

AN ENGINEER - ACADEMIC LOOKS BACK



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This article attempts to connect and correlate the various aspects which influence the life and career of a person, in this case, more specifically, an engineer. These include the factors that dictate the formation of one's attitudes and character, namely, the opportunities offered, and, the environment – social, political and professional. Although the traits in the character of a person may be dictated largely by nature – genetics and inheritance, the exposure and contacts of the early years, with parents, family and teachers go a long way in forming attitudes towards life. In this article, the writer has used himself as the example to construct one possible model of an engineer's life. While going through this journey it is imperative to understand the factors that made it what it has been, it is not out of place to recount any contributions one may have made to the profession or the National development. This enables an understanding of the total package.

Since my birth in March 1938, the narrative relates to three specific time windows. The first till the completion of formal education in 1964, the next, the period of regular employment as an academic at the University of Roorkee, from 1965 to 1998, and lastly, the period post retirement from 1998 onwards. As I look back before writing this narrative, I am convinced that providence has so far been most kind to me.

My father, Professor Jai Krishna, whom the fellows of the INAE will also identify as their Founder President, joined the Thomason College of Engineering at Roorkee as a Lecturer in 1939, and then the family joined him in 1940, with me a toddler. The College set up in 1847 by the British for formal engineering education, being one of the first globally, was spread over a sprawling (*for those days – today with almost ten thousand students that aura has diminished considerably*) campus. It was a serene environment with tall green trees. There was quietness and life was organised. Transportation was restricted to walking or a few bicycles, and, the air was clean. The snowclad Himalayan peaks could be seen from the campus. Growing up a little further, I began to notice the unmistakable traits of a highly disciplined civic life – there was punctuality, tidiness, regular participation in sports, utmost regard for seniors, and, so on. There is a reference to this aspect later too. At this point it will suffice to say that a growing up youngster was bound to be affected by this environment.

Although this was too early in years for me to carry any impression of the highly significant political developments going on in those years, the sense of turbulence was noticeable, and the coming of Indian independence in 1947 was obviously too important an event to escape any Indian. There was a mixed feeling - joy for getting independence but sorrow created by the turmoil due to partition of the country. The status of engineering education and development was not much to write home about. The change in status of the country opened the gates for growth. The Thomason College was converted into the University of Roorkee in 1949. The Indian Institutes of Technology were set up – 5 to start with – at Kharagpur, Bombay, Madras, Kanpur and Delhi. Projects such as the Bhakra Dam (Mr. Nehru's temples of modern India), setting up of India's space and Atomic Energy program, and, the establishment of the Council of Scientific & Industrial Research (CSIR), are only some examples of the initiatives taken.

On the personal front, I obtained admission to a Public School at Nainital, a touristic destination in the hills in UP, in 1948. This had been an English medium institution till 1947 and was taken over by the Birlas and converted into the first Hindi medium Public School in India. More relevant to the tenor of this article is the fact that during the four years of my schooling at that institution, there was exposure to the same spirit of discipline, punctuality, regularity, tidiness, and, civility, as I had observed while growing up at the Roorkee campus. Added to that was another experience that left an indelible impression on my mind. This was the total commitment of the teachers towards the welfare and education of the students. The hostels were a home away from home! Next at a College at Mussoorie, another town in the Uttar Pradesh, a public school run by Irish missionaries, the experience of Nainital continued.

The exposure of these early years, must have played an important role in forming me as a person. Besides this, growing up on the Thomason College campus, with its reputation as an outstanding place for education in this subject area, must in all likelihood have created an attraction to become a Civil Engineer. Admission to the University of Roorkee even in those early years was difficult, though not as tough as today. Therefore, my admission to the Civil Engineering degree programme in the year 1956 was not only a matter of great satisfaction for me, it was a great privilege, since this programme at the University of Roorkee was highly rated amongst the young students aspiring to become engineers. At that time I could not have asked providence for more.

The three years spent at the University of Roorkee as an undergraduate student, were very significant in providing a direction to my professional as well as personal life. Besides directly experiencing the special features of life at this institution, mentioned earlier too in the article, there were a few other things that need to be mentioned. The faculty were not only of sterling quality technically, their commitment to producing outstanding graduates, and their welfare generally, is remembered even today by the alumni of that era. Another point that characterised our education was the obvious mandate to make the students as self - reliant as possible, as well as to prepare them for serving the cause of National development. An anecdote narrated by one of our teachers, Professor O.P. Jain, who also was a student at Roorkee in the early 1940s, is most illustrative in this respect. His class was assigned to design a railway bridge over the Ganges canal. The task was to be completed in two weeks, and, no other information or data were given by the teacher. When approached by the class for this additional information, the teacher told the class – you are going to become engineers, please go and find the answers!!

Furthermore, the Roorkee graduate was exposed to the ‘grass roots’ of Engineering practice, while being imparted with fundamental knowledge required to remain a self - learner throughout life. Those were the years when students could have a brush with real life engineering through ‘shramdan’ besides the structured summer training, which was part of the curriculum. For better or for worse, our engineering education seems to have veered away substantially from this philosophy, which was central to the programme in those early years at the University of Roorkee, and, from what one can see, it served the cause of National development very well. The training packaged into the 3-year programme provided a good start to our engineering careers.

