

**Dr. R. K. Bhandari was the Chief Guest for the
Department session of the 54th Convocation
On August 13, 2016 at 3.30 PM in LA 302, IIT Bombay**

The following speech was delivered by Dr. R. K. Bhandari to the graduands of Civil Engineering Department.

CIVIL ENGINEERING AND THE FUTURE OF INDIA

It is a matter of great pleasure and pride for me to be a part of the Civil Engineering Department's Degree conferring function at this great Institution.

Fifty two years ago, I have had the privilege to be a student in the Department. The growth of Civil Engineering in India from the time I left IIT Bombay to the present day has been phenomenal and it wouldn't be an exaggeration if I say that IIT's have made a huge difference to the India's growth story and the products of IIT have won global admiration.

The difference between then and now is that those were the embryonic days of building the department brick-by-brick which is now flourishing in the prime of its youth. People like me who have seen its growth both as an insider and as an outsider, feel justly proud to be a part of its un-ending growth story. I salute you all for lifting the flag of glory and fame so high, and expect the new generation to do even better.

What others may see as the Department's excellence in the fields of Structural, Geotechnical, Water Resources, Transportation Systems and Ocean Engineering and Construction Technology and Management, the Department itself should see as a vibrant ready-made platform and a great opportunity to demonstrate the real power of multi-disciplinary research.

It was at this very institution half a century ago that I was fascinated by the invasion of the disciplines of geology, geo-morphology, seismology, thermodynamics, mathematics, statistics, instrumentation and remote sensing in the teaching of Soil Engineering.

It was at this Institute that I picked the scientific spirit of enquiry in Soil Mechanics. Professor R. K. Katti delivered several lectures on what makes one soil engineering problem different from the other. Professor Ranga Rao asked us to see, touch, feel, taste and, if need be, even chew soil during field investigation. Professor Parthasarthy took us deep into the micro-scopic structures of soils and rocks. Later in my education at the Imperial College, I

got convinced that solving a problem is like appearing in an examination where the syllabus is unknown, and sample question papers and their answers are not available. It became to me increasingly clear that field evidences are the weapons with which we can demolish even the most established of the theories.

It is a matter of serious concern that over the period of years, although the Geotechnical Engineers have increased in numbers, the culture of geotechnical engineering has steadily declined. Soil has become untouchable to most of “modern” geotechnical engineers, as their college education has given them a false sense of confidence that they can simulate any kind of structure–foundation-soil systems on the screen of a computer and predict their behaviors even without visiting the related site even once!

Over the period of years, Geotechnical Engineers have also lost their appetites for calculated risk in engineering practice. This is what Casagrande wrote in 1965 and his words are even more relevant today:

“Unfortunately, it is common practice in publications describing projects in applied soil mechanics to present a rationalized picture that has little resemblance to the truth about the actual approach followed in arriving at major design decisions. If judgment based on empirical knowledge played an important role in such decisions, why not admit it? If unknown risks or calculated risks were involved because of the large gaps in our understanding of the mechanics of soils, why not admit it? Authors who a posteriori, try to rationalize their decisions or make theories fit the facts, merely reveal their limited grasp of the realities of applied soil mechanics. With distorted presentation of important case records they hinder rather than promote progress; and they mislead their younger and less experienced colleagues”.

The trends are similar in other disciplines of Civil Engineering which is in fact an art of dealing with real life problems of development and construction, often under uncertain premises. Our structures rest on the ground which we do not wholly understand; and they are subject of forces which are neither easy to comprehend nor simple to analyse.

Uncertainties on account of aleatory (inherent) factors like randomness of an earthquake event in time and space are understandable. Epistemic uncertainties due to instrumental and human limitations are also generally condonable. What is really inexcusable, however, is the blind adoption of obsolete or inferior practices as a softer option.

This is the reason that the role of engineering judgment in Civil Engineering can never be replaced by sophistry in modelling and advancing and massaging

design softwares and fine-tuning computational methods. We may, by all means, position our "head in clouds" (to think and dream of big) but our feet must be firmly set on the ground.

One might ask where has the engineering judgment gone? As far back as in 1980, Professor R. B. Peck answered the question as follows:

“It has gone where the rewards of professional recognition and advancement are the greatest to the design office where the sheer beauty of analysis is often separated from reality. It has gone to research institutions, into the fascinating effort to idealize the properties of real materials for the purpose of analysis, and into the solution of intricate problems of stress distribution and deformation of idealized materials. The incentive to make a professional reputation leads the best people in this direction”.

