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New Arch Construction Technique

Un nouveau mode de construction des voûtes

Neue Bauweise für Bogenbrücken

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1. INTRODUCTION

The majority of the world's stock of arches are constructed of brick or stone and have stood for hundreds of years. They have shown themselves to be durable structures, capable of carrying loads very much greater than those envisaged by their designers.

The Department of Transport and the Science and Engineering Research Council are funding a nationwide research programme to study the performance of arch bridges. The Bolton Institute of Higher Education is one of the centres contributing to the research programme. In the course of his research, the author has developed a new arch construction technique.

2. DEVELOPMENT OF NEW TECHNIQUE

Consideration was given to the feasibility of producing arches using mass concrete. The first model was constructed using plastic sheeting 1mm thick which was cut to shape and glued together to form through thickness crack inducers (Figure 1)

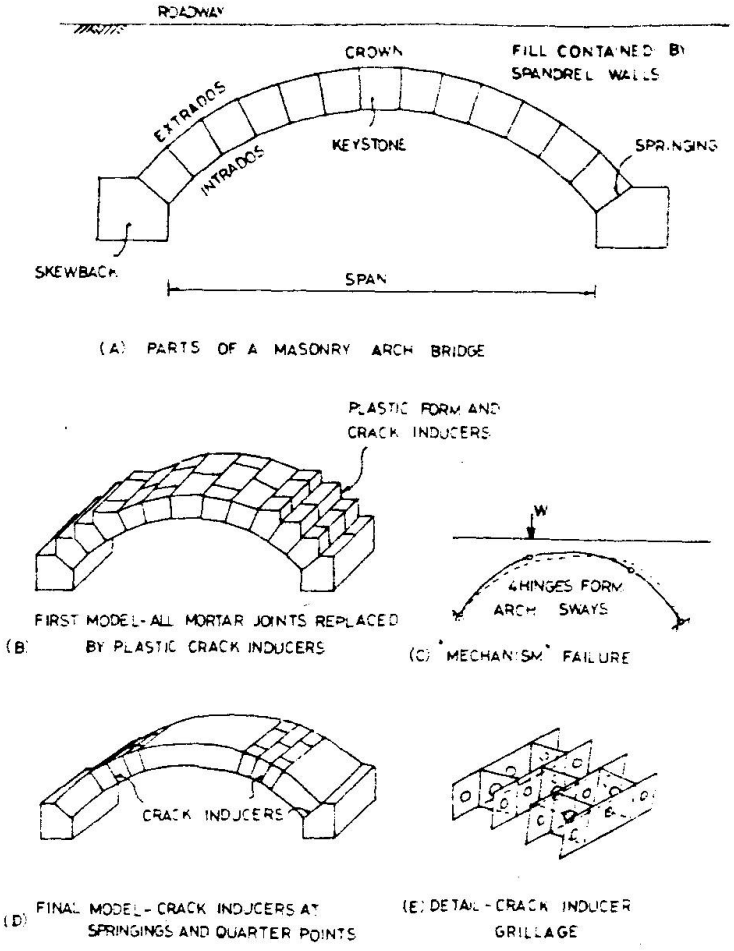

FIGURE 1 DEVELOPMENT OF CONSTRUCTION TECHNIQUE

These were positioned against the skewbacks. Subsequent crack inducers were installed with diaphragms. The latter acted as both stiffeners and spacers. The whole procedure was repeated until the entire soffit shutter was covered with crack inducers in a pattern similar to the joints in a stone voussoir arch. The stepped shutter arrangement allowed concrete to be placed without a top shutter - even at the springings. Subsequent testing of the arch showed that it performed in a similar manner to a voussoir arch, forming four hinges at collapse. The hinges occurred at the springings and in the region of the quarterpoints.

The construction technique was simplified to make it viable for full scale bridges. The crack inducers were restricted to the springings and quarterpoints. A simple procedure was followed as shown in Figure 2.

A series of tests were performed in the laboratory using various shapes of arch. In each case, the performance was similar to that of a voussoir arch.

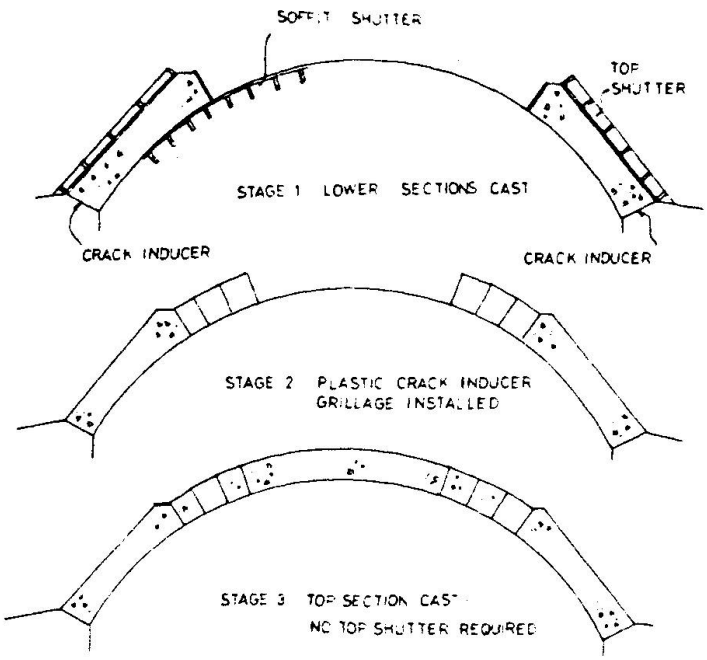

FIGURE 2 CONSTRUCTION SEQUENCE

3. PROTOTYPES

Two bridges have been constructed satisfactorily using the technique. Although they were relatively small with spans of 2.8m and 10.2m respectively. They have shown the method is viable for full scale construction. Both bridges have received SERC awards to be instrumented and tested. In each case the bridges performed well.

4. CONCLUSIONS

The construction technique has many advantages over that of its equivalent reinforced concrete arch:

(1) it is potentially more durable as there is no reinforcement to corrode;

(2) it is simple and quick to construct;

(3) the analysis and design are straightforward which makes design details simple and hence contract drawings minimal;

(4) Voussoir arches are less sensitive to thermal, shrinkage and settlement movements. The articulation of the voussoirs allows the stresses to redistribute without loss of structural integrity.