Another aspect worthy of mention, for the decade pertaining to the schooling at Nainital upto graduation from the University at Roorkee, was the compulsory participation in sports and games. It is my belief that sports help to teach a person about team spirit and also give him a capacity to take defeat. The young generation today is faced with harsh competition, and sports can help them to get de-stressed to a good extent.

After a stint as a graduate trainee at the Bridge & Roof Co. at Howrah for a year, there was another year at the University of Roorkee pursuing a Masters course in Structural Engineering. The B&R specialised in design and fabrication of industrial steel structures. These two years added to my

preparedness for a professional career. The next very significant turning point that followed was my admission to the postgraduate programme at the Imperial College of Science & Technology, London (affiliated to the University of London), with the objective of getting a doctoral degree. This again one would consider a fortunate opening, since the “Imperial” as it was called, had a great reputation for its quality of research in the area of Structural Engineering. Their higher education programme required a student to enter through the *Diploma of Imperial College (DIC)* course, before registration for research for a degree. Then, a research scholar was first registered for the M.Sc. degree before being moved on to the doctoral programme, if found fit. A very prudent arrangement! Having had the benefit of obtaining a master’s degree from a reputed college, I was exempted from the requirement of going through the DIC course after attending it only for a few weeks, and, could utilise the time that thus became available to me, for a few months of excellent experience in a Structural Engineering consulting firm. Subsequently, admission to the research programme came through in July 1962, leading to a doctoral degree in November 1964.

Although my technical education in India was from a top-rated institution, the research and training experience in the UK was comparatively more intense. The ethos was different, but there was similarity in the emphasis on self-learning and achieving excellence, besides many other attributes. A blessing was in having a supervisor in Professor S. R. Sparks, a brilliant experimentalist, and a great human being. Our discussion on my research was held on barely 7 occasions, though I had the pleasure of meeting him socially very many more times. There was often a feeling of having been pushed into a pool at the deep end to learn how to swim.

When leaving India for studies in the UK, research in the subject of *Suspension Bridges* was contemplated. Infrastructure development was beginning to grow in the Country, and, it was anticipated that as the hilly regions will open up, there will be a need to build many suspension bridges. However, when work was started at the Imperial College, it was suggested to me that within the general area of *cable suspended structural systems*, it could be even more exciting to work on *cable suspended roof systems*. It was a fascinating experience to explore this entirely new area of research. Barely any back up literature was available which dealt with such roof structures. This allowed plenty of scope for original thinking, and explore new vistas. This was a training of mind which stood with me in the subsequent years of my professional life.

There was also a new exposure to the use of digital computers, which were in the early stages of their development – something that has changed the pattern of life on this planet beyond imagination in the decades that have followed. In 1962, solving 5-6 simultaneous equations seemed to be quite a task. By the time my PhD work was completed, two years later, a number running into hundreds was a clear possibility. Thus, as the technology for computer hardware continued to improve, solving thousands of equations (that too in quick time) did not remain a challenge. This revolutionised the very manner of looking at numerical work and engineering analysis. On the other hand, and in parallels, the electronic revolution completely changed the entire field of communications. In the 50 years that have since elapsed, the world has become smaller!

Reverting back to my journey, the Doctoral degree from the University of London, completed my formal degree requirements, upon which I returned to India. India had been independent politically for more than 17 years, and for most of these it was under the visionary leadership of Jawahar Lal Nehru. There had been effort all around to lay the foundations of a modern Nation, embracing a scientific temper in its multifarious development. However, for a person like me returning to India, the difference between the western world and India (in fact most of Asia) was stark and huge, even somewhat depressing. However, what helped greatly was the determination to anchor my heels fully in India to make the best of whatever training had been received in the foregoing years to build up a career, and indeed to give back to the country to my utmost capacity. Providence was kind to me in upholding the decision.

There were opportunities to make a career in *Academia, Research, or, the Industry*. However, there was little to debate, as the privilege of accepting the offer from the Civil Engineering Department of the University of Roorkee provided an obvious choice. There were several plusses perceived. The University flaunted some of the best known peers in Civil Engineering in the country, and Structural Engineering was without doubt the strongest nationally and comparable internationally. As an Academic at the University of Roorkee, with its reputation, one could hope to get a good exposure to sponsored field work and carry out applied research, besides teaching. It turned out to be a very good decision, and permitted a balanced combination of all three. The period of 33 years (1965-1998) was mostly utilised at Roorkee.

