Career Profile of

Er Y.G.Patwardhan
Managing Director, Ameyas Infraprojects Pvt Ltd.

Recipient of S.B. Joshi Memorial Award for Excellence in Bridge & Structural Engineering for the year 2011

Cited by Alumni Association of College of Engineering, Pune

Date of Birth:

- 27th February, 1948

Educational Qualification and Training:

- Bachelor of Engineering (Civil) Pune University 1970, with distinction 1st in the merit list with all prizes including gold medal
- Master of Engineering (Structures) Pune University 1973
- Bachelor of Law Bombay University 1990

Professional Experience and Training:

- Managing Director – 1990 Till Date
  Ameyas Infraprojects Pvt Ltd. a Company mainly engaged in Construction and Rehabilitation of Bridge works including Design, Planning and Execution
- Partner Kolwalkar - Gupte Constructions – 1986-1990
- Superintending Engineer P. W. D. Govt. of Maharashtra – 1986
- Executive Engineer P. W. D. Govt. of Maharashtra – 1977 - 1986

Publications:

- Difficulties Experienced While Executing Balance Work Of Construction Of Major Bridge On Ulhas Creek Near Gandhari On Kalyan-Bapgaon Road In Thane District (Maharashtra)
  Published in IRC Journal 1997 vol.58 -2
  Author= S.K.Parikh, Finite Element Consultant
  Y. G. Patwardhan,

- **Short-falls in investigations for bridge foundations**
  Published in Foundations for major bridges - Design and construction: IABSE Colloquium, New Delhi, India 1999
  Author= S.T. Kenghe, M.V. Patil, Chief Engineer (P.W.D.) Maharashtra,
  Y.G.Patwardhan

- **Finite Element Investigations for Ratings purpose as well as for the purpose of widening the old Godavari Bridge**
  Published in IRC Journal 1999 vol.59 -3
  Author= S.R.Kulkarni, Engineering Geologist
  V.B.Borge, Chief Engineer (P.W.D.) Maharashtra
  Y. G. Patwardhan,

- **Widening of Major Bridge on Bindusara River in KM 255/800 MSH No.1 by Innovative Method.**
  Published in Indian Highways Journal 2000 vol.28 -5
  Author= S.T.Kenghe, Structural Consultant.
  V.B.Borge, Chief Engineer,(P.W.D.) Maharashtra
  Y. G. Patwardhan

- Importance of Sub-Surface Investigations by Core Drilling for Bridges with Particular Reference To Deccan Trap Areas
  Published in IRC Journal 2000 vol.61 -3
  Author= S.R.Kulkarni, Engineering Geologist
  V.B.Borge, Chief Engineer (P.W.D.) Maharashtra
  Y. G. Patwardhan,

Honors & Awards:

- Stood first selection to the Cadre of M. S. E. Class I
- Was recommended by Government of Maharashtra for examination held by. inclusion in cadre of I.in M.P S.C. in 1971 for A.S.
- C.M.Shah Concrete Technology Prize of 1995-96 by Pune Local Centre of Institution of Engineers for innovative centering provided for bridge on Ulhas River near Kalyan, Mumbai.

- **Most Outstanding Structures In India – 1997**
  This award is organized by Maharashtra India Chapter Of ACI.

- **Most Outstanding Bridge National Awards – 1997(Third Prize)**
  This award is organized by Indian Institution of Bridge Engineers for Godavari Bridge at Parabhani.

- **6th Most Outstanding Bridge National Awards – 1999 (Second Prize Category I) For Excellence in Bridge Engineering**
  This award is organized by Indian Institution of Bridge Engineers for the work of Patalganga Bridge.

- **6th Most Outstanding Bridge National Awards – 1999(Second Prize Category III) For Excellence in Bridge Engineering**
  This award is organized by Indian Institution of Bridge Engineers for the work of Konkan Bhavan Flyover.

- **Well Built Structures 1999**
  This award is organized by Builders' Association of India Pune Center for major bridge across Patalganga river & ROB near village Kharpada NH17 in appreciation of achievement in quality, speed and economy in construction

- **Certificate of Appreciation**
  This is organized by Builders' Association of India Pune Center for major bridge at Koregaon Park, Pune city for providing quality concrete to suit prestressing.

Affiliation with Professional Bodies:

- (India) Fellow of Institution of Engineers
- Life Member of Indian Road Congress
- Member of Indian National Group of the International Association for Bridge and Structural Engineering
- Member of Association of Consulting Engineers
- Fellow (Life) of Institution of Surveyors
- Life Member of Maharashtra India Chapter of American Concrete Institute
- Member of Indian Concrete Institute
- Life Member of Indian Institute of Bridge Engineers
- Life Member of The Indian Council of Arbitration
- Member of Builders Association of India
- Examiner for graduation and post-graduation for University of Poona

Details of Contact:
Address- 9,Yashashri,Kohinoor Colony
Sahakarnagar No 2,
Pune 411001,
Maharashtra, India.

Ph: 091-020-24231378,79 (O)
091-020-24228518,0356 (R)
Fax 091-020-24335744
9422320890 (Cell)

Email – ygp9@hotmail.com

17 40 YEARS OF MY BRIDGE ENGINEERING

Mr. Y.G. Patwardhan
Managing Director, Ameyas Infraprojects Pvt Ltd.

17.1 Introduction

17.1.1 My first salute goes to Late Er. S B Joshi, our father in Bridge Engineering.

17.1.2 Be rest assured that I am under no wrong impression that I deserve any award, whether this in his memory or any other. I remember saying of Goyankaji, the Vipaschana Guru. In Dhamma, one is rewarded for whatever good he does – Immediately. One is punished for his bad acts - immediately. This does not happen in Ethical or day to day life. One will not be rewarded for following traffic rules. One may not be punished even for a murder. In day to day life one has to follow the rules as a matter of his duty. I did this in bridges. So, no award is due to me.

17.1.3 Excuse me if you feel that I am miss-using this forum for what I am doing. But, today, at the fag end of my career, I take this opportunity to express my gratitude to my GURUS; all those who helped me in my career.

17.1.4 First is Mr. S T Kenghe. He taught me basics of structures. I was lucky to have him as a teacher. He is the only person I have met having absolute clarity of behavior of structures. I have digested two of his sayings – (i) "Every load has to pass to ground". Once this principle is understood, its travel path becomes absolutely clear to you and analysis of structure becomes easy or simple. (ii) "Some structures have no business to stand." So, don't be under wrong impression that just because a structure is standing, it is safe.

17.1.5 Next is late Mr. Remedios. We used to call him Ramdas. He taught me basics of concrete. He taught me how to make good concrete most economically with available materials. Some of his teachings I remembered whole of my life are (i) Doctors have trained nurses to assist. Engineers don't. We must develop such trained assistants to reduce burden of engineers. (ii) Give me a layman – even an uneducated worker – I will teach him how to do a particular job. (iii) Don't worry about offsets. They are natural. (iv)He reminded us of Dr.Vishveshwarayya and the Engineer's Day. Since then, we observe 15th Sept. as Engineer's Day faithfully. (v) He used to follow given time faithfully but was never angry or never commented if the other person was late. He had faith that that the other person was not late purposely or negligently. He must have some genuine difficulty. He used to reach on time and then keep on reading cuttings reserved for such time.