Peck further added “when an engineer at my age talks about judgment, he invites the criticism that he is too old to keep up with the latest advances in theory and methods of calculation and so, having slipped behind the times he must depend on a somewhat vague attribute called judgment”

The Global Science is as its elemental best; today’s technology looks no less than magic, the art of construction is growing by the day and the list of our achievements is impressive. The Indian growth story is steadily being placed in a much higher orbit with the added thrust on the building of smart cities, expansion of ports and harbors, construction of hydroelectric and nuclear power plants, linking of rivers and strengthening of communication systems and other infrastructure including housing. And with such ambitious plans and proclamations come the added responsibilities to ensure that the development is sustainable and the associated disaster resilience measures are integrated with development planning.

How do we see our future with the civil engineering profession fading in visibility rather than being at the vanguard of the India’s growth story? Despite the best of engineering and technology at our command, why, the small matters like pot-holes on the Mumbai city’s roads and dysfunctional storm water drainage systems are allowed to water down our achievements and soil our collective reputation? Nobody will believe that it is the same India which has given to the world many shining examples of Buildings, Bridges, Canals, Dams, Ports and Harbours, Tunnels and Subterranean Structures and event today breaking record by building the world’s highest Leh-Manali Highway, and the tallest rail-road bridge at Chenab between Bakkul and Kauri in Jammu and Kashmir.

In 1980s I studied the Ganga Canal in some detail with Dr A. D. M. Penman, a British expert. In the opening remarks at the concluding session he said “With all my power of imagination and computational skills I still do not believe that such a canal could ever be built”.

How on earth can an earthquake tremor prove mightier than the combined strength of Civil Engineering in India? Can we any longer stand the shame of hospital buildings killing patients and school buildings killing children? I know this as well as you do that the sorry state of affairs is chiefly because ineffective techno-legal regime, non-engineered constructions and fragmented responsibilities and absence of accountability. But I also know that this poor public perception of civil engineering can only be corrected if the institutions like IITs take the discourse beyond their present boundaries of adventure. They must shed tunnel vision and consider Civil Engineering as a borderless subject best pursued by team work. Luccock once said “No one can whistle a symphony. It takes a whole orchestra to play it.”

Let me cite a story from my stint at the Central Building Research Institute, (CBRI) Roorkee. In the year 1986, soon after assuming charge as the Director of the Institute, I had the opportunity to meet the Union Minister of Human Resource Development, Shri P. V. Narasimha Rao, who had come to the then University of Roorkee to deliver a convocation address. The Minister, in his speech, lambasted Civil Engineers for designing buildings which turn ovens in summer and refrigerators in winter. At the luncheon hosted by the University Vice-Chancellor, I thanked the union minister for shaking the conscious of Civil Engineers, and conveyed to him that, without a strong political will, the situation is unlikely to improve. Sir, is it not surprising that the Government of India has created institutions like CBRI with multi-disciplinary and state-of-the-art capacity in Building science under one roof, and yet the Government itself keep ignoring CBRI even while dreaming of building Resurgent India?

I was asked to report at the Ministers residence the next day, which I did. Hon’ble Minister told me briefly about Government’s plan to build a network of Navodaya Vidyalayas across the length and breadth of India, and asked if I was ready to mount a tiger? My nod was spontaneous and without any prior thought. Against fierce competition from CPWD and other institutions, the national task was assigned to CBRI, and within months, model school designs were approved by none other than Prime Minister Rajiv Gandhi himself. The Navodaya Vidyalaya Project which started in 1987 continued until 1999, well beyond the date I left CBRI in 1989. The project involved planning, design and construction of 305 schools, spread over 30 States and Union Territories for which HRD Ministry paid more than Rs. 10 crore to CBRI at that time, giving it the most visible project since its inception.

My message to all my fellow Civil Engineers is that go an extra mile to integrate the ongoing civil engineering discourse with the heightened societal concerns. By advancing frontiers of knowledge and generating intellectual and economic wealths, you are merely doing your duty but by integrating work with burning societal concerns, you will be serving humanity at large, besides doing a great national service. On both the routes, awards and rewards will await your good work with bouquets of flowers but at every juncture, destiny will leave each one of you to decide whether you would like to be a man of success or a man of value. *I cannot agree more with E. M. Forster who wrote that “We must be willing to let go the life we have planned, so as to have the life waiting for us”.*

According to Brihadranayaka Upanishads: *You are what your deep driving desire is. As your desire is, so is your will. As your will is, so is your deed. As your deed is, so is your destiny.*

“Ideals are like stars: you will not succeed in touching them with your hands, but like sea faring man on the ocean desert of waters, you chase them as your guides, and following them, you reach your destiny.”

I challenge all of you to experiment with this thought and you will conclude as Forster did that, *“Failure and success seem to have been allotted to men by their stars. But they retain their power of wriggling, of fighting with their stars, and in the whole universe the only interesting movement is this wriggling.”*

I congratulate you all on this occasion and hope that degrees you get today will give you the power of wriggling to give to your country the best you can imagine.