and materials except where specific safety or engineering considerations forbade this.

3. During the inquiry a brief visit was made to the site on 20 April 1993. At this time the main lock works-reconstruction of the lock sides and manufacture, supply and fitting of new lock gates-had been completed and only the surrounding safety and cosmetic stonework jobs remained to be completed. Work had started in December 1992 after the required section of the canal including the lock chamber had been closed and drained by BWB. Lock closure requires the authority of Engineering and prior advice to users: it is unpopular with boaters and normally takes place during the slack winter season for that reason. It was decided that the canal would be closed to navigation on Monday 2 November 1992 but must be fully operational on Saturday 13 March 1993, and that the lock gates had to be fitted in time for lock rewatering on Monday 8 March.

The procedure

4. BWB's programme of routine inspections of its structures is covered in the body of Chapter 11 and its overall process in contracting out major works is summarized in Chapter 10. The way in which the relevant procedures were followed in the case of Anchor Lock refurbishment are described below.

5. It had been noted by waterway staff that there were incipient problems with the stability of the Anchor Lock lock walls, and a primary assessment was made by the North West Region Principal Engineer together with an Engineer from central Technical Services (ETS). In this assessment, dated 14 May 1991, the problems were described as:

(a) condition and stability of lock walls slowly deteriorating due to leakage to and undermining; and

(b) subsidence of the lock surrounds.

6. An ultrasonic survey made by consultants in 1990 had indicated that there were large voids behind the walls where mortar had been washed out, the joints behind the stone blocks had opened out, and in places the lock wall had bulged into the chamber. The point was made in the project discussion that the lock used to have a road crossing just below the chamber in which the bridge abutment had been integral with the lock wall and the bridge deck had probably acted as a strut. The road had been realigned with the result that the bridge deck no longer acted as a strut and the movement in the lock wall had accelerated. The initial risk ranking score in the primary assessment was 29 but following more detailed investigation the final ranking for the whole lock was 32 and it was classified as a high priority major work. The North West Region Senior Project Engineer was appointed Project Manager. A first estimate of the cost of the whole project given in the primary assessment was £200,000.

7. Three options were considered for rebuilding the lock chamber:

- reconstruction using reinforced concrete;
- rebuilding using the dressed masonry blocks; and
- postponing the works.

The reinforced concrete option was costed at £350,000 and was considered unlikely to gain the approval of the local planning authority which was keen to support refurbishment in the original form. Dismantling the lock chamber, installing a cut-off curtain and rebuilding with the original masonry was estimated at £225,000 and listed building consent had been provisionally granted on the basis that the final appearance would not change. A review of the options showed that postponement of the works until the lock failed would increase the reconstruction cost and give rise to further costs due to disruption of navigation. The sensitivity analysis of postponement stated that the structure was very unlikely to survive beyond year 3 and that failure in year 1 was strongly expected. This was because the bulge in the lock wall of over 6 inches reduced the restoring moment of the blocks concerned to a point at which the factor of safety against overturning was below 1, which was unacceptable on safety grounds. NPV calculations on the effect of postponement showed that this became the cheaper option only after four years and then only at the relatively low disruption cost of £15,000 a year or below. Option 2 was recommended by the Project Manager as giving both the most economical and best aesthetic solution.

8. A formal request for authorisation (RFA) to rebuild the lock chamber and fit new gates was prepared based on a more detailed budget cost estimate. The total estimate of £222,500 included complete restoration of sills and chamber walls, new wood lock gates to replace the old steel ones and all associated works, including landscaping of the surrounding area sponsored by the Waterway Manager, as shown below:

Anchor Lock budget estimate

	£
General items, specific requirements (BWB)	20,000
Method-related charges (ancillary charges)	25,000
Site clearance to EPA requirements	12,500
Dismantling existing masonry and storage	10,000
Earthworks	15,000
Concrete work, rebuilding, new masonry	90,000
New wood lock gates (made/supplied by BWB)	30,000
Landscaping, including canal furniture	<u>20,000</u>
	<u>222,500</u>