17.1.6 Third is my younger brother Prakash, for his detailing. He is not an engineer by education. But at one stage I used to say that he is the only engineer in our company. This statement will suffice to state what he is.

17.1.7 Fourth comes my colleague and assistant Vaishali. There is fun in discussing about structures only with a few persons. She is one.

17.1.8 To Late Dr. S R Kulkarni, the only Engineering Geologist in real sense I have met comes next. Our relations were somewhat different. Obviously he was my guru but we also were good family friends. He was our "foundation consultant" practically for all our bridges. Whenever question of quoting for any work came up, first telephonic call would goto SRK. I miss him.

17.1.9 Any achievement was not possible without work sharing by my wife, Ranjana. She looked after our home and I kept on working. There were number of occasions in our life when I should have been with her but I was not. This was true whether it was her medical treatment with full anesthesia or birth of our children. She never complained.

17.1.10 I also express my thanks to Mr. M.B. Gharpure for a few things. In 1980 or so I requested him for a job. He advised me otherwise. He told me "Your salary is Rs. 1000 pm, say 12000 per year. Take work of Rs. 12 lacs and earn that much profit. If you have difficulty in completing the work at any stage, I will take over and complete it". This removed my idea of doing a job. Second is his help after I started working as a contractor. One of his works was nearby ours. Although I was a gold medalist and topper of MPSC, I did not know how to make a PSC cable and whether to put sheathing first or wires. His staff helped us.

17.1.11 I may add one thing here. When I looked at the list of the earlier awardees of this Award, I found that all of them are either planner or designer or head of a big Company. I am probably the only "Executor" or "worker" of bridges. I don't underestimate the other aspects and am aware that all are equally important. In lighter sense, it is like actual cooking. Planner gives you the menu; designer gives recipe, chef i.e. a contractor cooks.

17.1.12 Relations with S B Joshi - When I went to Alibag as Executive Engineer in 1977, three works of S B Joshi Company were in progress in Raigad District, Savitri at Mahad, Savitri at Ambet and Revdanda. When I left Alibag in 1982, first two works were completed. Third was in progress but in difficulty. We tried our level best to avoid termination of contract and we succeeded. Revdanda was completed in 1984 or 85. Probably these were the last contracts executed by their company. All these structures are really beautiful structures and I always remember late Mr. S B Joshi when I pass over these bridges.

17.2 Bridges I was associated with while in Government service

17.2.1 Bridge on NH 3 beyond Dhule – This was a simple structure of five spans of 10 m with solid slab and open foundation. But there was a challenge. I took over on 2nd April 1974 and the bridge was to be completed before onset of monsoons which was done. I learnt my first lesson here. Centering for superstructure of one span was done with two meters of filling. Offset of the earthwork was inadequate. One corner support of centering settled due to dripping of water and we had some period with tension.

17.2.2 Kalwa Bridge on Thane Bhiwandi Diversion on NH 3 – This Bridge had two balanced cantilevers of 100 m each and abutments resting on filling. When I was Assistant engineer, in 1975 – 77, only well foundations were in progress. We faced problem of steep sloping rock which Gammons had anticipated. They had provided notches in well kerb for support which worked. One pier well remained hanging for over a meter practically for two months and one fine morning it settled. The abutments on filling gave a lot of problems and PWD thereafter prohibited such foundations. The bridge was opened when I returned to the Division in 1982 as an Executive Engineer.

17.2.3 Savitri at Mahad – Although I was not directly associated with this bridge, I remember one problem. The design of super structure provided a neck at junction of cantilever foot path and the carriage way for which officers were worried. I am told that the bridge is functioning well.

17.2.4 Savitri at Ambet – This was a dream project of Mr. A R Antule. The bridge saved a detour of 40 kms for NW Ratnagiri and it really was a necessity. I got associated with the work when I took over at Alibag as Executive Engineer in 1977. Walking over launched T girders with water below at 10 m and water depth of 10 – 12 m was a life time experience. I saw the type of launching girder used on this bridge for the first time and learnt a few critical design aspects thereof from my chief engineer. We fabricated a similar launching girder and used it on

Kharpada and Dharamtar Bridges. *Fig 17.1* shows this girder. *Fig 17.2* shows the Bridge. The bridge was opened some time in 1978 at the hands of the Chief Engineer when Mr. S B Joshi was the chief guest.

Fig 17.1 The launching girder

Fig 17.2 Completed Ambet Bridge

17.2.5 Revdanda - This again was a dream project of Mr. A R Antule. The bridge saved a long detour for western part of Raigad and particularly Murud and this bridge also was a necessity. Award of this bridge to S B Joshi Company had a story. The Chief Engineer was not prepared to award this work to the company. The Chief Engineer was replaced and the work was awarded. The bridge was transferred to me immediately after I took over at Alibag in 1977. My predecessor was diffident of passing foundations and I passed five well foundations in first 15 days, really speaking without knowing what I was doing. Looking to the difficulties in the work, Government granted a special advance of Rs. 5 laks to the contractor which, at the back of mind, was not recoverable. To the bad luck of the project, one negative minded and totally diffident chief engineer came in picture who was more worried about recovery of this advance than completion of the project. Had this not happened,

the bridge would have been completed at least two years in advance. Somehow the bridge was completed sometime in 1984 – 85 through the same contractor.

17.3 Retrofitting

17.3.1 Retrofitting has been my passion rather than profession. Today, in big projects, the trend is more towards reconstruction. But during the peak period of my carrier, availability of funds was a problem and widening and strengthening, if possible, was preferred. This was true of all types of bridges and more particularly old Arch bridges. There can be 204 different combinations for old bridges to be widened and / or strengthened and we had developed solutions for all of them. We treated every one of such old structures as a problem in itself and tried to find an economical solution.

17.3.2 Arch Bridges: Earlier, many of the highway bridges in our country were built in the form of Brick or CR masonry arches, support over the abutment and piers also made from the same materials. In many cases, those bridges, which were built several decades ago, were designed to cater to the traffic prevalent in that period. Without exception, such bridges were narrow as compared to present standards and invariably needed widening. Suitability for present loads and if not, possibility of strengthening them for current loads was the next problem. On inspection of these bridges, however, an inescapable conclusion could often be drawn that in spite of aging, the bridges could be strong enough to permit their rehabilitation so as to make them worthy of the relatively heavy traffic of the present time and widened to the present requirements. Further, it would be both economical and time saving proposal if the bridges could be rehabilitated to cater to the present requirements of the traffic rather than abandoning such bridges.