Soon after joining the University of Roorkee, there was a welcome opportunity to go abroad to accept offers of visiting assignments for two years (1968-1970) – first at the University of Illinois, Urbana in USA, and, in the next year at Imperial College, London. Although both these stints provided invaluable experience in their own different ways, the US assignment gave a completely new dimension, in that this gave me an opportunity to understand the US system for the first time. The department of Civil Engineering, rated the best in that country, had a faculty of 105 which included some of the best known names in the discipline, led by the redoubtable Professor N. M. Newmark. I felt humbled, and made my best efforts to learn as much as possible during the limited time I had there. In a significant development, it was possible for me to initiate the project for writing the first book on *Cable-Suspended Roofs*, under the banner of the McGraw-Hill Book Co., New York - add to the text substantially in the following year at London, and, complete it later upon my return to Roorkee.

Late, temptations came for going to the West as well as the middle eastern countries, but better sense prevailed. There was indeed no lack of opportunity within the Country. The model followed was to keep in touch with the developments abroad through visits for conferences and exchange programmes (*besides the two years for teaching assignments mentioned above*), but keep the anchor at Roorkee. Assigned to teach *Structural Mechanics*, and, *Design of Steel Structures*, I built up specialisation for these, besides the non- conventional area of *Cable Supported Structures*, a legacy from my doctoral research. *Cable Supported Structures* led to a logical interest in the subject of *Wind Engineering*. In the mid - seventies, my father, Professor Jai Krishna, who had championed the cause of establishing *Earthquake Engineering Research, Development and Extension in India*, nudged me to plunge more seriously into developmental work on *Wind Engineering*. He envisioned that as the country grows into a modern nation, it will build many tall as well as wide span structures, besides power systems of different types. These will often consist of slender and wind-sensitive structures. Thus capacity building in wind engineering was required. It is gratifying to record that Roorkee became a destination for sponsored work related to both the last named specialisations of cable structures and wind engineering.

In fact, for the developments in *Wind Engineering*, Roorkee attained a leadership position in India. Pioneering steps were taken to set up the first large boundary layer wind tunnel in India, in the early 1980s, at the University. Incessant effort was made to strengthen this field of engineering. The first Symposium on Wind Engineering to cover the Asia Pacific region was held at the University of Roorkee in 1985, and has since established itself as a 4-yearly event. I was privileged and honoured, to have been elected President of the International Association of Wind Engineering for the period 1991-95 (the only Indian so far), and India organised the 4-yearly International Conference on Wind Engineering for the first time (and only time so far) at Delhi, in 1995. An Indian Association of Wind Engineering was set up in 1993. Significant contributions were made towards wind disaster mitigation efforts of the country.

During the period being addressed at the University of Roorkee, there was ample interaction with the industry which was personally very satisfying, since it enabled exposure to problems related to complex structures often requiring a novelty of approach for their solution. Some of these worthy of special mention are, the work on several cable stayed bridges, the TIFR Giant Metre Wave Telescope system, numerous power and communication structures tested in the wind tunnel, and, so on. The year 1996-97 provided a unique excitement as the Institution celebrated its 150th year. *Soon after, in 2001, the University was converted to an IIT.* It is needless to mention that the most enjoyable and rewarding task of all was to teach the undergraduates, and, to notice the sparkle in their eyes when they grasped a point well made.

It may surprise the reader, but the (nearly) 20 years post retirement from Roorkee have brought for me as much challenge and excitement, as perhaps the 20 years in the pre-retirement period. Part of the reason for this ongoing opportunity is the globalisation mentioned below. The experience gained in earlier years has enabled me to contribute to some iconic engineering projects – to name a few - membrane roofs; cable bridges; a 115m high Shiva murty (under construction); a 486m span railway arch bridge over the river Chenab (under construction), which will be one of the highest in the world; a state-of-the-art wind tunnel being constructed at Guna (MP) by JAYPEE Associates; a major Rail-Road bridge under construction over the river Ganga at Ghazipur (UP). Of equal satisfaction has been the association in the INAE work, in earnest after 2008, the first 6 years having been as its Vice-President. An opportunity to mentor the research activities of the Central Building Research Institute at Roorkee as the Chairman of its Research Council for the last 7 years has provided me with an entirely new dimension. There were awards and recognitions but the one most cherished was the Distinguished Alumnus award 2012 of the IIT Roorkee.

Opening up of the Indian economy and globalisation from mid 1990s onwards brought about a sea change in all round growth, including that related to Engineering and Technology. We as engineers have been playing a commendable role in contributing to this growth*. I feel proud to have been part of this fraternity, and feel that this has given me a life well lived. Some industries such as the one dealing with Information Technology, gave a great fillip to the economy of the country. Similarly, there has been enormous progress in departments such as aerospace making the country proud. The Civil Engineering profession has served the goals of development well and steadily, but perhaps there is not enough glamour so as to get better recognition.

The problems of our country have varied and have enormous proportions, whether these be political, societal, or, developmental. The world order, economic or political, is not making things any easier. There is often much turbulence experienced. It is nevertheless a good augury that the dynamics has given rise to a positive direction to the growth of the Nation.

In the final count, for me as an individual, life so far has proved Swami Vivekanand's words, whose essence is that, God does not give what you want but gives all you need.

- See "*Glimpses of Indian Engineering Achievements*", *A Coffee Table Book*, INAE, 2012.