The Confidence to Build.
Understanding and Analysis in the Re-use of Structures

Bill HARVEY
Civil Engineer
Bill Harvey Associates Ltd
Exeter, Devon, UK
Bill@obvis.com

Bill Harvey, born 1947, BSc, PhD, Leeds, England. Worked for Leeds City Engineer, Freeman Fox and Partners, RDL(Contracting)Ltd, British Bridge Builders Ltd. Lecturer then Senior Lecturer, University of Dundee, Prof of Civil Engineering, University of Exeter. Now in practice as a consultant, especially on masonry structures.

Summary

The author acts as a consultant of last resort on arching structures, chiefly in the UK. He has been involved on the periphery of a number of major infrastructure projects where interaction with historic structures has been an issue. Mostly, this work is in unlocking restraints that have been imposed as a result of lack of understanding. Modern computer analysis is very demanding of knowledge, skill and time. Developing analytical skills seems to develop a corresponding belief system that the computer knows better than the structure, but any analysis is only as good as its input. The input requires understanding of:

The analytical tools
The likely behavior of the structure
The interaction of what can be modeled and the real behaviour
The values and confidence levels of the input
The values and confidence levels of the output.

If any of these is missing, the results are unlikely to be useful. Unquestioning confidence in the output of analysis may lead to either grossly un-economic or even dangerous designs.

The paper discusses a number of examples where complex analysis has yielded false results. Most often this is because the model constructed falls far short of representing the real structure. Each example is tested against the fundamental principle of statics, that every force must be traced from point of application to an adequate foundation, while remembering that “every structure is a system of interconnected stiffnesses” (Happold).

Keywords: understanding; analysis; existing structures; re-use; stiffness.

1. Introduction

Structural analysis is too often perceived as easy, just a matter of feeding data into a computer. In fact it is necessary to create a conceptual model, then a mathematical model from that, then populate the mathematical model with data. The engineer must ensure that the model is capable of delivering the results required and that it actually does so. Finally, the meaning of the output must be interpreted.

These issues are very much less demanding when dealing with new build than is the case for existing structures. In new build, the drawing can be modified to closely follow the model. In an existing structure the model must be truly representative or at least deviate from that in ways that can be understood.

Analysis of traditional masonry structures is often particularly difficult. The underlying stiffnesses are very high but differential stiffness, which rules behaviour, might still be considerable. What is more, soil structure interaction can be very important and is very poorly understood in general.

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