Initially we did not have any guide lines to decide whether an existing Arch bridge is safe to carry required loads and if not, whether and how it can be strengthened and in either case how to widen it. During 80s BARC was facing one problem. They had to take their heavy loads over existing High Ways. If the road surface was weak, easy solution was available that they would repair it if damaged but bridges; small or big, posed a problem. It was necessary that they obtain permission of the highway authority but the highway engineer faced difficulty either in clearing the loads or objecting to it because he had no tools to decide. BARC therefore developed a simple computer program to decide whether an Arch Bridge was safe and if not how it can so be made. We used to take our cases to them to find the answer.

While in Government service, we used BARC method and did retrofitting of two bridges on Pen-Khopoli road and two on Panvel-Uran road. We also carried out load test on all these bridges and declared them safe for current loads. Load testing of two bridges on Alibag Khopoli road showed that they were weak and were replaced.

Later, I and Prof. S K Parikh developed software for the three dimensional finite element analyses for arch bridge systems. We together must have analyzed more than 150 bridges. The concerned engineer had to inspect the bridge and fill up a questioner. We used to give solutions.

As a consultant I have inspected and analyzed 14 major bridges in PMC out of which 6 were Arch bridges. We had informed PMC that except Bund Garden Bridge all others could be widened and strengthened. Bund Garden Bridge is a flat elliptical arch and could not be retrofitted.

17.3.3 Special retrofitting works we did

17.3.3.1 Kawad at Bindusara River Bridge in Beed district

The existing major bridge on Bindusara River in Km 255/800 of Solapur Osmanabad Beed Aurangabad Dhule MSH1 was constructed sometimes in 1930. Its carriageway width was 5.5m. The bridge falls in approach length of MSH to Beed town. The city has been growing beyond the bridge owning to its strategic location in the State. In addition to the highway traffic, a lot of pedestrian and local two-wheeler traffic is using the bridge. There was heavy demand to widen it to standard two lane width and also provide footpaths. Due to typical structure of the existing bridge and the bed conditions, widening by conventional method was costly and time consuming. Founding level of piers below bed level was about 5 m. There were pebbles in bed due to which excavation up to foundation level and widening piers from foundation level was rather impossible. An innovative method was, therefore, devised and adopted. We suggested and adopted a scheme which the Chief Engineer has named as "Kawad over pier". Existing super structure had 4 RCC girders and we decided to provide 2 additional girders of same size, one on either side for widening. To support these extra girders we decided to provide a reverse cap over the pier which is hung from top of the pier. Gap available between existing beams is used for this purpose. Masonry piers were checked for the additional load. Widened portion of superstructure rests over cantilevers taken out from this hung cap. The lower ends of the pier cap cantilevers on either side were connected by a small beam. *Fig 17.3* shows the structure.

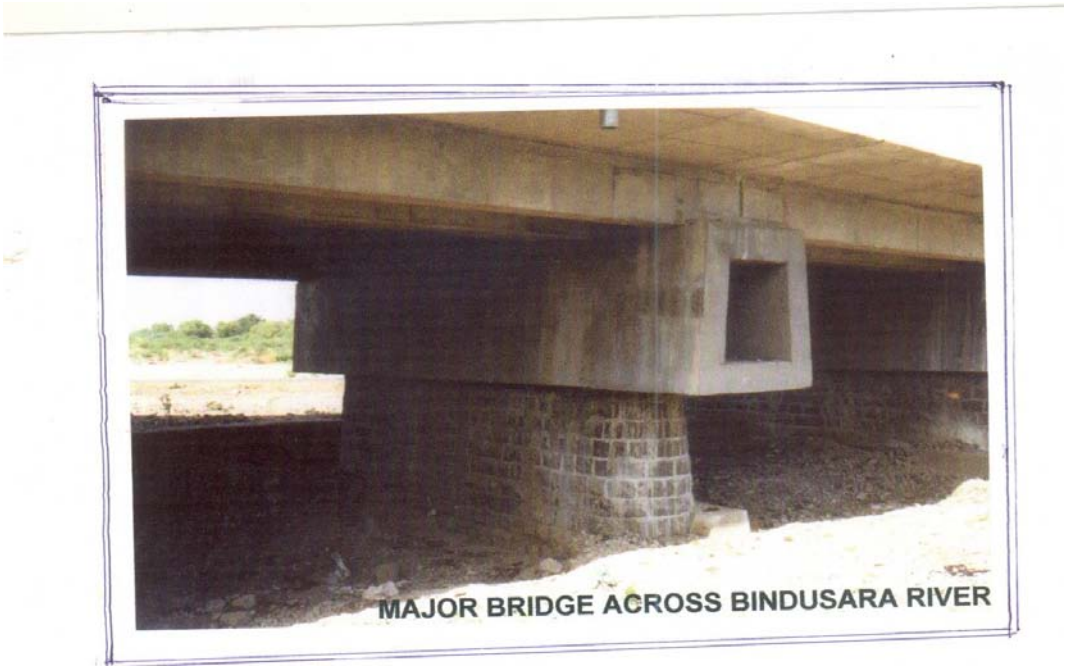

Fig 17.3 Bindusara Bridge

17.3.3.2 Slab on slab in Rahata Bridge near Shirdi

This idea struck to me over a cup of tea in 1978 or so. There was a very narrow bridge in the mid of a village on a village road in Mhasala Taluka of Raigad District. I made some calculations on spot and instructed my staff to cast a slab over existing solid slab with cantilevers. I presumed that the foundations will take the load. We adopted the same technique on bigger scale on Rahata Bridge. Widening was required to make carriageway to standard two lanes and also provide foot paths. RCC slab of required width was laid on existing solid slab by providing shear connectors embedded in existing slab. *Fig 17.4* shows the arrangement.

