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# The Nature of Engineering Design: a Conference for Students

## L'essence du projet de génie civil: une conférence d'étudiants

## Die Entwurfsarbeit des Bauingenieurs: eine Tagung für Studenten

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**SUMMARY**

In January 1983 an open conference for building engineering students was held at the University of Bath, England to which many distinguished engineers came, to describe and discuss what they saw as the nature of engineering design. The paper by E. Happold briefly describes the conference, the papers by F. Leonhardt and F. Wenzel are the contributions from the Fed. Rep. of Germany.

**RÉSUMÉ**

En janvier 1983 eût lieu, à Bath, Angleterre, une conférence d'étudiants en génie civil; de nombreux ingénieurs renommés y participèrent et présentèrent leurs points de vue sur l'essence même du projet de génie civil. L'article de E. Happold présente brièvement la conférence, les articles de F. Leonhardt et F. Wenzel sont deux contributions allemandes à la conférence.

**ZUSAMMENFASSUNG**

An der Universität von Bath, England, fand im Januar 1983 eine Tagung für Bauingenieur-Studenten statt, an welcher viele berühmte Ingenieure teilnahmen, um zu umschreiben und darüber zu diskutieren, was sie unter der Entwurfsarbeit des Ingenieurs verstanden. Der Bericht von E. Happold beschreibt kurz diese Tagung. Die Berichte von F. Leonhardt und F. Wenzel sind Beiträge aus der Bundesrepublik Deutschland.

Bath University has a joint school of architecture, structural and environmental services engineering. It has an entirely joint course in the first year and has considerable joint teaching in succeeding years. There are two main reasons for this. Firstly that the British construction industry is riddled with mutual disrespect; it is even taught to students in schools. It is felt that those who will subsequently work together should be taught together. Secondly that the various disciplines are taught and trained in method, not just information, and that an understanding of a broad range of methods will strengthen the education of all these disciplines.

In Britain, and also in many other countries, architectural education is seen as a course based on historical scholarship - in principal and detail. Its teaching is mainly an extension of the old apprentice system. The student is set design problems and tutored towards his solutions. The engineering student is mainly taught a series of neatly compartmented science and mathematical subjects and the project work is structured laboratory or drawing office projects in which the object is defined and its behaviour to be analysed. What the engineering student is not taught is how to use his experience to conceive new solutions.

The course for engineers at Bath uses both forms of curricula - the integrated type of the architects and the collection type of the engineers. It is hard on staff and students.

In 1982 the engineering students of the Bath University questioned why their course was both harder and different from the courses of their contemporaries at other universities and we had an interesting discussion on this. They confirmed their belief in what we were trying to do together but expressed concern that, unlike their architectural student contemporaries, they neither knew who were the important designers in their disciplines or had ever heard them talk about their values and methods. They went on to say that while they at least had some understanding of the nature of design they doubted if their contemporaries in many other universities had and would like to explore whether this was really so.

I offered to close the school for three days and to try and seduce some of the greats of engineering to come and talk to them. I had no money for this purpose - it would have to depend on the generosity of those engineers. The students and staff conceived a student conference, free to all comers. They wrote to all schools of civil and services engineering in the country inviting them. The replies were varied. Some welcomed it enthusiastically, some asked if we could provide money for them to come! Some even said that the students would miss two days lectures and the staff could not allow that. In frustration we sent the attached poster out - it became a cult object. Nearly every invited speaker came and the staff put them up. Over three hundred students arrived, most bringing a favourite lecturer with them. What evolved from the initiative was a conference for students on the theme "The Nature of Engineering Design". Lecturing went on for ten hours continuously each day to a packed and enthralled audience. Discussions and design exercises, critted publicly, went on simultaneously.

The list of speakers contained most of the famous names of British civil engineering. Such as Oleg Kerensky, Paul Back and David Lee gave the students an opportunity to hear the views of people who designed the Kariba dam, the Severn and Forth Bridges, the Sydney Harbour Bridge and so on. As a Times Higher Education reporter wrote, "Their design credentials were demonstrated by the profusion of slides which brought home the engineers' unanswerable reply to the pervasive academic snobbery which holds that engineers are rather dull people with limited horizons: instead of books, papers or lectures, engineering designers help produce useful, striking and often overwhelmingly impressive

objects and artefacts. And they are not constructions which can really be studied in universities because they consume money and time far beyond the resources of an academic institution."

Paul Back, the dam designer, explained how he tried to work with nature. Derek Sugden discussed the balance between engineering intuition and architectural precedent. Tom Maver showed the latest computer aided design techniques. John Derrington took everyone through the decision stages of a concrete gravity platform for North Sea Oil. James Gordon like most other speakers argued for formal education but including a wider focus, seeing the whole rather than parts. Also two German engineers, Fritz Leonhardt and Fritz Wenzel came over to take part, their contributions follow this introduction.
One thing was clear: Very few engineers are asked to philosophise on their work. As Stefan Tietz said, he felt like a centipede trying to describe how he walked "I know how I got here but I am not too sure which leg I moved first." Yet the attempts fascinated the students. It is very much hoped that the contributions by F. Leonhardt and F. Wenzel will find the interest of our Profession.

**Who is Who on the Poster**

Robert Stephenson: 1803-1859. Son of George, joint constructor of 'The Rocket' London-Birmingham-Holyhead railway, Britannia Tube Bridge, etc.
Abraham Darby (III): 1768-1789. Ironmaster. Fabricator of early steam engines. Client and fabricator of first iron bridge in 1778.
Batty Langley: Bridge designer (Westminster Bridge, London 1736)
William Etheridge: Piled London Bridge. Designed method of sawing off piles under water.
Robert Maillart: 1872-1940. Swiss reinforced concrete bridge designer and constructor.
Thomas Brassey: 1805-1870. The first great railway contractor. Built 23,740 miles in Britain, France, Italy, Spain, Switzerland, Holland, Norway, Sweden, Denmark, Canada, Australia, South America, Turkey, Austria.
William Fairbarn: 1789-1874. Engine designer and general engineer. Worked on Britannia Tube Bridge.
Edwin Chadwick: 1800-1890. Social reformer, improved working conditions on sites. His report on public health (1842) led to the great expansion of public works engineering in the UK.
William Jessop: 1745-1814. Canal builder, bridge, drainage and harbour engineer.
Isambard Kingdom Brunel: 1806-1859. First Thames tunnel, Bristol Suspension Bridge, Great Western Railway. Chepstow and Saltash Bridges. Boat Designer.
George Stephenson: 1781-1846. Stockton-Darlington railway, Liverpool Manchester railway. 'The Rocket'. Founded the Institution of Mechanical Engineers.
John Smeaton: 1724-1792. First consulting engineer. Designer of wind and water mills. Steam engines. Eddystone lighthouse, canals, etc.
Joseph Locke: 1805-1860. Railway engineer. With Brunel and Stephenson known as the great triumvirate.
Thomas Telford: 1757-1834. Civil engineer. Canal builder. Road builder Bridge Builder. Conway suspension bridge.
George Deacon: 1843-1909. Water engineer. Vyrnwy dam.
James Jardine: 1776-1858. Water engineer. Union Canal Edinburgh water supply.
J E Errington: 1806-1862. Railway engineer. Became Joseph Locke's partner.
F Pritchard: 1723-1777. Designer of first iron bridge in 1778.

# We the undersigned, deplore and oppose any intention to prevent us attending the civil engineering students Winter Conference at Bath University, 26 - 29 January 1983

Further details are available from : your student liaison officer or Dept Building Engineering, University of Bath