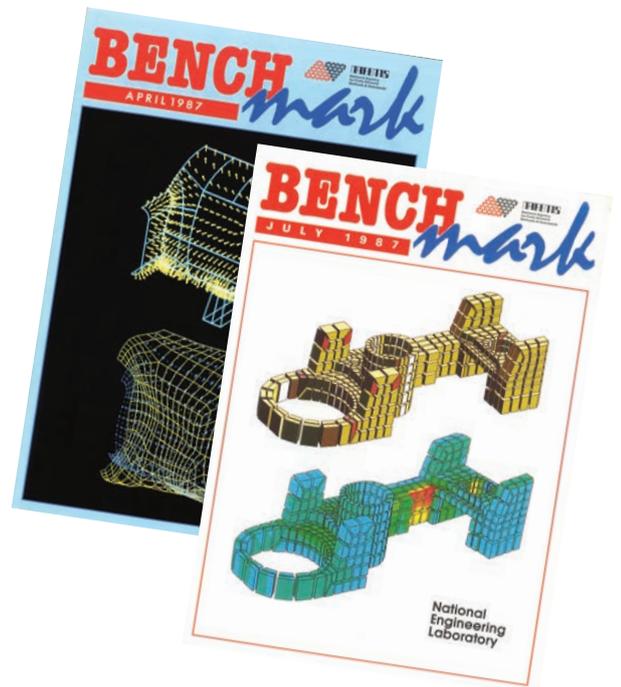


# NAFEMS

## *the early days*



The seed of an idea that was to grow to become the international, multidisciplinary organisation that we know as NAFEMS lay within the US aerospace industry. At the time it was commonplace for the US aerospace companies to recruit trained engineers to work as contractors. Throughout the '70s the displacement finite element method had largely replaced force methods but both the proprietary codes and the custom versions of NASTRAN maintained within aerospace companies had yet to give way to commercial software. NASTRAN and the in-house finite element codes were used primarily as the means to determine internal load flows that formed the input to a wealth of traditional detail stressing methods.

During the 1970s John Robinson had become known for running a series of "World Congresses on Finite Elements" as well as publishing "Finite Element News". The earliest record I have of John Robinson is a meeting he had with Alan Morris at the UK Royal Aircraft Establishment on Friday 17 December 1976; "John Robinson to discuss equilibrium elements" but, to the best of my knowledge, nothing immediate came of that particular discussion. For a period John worked within the US Aerospace industry as an invited researcher and method developer. He returned from such a tour with a mission. He argued that both coding and modelling errors were commonplace and only time separated the community from computer-aided catastrophe. This, he believed, was made all the more likely by the uncritical faith shown by many in the output from computers. In due course, Alan Morris was to place a significant MOD/RAE contract with John to examine discretisation errors that might arise in the application of FE to a cantilever beam problem. Exact plane stress/strain solutions are available for the problem, and CQUAD4 and CTRIA3s were used for the study. The effect of changing mesh density and aspect ratio were examined. What became apparent was that very large discretisation errors could arise if the modeller did not take into account the steep through-thickness stress gradients

that characterises beam and plate bending. Errors of the order of 50% were documented. The study also showed that the quadrilateral elements performed somewhat better than the triangular elements for that class of problem. The work was presented to a UK Research Advisory Group, mainly comprising Chief Stressmen drawn from the various airframe manufactures, at meetings held in 1982.

Meanwhile, in 1981 John had delivered a lecture at his World Congress held in Beverly Hills, USA, in which he proposed the formation of 'A World FEM Association' which created considerable interest. Besides seeking support from the RAE, John had visited Aerospatiale in Toulouse and also approached Dr Jim Dixon of the National Engineering Laboratory in East Kilbride, whom he had known for some time.