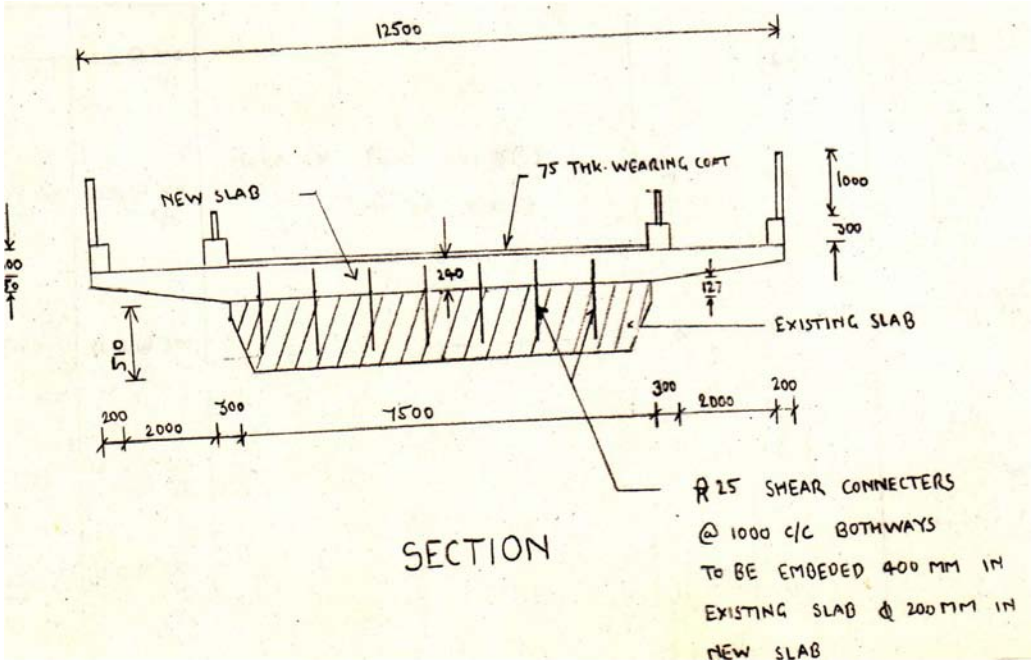

Fig 17.4 Rahata Bridge

17.3.3.3 Widening of bridge on Mula River near Rahuri, Ahmednagar

The Bridge is in the mid of Rahuri town and widening to provide standard 2 lane width with footpaths was required. Well foundations were checked for the extra load. Piers were encased and widened on existing well cap. Extra beams were provided on either side at same spacing as that of existing beams and cantilevers were taken out for widening. Entire traffic was plying over the bridge during widening. While planning for the work it was not clear from the available drawing whether wells are resting on rock. We were worried. A layman was listening to our discussions, came forward and told us that he was working as a supervisor when the bridge was constructed about 20 years back and confirmed that wells were properly resting on rock. We were relieved. *Fig 17.5* and *Fig 17.6* show the arrangement.

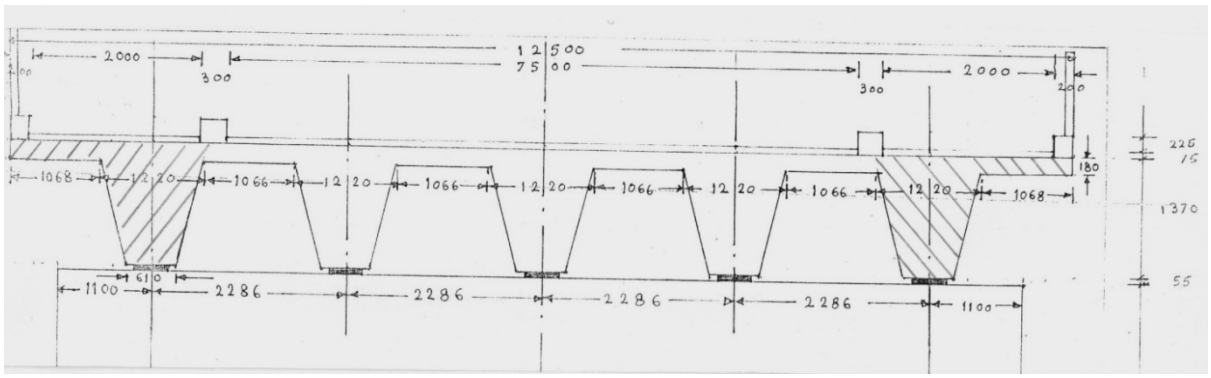

Fig 17.5 Bridge on Mula river at Rahuri

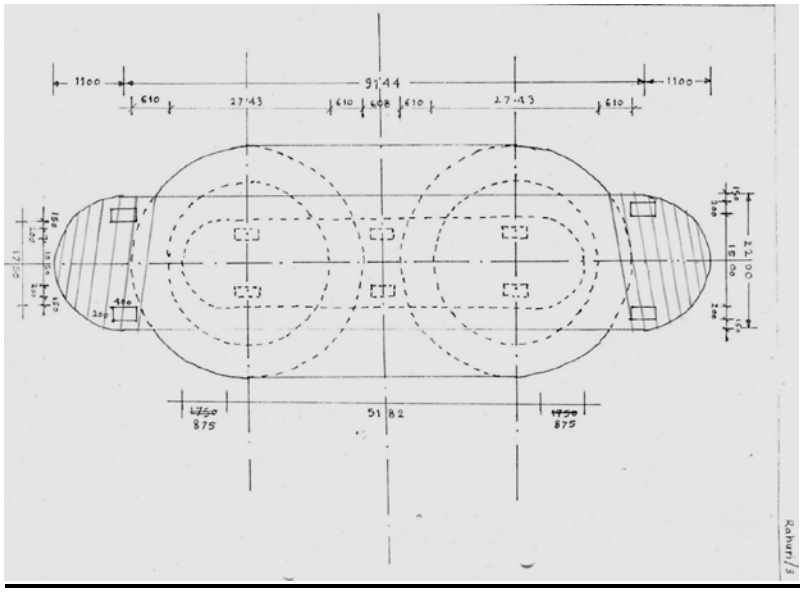

Fig 17.6 Bridge on Mula river at Rahuri Hatched portion shows widening work

17.3.3.4 Widening of Ghod Bridge on Pune – Ahmednagar road

Existing masonry arch bridge was widened by removing equivalent cushion material and replaced by PCC leveling course and RCC slab. This challenging job was completed in a record time of 59 days.

17.4 Mentionable major Bridge works

17.4.1 From 1985 till date, I have been associated with construction of 112 bridges with open, pile & well foundations. They included flyovers, Railway over Bridges, Bridges on rivers; in back waters and on creeks. Only type that remained is cable stayed bridge – since I did not get opportunity.

17.4.2 Some statistical achievements in new construction worth mention are:

Longest continuous span – 4 continuous spans totaling to 152m on Chhedanagar flyover in Mumbai.

Longest prestressed concrete box – 2 continuous spans of 60m each on major bridge across Rohile creek on Rewas Reddi.

Largest diameter well for foundation was 14 m for Mithbav resting on alternate layers of shale and quartzite.

At Chhedanagar flyover, we did grouting in rock to improve SBC. Bore was taken after grouting and results were excellent.

We are at present executing Khopta Bridge near Uran with 75 + 45 m continuous PSC box type superstructure and two such units. One of the foundations has well of 12 m diameter. The weathered rock at foundation will be grouted to improve SBC.

Terekhol Creek Bridge near Sawantwadi with 59m PSC T girder.

17.4.3 Balance work of bridge on Gandhari (Ulhas River) in Kalyan, Thane

The previous contractors had completed all five well foundations, part substructures and superstructure of span no.1. While casting the second span the centering collapsed along with the superstructure. The work was withdrawn from the original agency and the balance work was

entrusted to us. We had to break the collapsed span and clear the creek and complete the balance super structure. *Fig 17.7* shows the completed structure.

17.4.3.1 Difficulties faced

- Water in the creek was polluted due to chemical disposal of factories on upstream and was black and with very stinky bad odor so much that divers could not see with their torch and could not work for long.

- Concrete of collapsed span was too good to break. We could not estimate cost thereof reasonably while quoting. Quotations received after award of work only for clearing the collapsed span ranged from 1 to 1.5 crores in a job of 3.5 crores. We did the job economically with our own staff.