9. The RFA was signed by the Waterway Manager (Leeds & Liverpool East) as sponsor, the Senior Project Engineer (North West) as Project Manager, a Principal Engineer (ETS) as engineer representing the central services and the Finance Manager (North West) as administrator and cost controller. The RFA was approved by regional management in May 1992 and endorsed by the Director of Engineering and minuted to the Board as required by the procedure for estimated project values over £200,000. Planning requirements concerned both the closure of the lock and obtaining consent to work on a listed structure: the latter can be a long and involved process of negotiations with the local authority but in this case, as the proposed refurbishment was heritage-friendly, permission was readily given by Craven District Council on 11 May 1992. Design for the works was carried out by the ETS at Leeds and relevant drawings and contract documents prepared. Lock refurbishment apart from gate manufacture and hanging was described as straightforward civil engineering capable of being attempted by those contractors with experience of working for the water industry and with suitable advice from BWB: however, where puddle clay is involved there are very few contractors able to perform what is in effect a technique unique to canal and reservoir construction.

10. Full tender documents and detailed specifications for the work on the lock chamber were prepared by the ETS. A tender was issued to contractors selected on the basis of past performance, availability and location (BWB seeks to use local contractors provided they are competent). The invitation to tender was sent out to six potential bidders who were given just under one month to respond. Final receipt date for these tenders was 28 September 1992. As required by the procedure, they were opened by a senior member of BWB staff not directly

involved in the project, in this case the North East Region Financial Manager. The six bids were analysed, an engineering judgment taken and the lowest bid recommended to the North West Region by Head of Technical Services. Regional management accepted the recommendation and it was finally authorized for acceptance by the Director of Engineering on 26 October 1992 with the requirement stipulated by headquarters Accounts that it was essential to obtain a performance bond [*Details omitted. See note on page iv*]. As the tenders for the major works were substantially lower than expected due to a very competitive contracting environment, it was necessary to issue an advice of project change (APC) for approval, in this case for £160,000 (an APC is required when the cost varies by ± 10 per cent from the RFA). The letter of acceptance to the chosen contractor was drafted by the Head of Technical Services, who designated a member of the central engineering staff to be responsible for all engineering matters on the project, and was signed by the Regional Manager. In addition to these main rebuilding works, the new lock gates were placed on order at BWB Northwich workshops, and the landscaping work was contracted out to a local firm.

11. A post-tender meeting was held with the contractor at which the commencement date was confirmed (this date is often specified in the contract document because of the need to stop and drain the section or lock concerned). BWB installed the stop blocks as required and site responsibility was then handed over to the contractor who erected earth bunds within the stopped section as an extra precaution. The only additional instructions concerned the maintenance of the bywash and the procedure in case of flood. Progress meetings were held weekly.

12. Manufacture of the new lock gates was carried out by BWB at its Northwich workshops at a final cost of £37,500. On this occasion the contractor was given the opportunity to fit the gates under close supervision by BWB staff and with BWB's know-how and standby assistance. When viewed during the visit the fit did not appear to be up to BWB's normal standards and further work by BWB staff might be required to achieve a proper degree of fit required to minimize water leakage.

13. During the contract the Designated Engineer was responsible for the contractor's behaviour but the Project Manager carried out all the reporting through the normal business information channels. If it had become apparent during the course of the contract that further work was needed, eg large voids discovered behind the lock walls once drained and examined, then the Project Manager would have been responsible for seeking any extra funding, but there were no major problems with this contract after the work had commenced. It is at the discretion of the Waterway Manager to have extra work such as landscaping done for commercial reasons at the same time as the major works but this would be funded by the waterway or the region: as noted above, in the case of Anchor Lock an extra £20,000 was spent on such work.

The outcome

14. The work was completed to the Designated Engineer's satisfaction and the drained section was rewatered and handed back to the Waterway Manager. The deadlines for fitting the lock gates and rewatering had been met and the lock was fully operational on Saturday 13 March 1993 in time for the Easter holiday traffic as planned. The contract work was completed on time and within budget.

15. This case study shows that the refurbishment of Anchor Lock was carefully planned and managed and the procedures followed. The overall cost was £169,870 (as at 26 August 1993) and all works were completed on time for the planned reopening. The contracting out of the major works involved appeared satisfactory with the possible exception of the fitting of the lock gates. As BWB told us on several occasions that lock gate fitting is a highly skilled and specialist job normally performed by in-house staff familiar with the problems of lock gates, this is not surprising, and serves to confirm that it is perhaps inadvisable to contract out this particular task. The case study shows that the procedures were followed and that the necessary checks and balances were fully operational in the refurbishment of the Anchor Lock, Gargrave.