On 14 October 1982 George Leckie and Bill Mair from the National Engineering Laboratory in East Kilbride visited the RAE to discuss the Finite Element evaluation work performed under contract and outline their thoughts on the possibly ways of taking the matter forward. I also understand they visited John at his offices in Dorset in February 1983 where he recommended a number of individuals as possible members for a working group. By this time, Alan Morris had left Government service and it was on the 11th of March that year that a further meeting was held at Cranfield College of Aeronautics, in which Bill and George further outlined their plans. I then attended a meeting at the DTI (UK Department of Trade and Industry) along with Bill Mair at Kingsgate House on the 29th of March 1983, having obtained support for the proposed venture from the MOD (UK Ministry of Defence). Clearly I was not involved in all of the meetings leading to the creation of NAFEMS, far from it. One such meeting that I am aware of though was held at the Café Royal just before Easter with Bill, George, Alan Morris, John Robinson and Anne Creechan, at which the decision to launch the project was made and the set-up path agreed. The 'National Agency for Finite Element



## The Captain and his Crew

After the May Conference a New Steering Committee was set up to guide NAFEMS through the year ahead. We describe them below and, as you can see, the ship is in good hands!

**Professor Ian C. Taig** (Chairman), Coventry, Advanced Aeronautics Technology, Bristol, Avonport, etc. Honorary Fellow at Imperial College, London. A pioneer of FE methods since 1971. He received the Von Karman award for his work in 1974 and the RAE's Strain Medal in 1976. He is a leading company

**Professor G. A. D. Spinks**, Head of Department of Aeronautics at Imperial College. Graduated as a Civil Engineer in 1955 then as an aeronautical engineer at Cranfield. Worked in advanced projects at British Aerospace since



**N. R. Otter**, Head of Structural Mechanics Division of the Mechanical Engineering Laboratory of the General Electric Company. Read Maths at Manchester



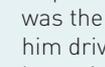
**W. M. Main**, Works at the National Engineering Laboratory (NEL). Particularly concerned with the production and the performance of elements. Co-edited Engineering (Mechanical Engineering) then worked on the



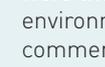
**J. Barber**, Set up the Rolls Royce FE Development team and is responsible for the company's FE analysis system. Has over 20 years experience in the development and operation of the equipment including extensive work in



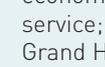
**John Robinson**, Retired from the USA. He went on to publish in FE topics for 15 years in education and has inspired at seminars in the UK and North America.



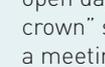
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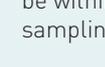
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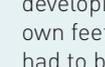
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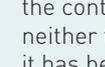
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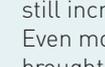
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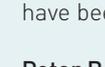
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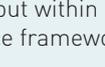
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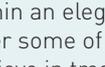
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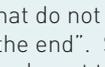
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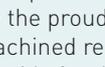
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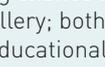
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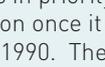
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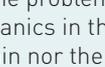
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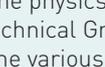
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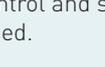
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## Dates for your Diary

- 15-16 May: Quality Assurance and Standards in Finite Element Analysis. International Conference organized by NAFEMS at Cranfield, Bedford, Bedfordshire. Contact: The Conference Organiser, NEL, Lion Works, Cranfield, Bedfordshire, MK43 0QJ. Tel: 015 25 2025.
- 19-21 June: Nonlinear Finite Element Analysis and AEREA. 6th Conference on. At MIT, USA. Contact: Prof K. J. Barber, MIT, 77 Massachusetts Av., Cambridge, Mass 02139, USA.
- 20 June: Quality Assurance in Finite Element Structural Analysis. Informed meeting at the Institute of Physics, Contact: Meeting Office, Institute of Physics, 47 Belgrave Square, London SW1X 8QJ. Tel: 01 235 6111.
- 20 June: 3rd July Numerical Methods in Thermal Problems. Fifth International Conference on. To be held at Montreal, Canada. Contact: Professor R. W. Lewis, Dept Civil Eng, University College of Swansea, Singleton Park, Swansea SA2 8PP.
- 4-10 July: Numerical Methods in Laminar and Turbulent Flow. Fifth International Conference on. To be held at Melbourne, Canada. Contact: Prof J. R. Bennett, Faculty of Engineering, Univ of Melbourne, Parkville, Victoria 3052, Australia.
- 21-23 September: NAFEMS Annual General Meeting. In York, Great Britain. Contact: Mike Adams, Chairman, NAFEMS, National Engineering Laboratory, Lion Works, Cranfield, Bedfordshire MK43 0QJ, UK. Tel: 015 25 2025.
- 28-30 September: MSC/NASTRAN Aeroflight. London, UK. Contact: P. Newton, The MacNeal-Schwendler Co Ltd, Toward, East Lothian, East Lothian, Midlothian, Scotland, Midlothian, Scotland, Midlothian, Scotland. Tel: 01 300 225.
- 5-9 October: Finite Element Methods, 5th World Congress and Exhibition on. To be held at Salzburg, Austria. Contact: Prof J. R. Bennett, Faculty of Engineering, Univ of Melbourne, Parkville, Victoria 3052, Australia.
- 28-29 October: MSC/NASTRAN Advanced Modeling Workshop. Contact: P. Newton, The MacNeal-Schwendler Co Ltd, Toward, East Lothian, East Lothian, Midlothian, Scotland, Midlothian, Scotland, Midlothian, Scotland. Tel: 01 300 225.