- There was exposed rock in bed. Box type super structure had to be cast in situ. Standing water with current was to be faced. We adopted simple to look but complicated to understand and economical centering. Supports consisted of trustles and trussed beams with tor steel as tension members; a concept we tried first time in my career. The divers developed foundation of the trustles with un-believable accuracy. Thanks to Mr. Kenghe's confidence.

Bearings were not supplied in time. As monsoon was fast approaching, concreting of superstructure was done first by placing structural steel pieces and subsequently bearings were placed by lifting the superstructure.

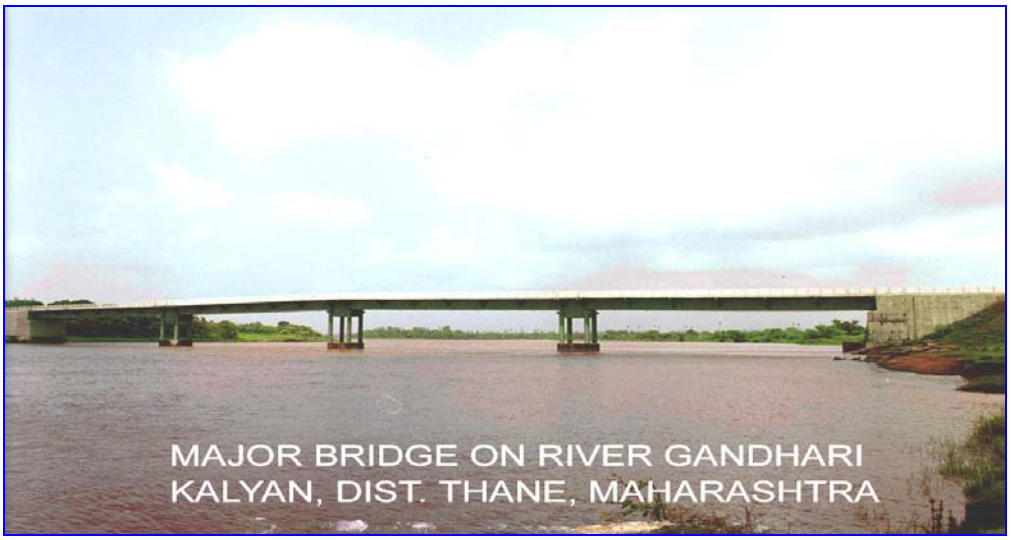

Fig 17.7 Bridge on Gandhari at Kalyan

17.4.4 Mithbav Creek Bridge near Deogad

NIT showed good hard rock for foundations and specified SBC of 200 t/sqm, being the upper limit specified by IRC. After award of the work to us trial bores were taken. I and Dr. S R Kulkarni went to site to inspect the cores and to decide foundation levels and SBC. I was happy to see the shining core pieces and Dr Kulkarni was shocked. Actual strata met with were alternate layers of shale and quartzite with SBC of 20t/sqm to 200t/sqm.

Our original tender proposal was 2 units of 2 spans continuous. Since the rock could not be certified as non-settleable, continuous spans were ruled out and we had to go for simply supported spans.

Central location had worst conditions. Hence the design was converted in to 3 simply supported spans.

We had to provide one pier foundation with 14m dia well and RCC bottom plug.

Last span was cast just before monsoons. As flood came, there was a fear of centering washout. So we adopted partial stressing on some cables and full stressing after words. While doing so, we faced problems due to slippage of master wedges.

17.4.5 Dharamtar Creek Bridge near Alibag

The Bridge was constructed on B.O.T. basis.

New bridge was at 15 m from the old one. NIT provided for a vertical curve with 2% gradient but when work was started it was realized that with this gradient, earth behind abutment would spill on existing road which could not be permitted. Hence, the gradient was changed to 3%, upsetting the whole planning and wasting the original designs.

Old bridge constructed in 1952 was weak. When I took over at Alibag as Executive Engineer in 1977, I received complaint that there are heavy vibrations on the bridge. I was instructed to look in to and to my utter surprise I realized that, for economy, only two outer plate girders were provided instead of total four. When analyzed, it was found that bridge was safe only for “class A” load. Load restrictions were imposed in 1978. In further 20 years the steel super structure started showing signs of rusting. So the condition was critical and there was pressure to complete new bridge as early as possible.

While quoting for the work, we had assumed cast in situ Box girder. Subsequently we realized that if we go for pre-cast and launched girders, we could complete the bridge eight months ahead, no doubt at extra cost of about 1.25 crores. Being a BOT work and due to the tender provisions allowing early start of toll collection, we preferred this arrangement and completed the work in 17 months.

While the work was in progress, pier well no.6 got tilted beyond permissible limits. Just after concreting of 6^{th} lift, the well got tilted up to two meters partially damaging the island. Angle of inclination was practically 40 degrees. Firstly the reason of tilt could not be imagined and secondly the fear of further tilt continued. Subsequent enquiries revealed that more difficulty was experienced while driving ballies for the island made for this well on Alibag side as compared to Pen side. Practically one extra bulli of 4 m height was required. If this had come to surface in time, proper precautionary measure could have been taken. Attempts were made to take out sample of the material met with at cutting edge. It was observed that there was stiff clay on Pen side and softer clay on Alibag side. Luckily even after waiting for six weeks the well did not tilt further. Opinion of number of experts was obtained. At one stage even the possibility of dismantling this well was considered but was not needed. Finally the well of P5 was completed, P6 well was tied to P5 well by HT strands and the well was pulled by stressing these strands. This worked and the tilt got rectified. Particularly, the final tilt in case of P6 is the lowest amongst all wells. *Fig 17.8* shows the tilted well. *Fig 17.9* shows the arrangement adopted for correcting the tilt.

Before that, we had corrected tilted well of Mula River Bridge at Manjari near Rahuri pulling the well with wire rope taken around a tree and using poclain.

Fig 17.8 Tilted well of pier no 6 of Dharamtar Bridge

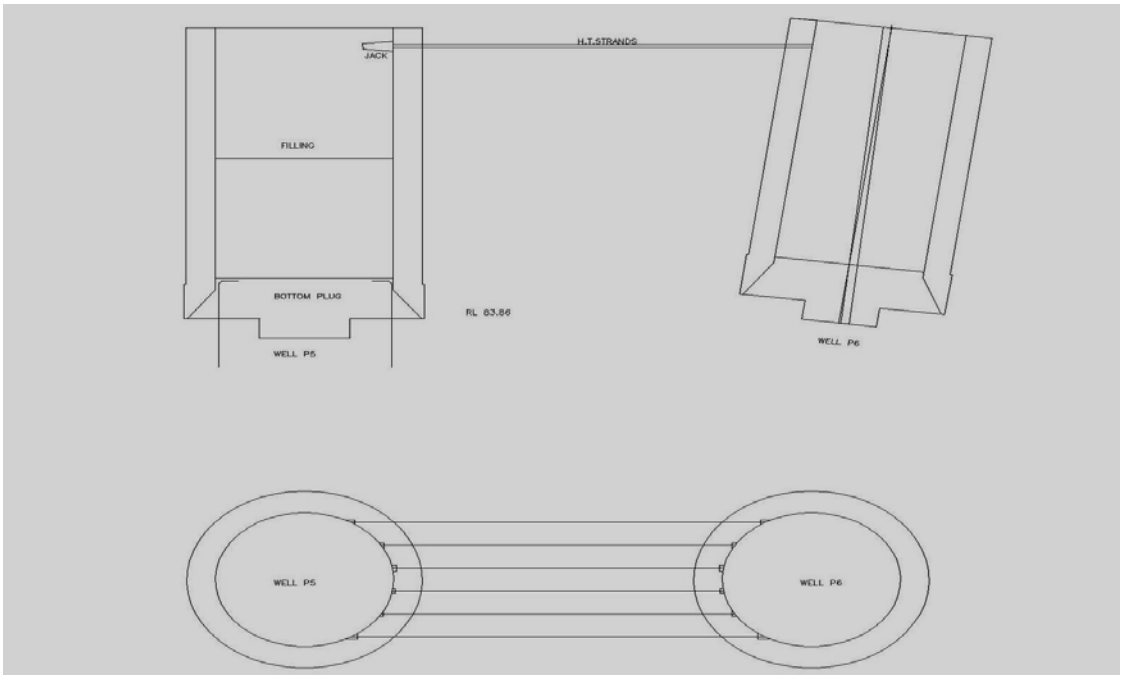

Fig 17.9 Tilted well of pier no 6 of Dharamtar Bridge tied to well of P 5

17.4.6 Terekhol Creek Bridge near Sawantwadi

The Bridge is under construction. Here again original proposal was to cast and launch "T" beams. When design of launching girder was attempted, we realized that it was very costly and time consuming. Hence we adopted casting of the three girders one by one and side shifting. For this we have adopted simple light weight and economical centering for 59m PSC T girder having girder depth of 3.7m. For one unit, we divided the span in three parts. Ends are supported on piers and there were two trustle foundations. For second unit of centering, span was divided in two parts with four no of Main centering trusses of 25m span, each having weight approximately 3.0 Tons and four no of outer centering trusses of 28m span, each having weight approximately 1.5 Tons. Maximum centering height is 20m. Due to coastal region rusting of truss members occurred. We also faced problem of bending and

buckling of truss members during stacking and lifting of truss by crane. But we are successful in casting of 59m girder in situ on these trusses. Once again, thanks to Mr. Kenghe's confidence. *Fig 17.10* shows the centering arrangement of unit

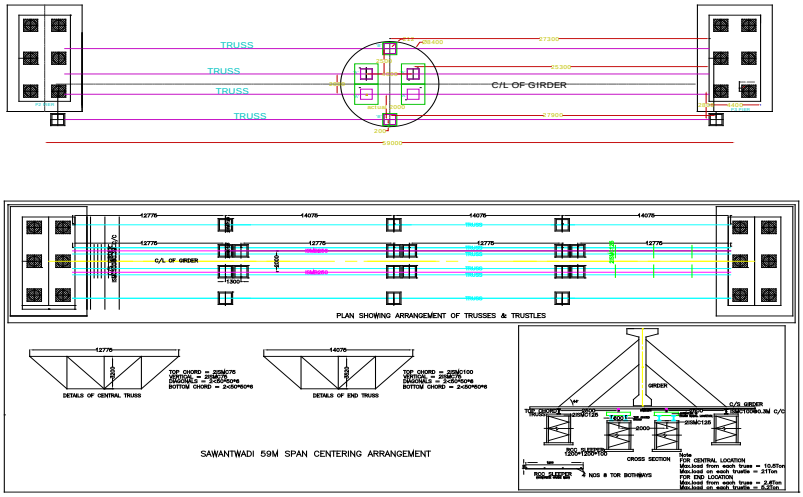

Fig 17.10 Centering arrangement of unit 2 of Terekhol Bridge

17.5 Mistakes in design done by me

17.5.1 We usually use simple cantilever brackets for cantilever slab centering. At the initial stages I designed one such bracket where tension bolt was away from diagonal. The end vertical member got bending moment which was not considered and the vertical member got bent. The correct method is to provide diagonal members on either side of tension bolt. *Fig 17.11* shows the correct position whereas *Fig 17.12* shows the wrong one.