Methods and Standards' was launched later that year as a Special Interest Group supported by the DTI. The other key players were Iain Taig (as the first Working Group Chairman), Glyn Davies and Nick Otter.

The remit of the fledgling organisation, soon to be known by the acronym NAFEMS, was:

"To promote the safe and reliable use of finite element and related technology"

To publicise and promote the new organisation, a series of road-shows followed, held in key locations around the UK. I attended one such on 29 June the following year at the Royal Bath Hotel in Bournemouth. The first NAFEMS Annual meeting I have recorded as being held on 12 October 1984 but the venue is not specified.

The development of benchmarks was a major activity within the fledgling organisation. Some tact was required to avoid this being seen as an attack on vendors and their products but, ultimately, both users and developers have a common interest in improving the reliability and accuracy of engineering analysis, and a balance of interest was established. John Robinson was to retire from the world of engineering analysis and FEM for personal reasons and to devote a greater proportion of his time to his other passion of music. In due course NAFEMS was to launch its own sequence of NAFEMS World Congresses as a flagship event.

NAFEMS was fortunate to have, pioneers of the finite element method amongst its active members. The early publications were produced under a cloak of anonymity but often relied upon a single individual drawing upon a wealth of experience. Thus the first publication 'Guidelines to Finite Element Practice' (1984), written by Iain Taig, had a strong aerospace flavour, being a compendium of avuncular advice such as Iain would have deployed to encourage best practice at BAC Warton (essentially an in-house guide). John Barlow of Rolls-

Royce had played a significant role in the development of isoparametric elements but within the NAFEMS context it was the Quality Assurance framework that I remember him driving through.

I wasn't all work though. The networking opportunities were there and often within an elegant social environment. I remember some of George Leckie's comments such as "I believe in treating other people in the manner I would like to be treated" or "It is a false economy to use venues that do not offer to highest quality service; you pay more in the end". So we met at the Grand Hotel in Brighton and went to Shakespeare performances in Stratford upon Avon. During a NEL open day, when I became the proud owner of a "nut and crown" souvenir (a 3D machined rendering of their logo), a meeting room was set aside for the use of NAFEMS members. By an amazing chance this just happened to be within the nearby distillery; both the tour and the sampling proved highly educational.

Of course, major changes in priority were critical to developing the organisation once it had to stand on its own feet financially after 1990. The membership base had to be widened and to do that delivering membership value was paramount. The problems first addressed in the context of solid mechanics in the UK are specific to neither the physics domain nor the territorial region, and it has been fascinating to see how the organisation has risen to the challenge. The physics domains covered are still increasing as new Technical Groups are formed. Even more importantly, the various Regional Groups have brought their own character and ways of working to the organisation and both control and sense of ownership have been internationalised.

Peter Bartholomew

**Disclaimer: These are personal recollections of the author. No doubt there were many other influences that shaped the early days of NAFEMS but I can only speculate.**