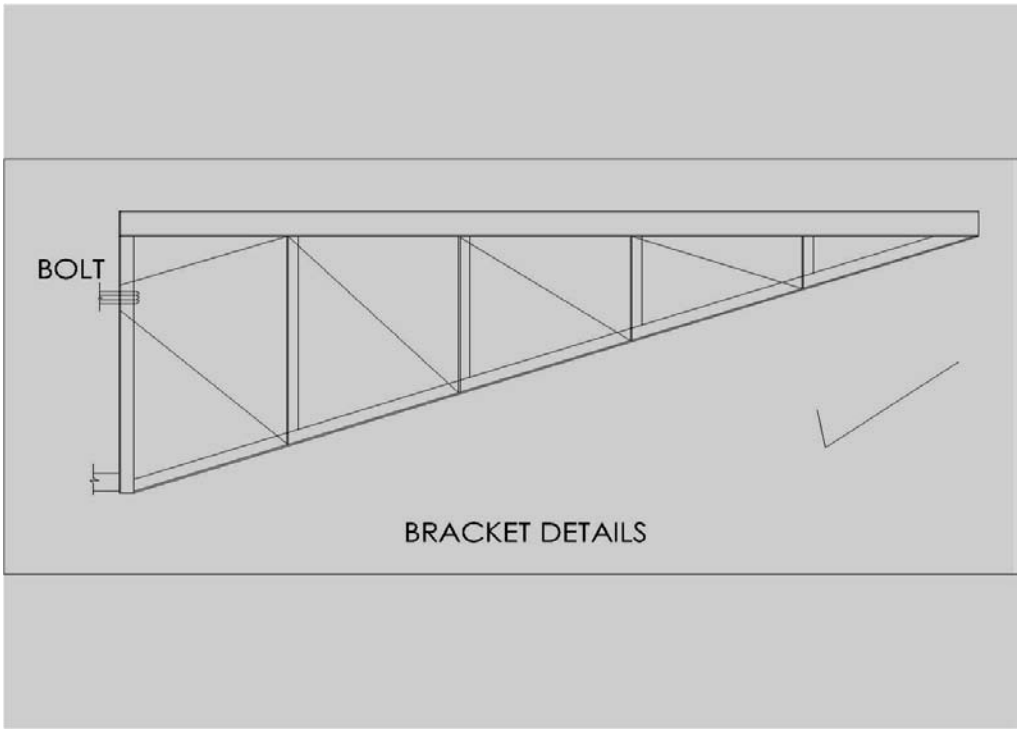

Fig 17.11 Simple bracket usually used for cantilever

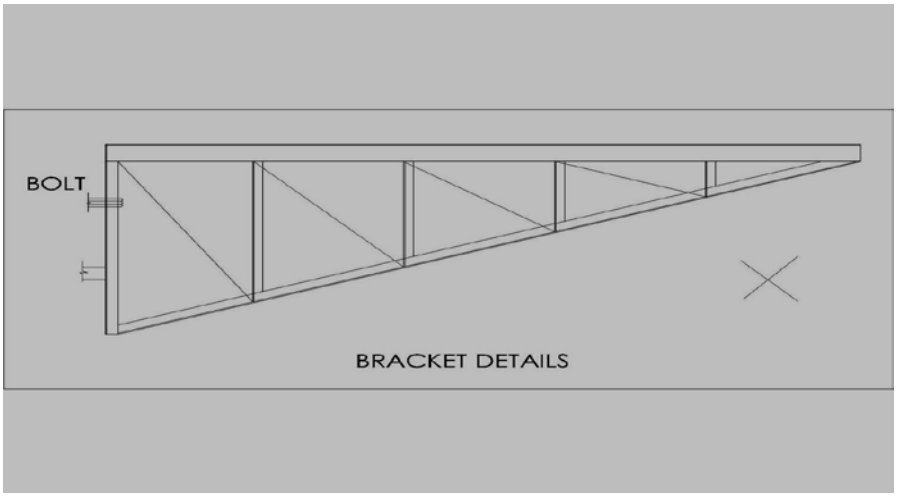

Fig 17.12 Simple bracket usually used for cantilever

17.5.2 Centering trusses for Konkan Railway Bridge

The super structure was a 2 span continuous portal. Height from bed was about 10 m. We decided to provide full span trusses for centering. Shape given to the truss was as per shape of super structure. Sketch 8 shows the truss. I prepared the design of centering which was submitted and approved in good faith. Trusses were erected. It was middle of April. When I went to site and saw the progress I realized that completing super structure before monsoons was difficult. The bridge was in a valley and there was heavy wind. Reluctantly and painfully we decided to cast the super structure only after monsoons. Now, leaving the trusses in place was risky and we decided to bring them down. Since time was available, we decided to load test the trusses on ground. When full load was applied and just after Mr. Kenghe and my brother, after inspecting the trusses from below, came out, the truss collapsed. Reason was some portion of top chord got bending which was not catered for. Though the accident put us to a substantial financial loss it was a blessing in disguise since (i) Mr. Kenghe and my brother survived and (ii) the havoc that would have been created had the trusses collapsed after the super structure casting was started was avoided. Lesson learnt – be careful for bending in trusses. Plan for it if it is un-avoidable.

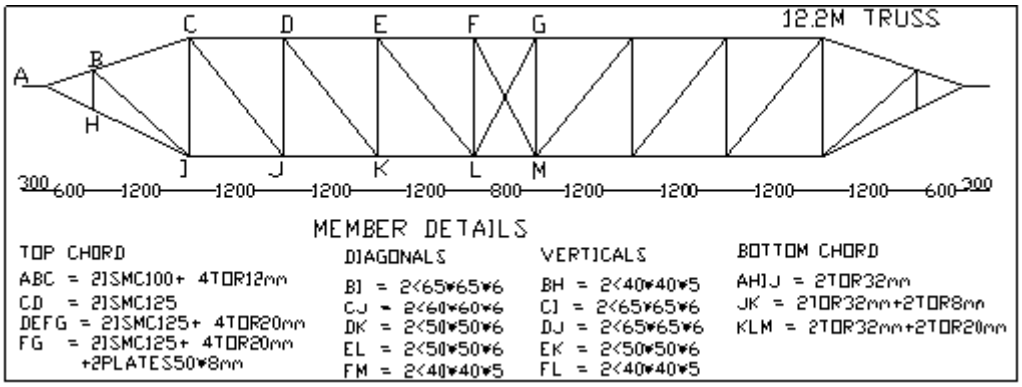

Fig 17.13 Centering truss for konkan railway bridge

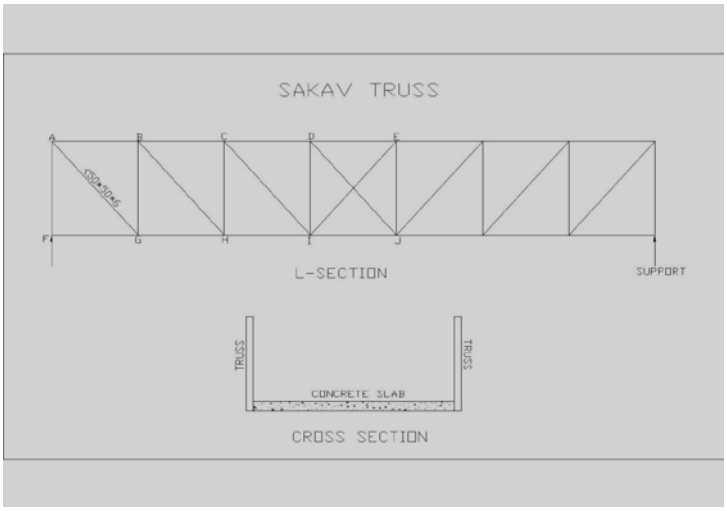

Fig 17.14 Sakav truss

17.5.3 Sakav Truss

Sakavs are foot bridges. In 1980 or so the Government of Maharashtra took a crash program of constructions of sakavs. I was keen and rather in hurry to execute the program since I knew the necessity and importance of such foot bridges. My father had survived twice while crossing temporary foot bridges constructed of tree branches. I therefore obtained the drawing from Designs Circle before it was officially issued and started the work. *Fig 17.14* shows the truss. It was a through type steel truss with precast slab for flooring. Since site conditions were favorable, we decided to cast the slab in situ. 1st tension member was provided as single angel. During casting of slab some un-expected support occurred. Tension member got converted in to a compression member. The sakav collapsed while removing centering. One person died.
Lesson learnt – Always check frames for reversal of stresses either during construction or during functioning.

17.5.4 Concrete Quality

I used to be proud that in the 25 years, except for 2-3 cases where we were not at fault, there was no failure to achieve concrete strengths. When I told this to Mr. M.M.Tilak of BARC with pride, he gave me a shock. He told me that this is not adequate. He asked me what our standard deviation was. IS 10262 provides suggested values of standard deviation -

Grade of Concrete	Standard deviation for different degree of control in N/mm2		
	Very Good	Good	Fair
M25	4.3	5.3	6.3
M30	5.0	6.0	7.0
M35	5.3	6.3	7.3
M40	5.6	6.6	7.6

I did not know the answer. When checked, we found that our standard deviation was much lower than that provided for best control.

17.6 More stress on user's convenience

Gandhiji has said that your customer obliges you by coming to you. Don't be under impression that you oblige him. According to me same is true for users of bridges. We should be concerned about the users' convenience. The users are not much concerned with the foundations or the type of super structure adopted. They are concerned with their comfort while travelling over a bridge. I kept this in mind while in Government Service as well as while working as contractor. I always

told my people to take utmost care about level of wearing coat, line and level of railing and avoid jerks on expansion joints. I feel I have reasonably achieved this. We made one successful experiment and placed Expansion Joints after casting flexible wearing coat. Results are excellent.

Actually it is engineers' job to provide Vertical curves to avoid sudden jerk. This should be done for every size of bridges, but unfortunately the aspect is many a time neglected. In every case where a bridge has sloping approaches on either side, the elevation must be a vertical smooth curve.

17.7 My idea about communication with structures

There are 3 types of patients – smart, medium, innocent. Structures are of 3rd type. We have to talk to them and then they do so with us. It is only by visual inspection I know whether my patient is well and if not, what is wrong with it.

17.8 Other contributions to bridge engineering

17.8.1 Worked on a number of IRC committees. Particularly in case of sub-surface investigations done before calling tenders, I and late Dr. S. R. Kulkarni found that a lot needs to be said. It is my general observation that codal provisions are pre dominated by officers from North India where conditions are quite different. There, rock is not available in foundations in majority of cases whereas in Maharashtra it is abundantly available. At the same time, one cannot relax with assumption that what is available is always reliable. We wanted Maharashtra Government to modify the codes to match with the local conditions.

17.8.2 We wrote two papers on the subject. The first one was titled "Importance of Sub-Surface Investigations by Core Drilling for Bridges with Particular Reference to Deccan Trap Areas. This was published in IRC Journal 2000 vol.61 -3. The other paper was "Short-falls in sub-surface investigations for bridge foundations". This was published in Foundations for major bridges - Design and construction: IABSE Colloquium, New Delhi, India 1999. The paper was presented and discussed. The papers dealt mainly with Deccan Trap. This covers 85% of Maharashtra and also occurs in M.P., Gujrat, Saurashtra, Karnataka and Andhra Pradesh. Some special features of Deccan Trap were discussed. Important features of proper investigations were then explained. A review of various codal provisions was taken and some modifications suggested. Case histories both for success and failures were given.

Actually, adequate guidelines are available in various I.S./I.R.C. codes and Chapter-6 of P.W.D. handbook of Government of Maharashtra. However, in practice, these guide lines are not faithfully followed. In order to extract maximum possible information from the process of drilling, it is necessary that the cores obtained are kept in a good condition, properly arranged and accurately marked. The information obtained during drilling operations further needs to be faithfully and completely preserved. Interpretation by a trained and competent person is equally important. Although, importance of proper investigations and proper interpretation is said to have been realized by engineers, in field the picture is totally different. Core drilling is being done more as a formality. This is true whether the investigations are carried out by a renowned agency or a local one. Interpretation is either not done at all or is done by persons not competent for the purpose. While doing investigations in general and interpretation in particular, what is not obtained in the core is more important than what reverse is obtained. What is not obtained can be analyzed only if very detailed observations are recorded during drilling and then the total information so collected is interpreted by a person who is well conversant with the geology of the area and the behavior of the structure for which investigations are carried out. Even in recent past there are a number of projects which have suffered due to inadequate or improper sub-surface investigations. A number of collapses have occurred due to improper interpretation

of founding stratum. At the same time there are a number of projects where considerable economy is achieved with proper investigations.

17.9 **My experiences as a contractor**

It has been my dream that the client should treat the contractor as an equal. We see pictures in news papers or on TV when two contracting parties sign a contract and hand over copies to each other while shaking hands. My dream is yet to come to reality. No doubt, this depends on demand-supply ratio. But, it must be remembered; particularly by Government Officers that they and the contractors are two sides of a coin. None would have existence or would be successful without the other.

Rights and responsibilities – While working as a contractor, I always experienced that only the contractor's responsibilities and the officer's / client's rights are remembered. The always forgotten. Government contracts are one sided for obvious reasons. However, no body stops an officer to be reasonable. Comparatively, FIDIC document is reasonable and takes care of both sides.

Approval to centering design – Invariably, the contractor is insisted to submit design but in the last 25 years I do not remember a case where the design is approved before the super structure is cast. At times, the officers shamelessly approve the design after ascertaining that the casting is complete and the centering has not collapsed. One officer told me a case with pride. He was forced to check and approve the design and then inspect and approve erected centering. He went to the site and took 100 remarks which the contractor could never comply. Only change that happened thereafter was that that officer was never asked to do so.

17.10 Published Technical Papers

- **Difficulties experienced while executing balance work of construction of major bridge on Ulhas Creek near Gandhari on Kalyan – Bapgaon Road in Thane District (Maharashtra) –** This was Published in IRC Journal 1997 vol.58 -2. Authors were S.T.Kenghe, Structural Consultant, M. V. Patil, Chief Engineer (P.W.D.) Maharashtra and Y. G. Patwardhan. The report presented therein is regarding difficulties experienced while completing the balance work. This paper was awarded Gold Medal by IRC.
- **Short-falls in sub-surface investigations for bridge foundations –** This was Published in Foundations for major bridges - Design and construction: IABSE Colloquium, New Delhi, India 1999. Authors were S.R.Kulkarni, Engineering Geologist, V.B.Borge, Chief Engineer (P.W.D.) Maharashtra and Y. G. Patwardhan.
- **Finite Element Investigations for Ratings purpose as well as for the purpose of widening the old Godavari Bridge –** This was Published in IRC Journal January 1999 Vol.59 –Part 3. Authors were S.K.Parikh, Finite Element Consultant and Y. G. Patwardhan. The theme of the paper was - A masonry arch bridge represents a complex three dimensional continuum, comprising an assembly of arch barrels, Piers / Abutments , cushion material and spandrel walls. These components interact and share the applied vehicular and other loads. Rational understanding of the phenomenon of interaction would go a long way towards realistic rating analysis; for which a three dimensional finite element analysis serves the purpose admirable. This paper deals with – Brief description of the proposed finite element analysis, Application of the analysis software for rating of old Godavari arch bridge at Nanded, Maharashtra and Application of the analysis software for design in respect of widening of the Godavari Bridge.
- **Widening of Major Bridge on Bindusara River in KM 255/800 MSH No.1 by Innovative Method –** This was Published in Indian Highways Journal May 2000 Vol.28 No.5. Authors were S.T.Kenghe, Structural Consultant, V. B. Borge, Chief Engineer, (P.W.D.) Maharashtra and Y. G. Patwardhan. The paper gave account of concept, design and execution of the work.

- **Importance of sub-surface investigation by core drilling for bridges with particular reference to Deccan Trap areas–** This was published in IRC Journal 2000 vol.61 -3. Authors were S.R.Kulkarni, Engineering Geologist, V.B. Borge, Chief Engineer (P.W.D.) Maharashtra and Y. G. Patwardhan.
- **Non-linear finite element analysis of old masonry bridge and corroboration with prototype load test till failure –** Published in Structural Engineers world congress in 1998. Authors were S.K. Parikh and Y. G. Patwardhan.