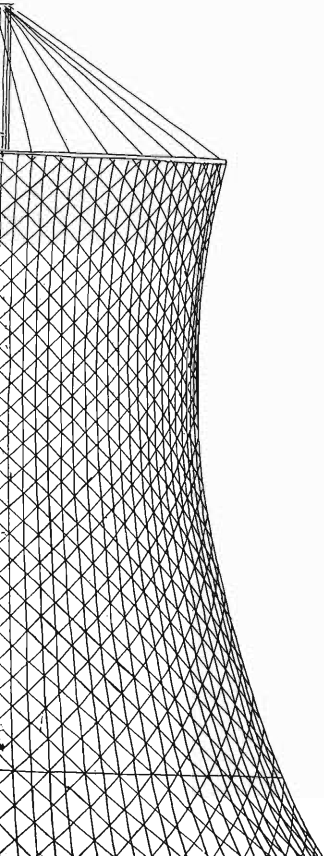

contour

The Civil mag

FROM THE EDITORS

HELLO! and welcome back to the beginning of another new semester. We hope the last sem. went off well and this one will be equally good. For the 2nd and 3rd years this is the time for building up CGPA'S - for final years, a time for relaxing, waiting for those AIDS and jobs, and reflecting on the last $3\frac{1}{2}$ years here. And, we hope this is a time when all of you out there will contribute to our magazine.

Which brings us back to the first issue of CONTOUR - the response from the students side has been extremely poor. Even among those whom we personally approached, only a handful finally contributed something. In such a state of affairs, it seems unfair to crib about CONTOUR not coming out regularly, not enough issues, etc. etc. We hope this trend will be reversed, and expect an overwhelming response this time from U.G.'s and P.G's. The faculty on the other hand, have been very helpful and cooperative in handing over interesting and informative articles.

A short note on CEA (remember it!). The CEA's activities over the years seem to be showing an exponential decay. First, we had enthusiastic participation in all events. Then we had several lectures, filmshows etc., but limited student turnout. And now, the years activities haven't even taken off. It is imperative that the students take an interest in, and help rejuvenate the CEA. We feel that this is an extremely useful and perhaps essential organisation for furthering the student-faculty interaction, and for gaining knowledge which is not found in text books.

Coming back to this issue, we have in store for you articles on CAD, water treatment, interview with Prof.R.Radhakrishnan etc. Before we sign off, we would like to thank the HOD, typists, and the printing section people who were instrumental in bringing out this issue.

HAPPY READING!

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THE COVER PAGE SHOWS A PART OF CABLE NETWORK SYSTEM FOR A DROUGHT COOLING TOWER.

DESIGN JOJU / AMALAN

LETTER FROM THE HEAD OF THE DEPARTMENT

It gives me great pleasure to learn that the students of Civil Engineering are bringing out the next issue of Contour, a student magazine for Civil Engineering and related interests. At the outset, I congratulate the Editors and all those responsible for bringing out this issue of Contour.

In a developing country like ours, the Civil Engineers have a major role to play in building up the infrastructural facilities in the very important areas of housing, water supply, sanitation, irrigation, transportation, industrial structures, ports and harbours. The graduates of IIT have a special responsibility in the above nation-building activities. The nation expects them to play a leading role in design, analysis, construction, innovation and optimisation. With the introduction of personal computers and more recently computer work-stations, curriculum and training pattern in IIT has been vastly re-organised to suit the modern developments. With the excellent training that has been imparted to the high calibre basic material of the IIT students, I am sure they can play a leading role in the national development in the years to come.

I wish all the Civil Engineering students success in their career.

(HARIHAR RAMAN)
PROFESSOR AND HEAD

PROF-FILE

In this issue the spot-light is on Prof.R. RADHAKRISHNAN. Contour editors Joju and Dinesh had a chat with him on 29th September (incidentally his birthday) and discussed various matters of interest to all of us. We present here some facts about Prof. RRK and his views on a wide range of topics.

Prof. RRK was born in Thanjavur District. His father, who is a retired school teacher, had his services completely in Trichy district. Hence all his schooling was done in the same district. For his school, the so called SSLC on those days, he had to walk 5 miles up and down daily to a place known as Lalgudi. After completing the SSLC with the Second rank in the school he moved to National College, Tiruchi for his intermediate examination which he passed in 1950 by getting four distinctions out of the five subjects. Then he joined the College of Engineering, Kakinada in the then composite Madras State. He had some problem of health during the course but the determination and the encouragement from many of his friends and relatives enabled him to complete the course in 1956. Then he joined the Engineering College,Guindy as Asst. Lecturer in Civil Engineering and continued there till 1958 when he joined the graduate Programme in Structural Engineering which he completed in 1959. He continued again in the same college till 1961 when he joined I.I.T. Madras when it was located in the CLRI buildings. It must be mentioned here that Prof.RRK was topper (with record marks in B.E.) both at Kakinada and at the College of Engineering, Guindy In the Structures division, he is one of our senior most professors. Just to have a change from the beaten track, Prof. RRK chose the newly emerging field of Structural Dynamics by attending a specialist course in the University of Rourkee where there is a full fledged department of Earthquake Engineering. Later in 1967 he went to FRG to continue the specialisation in the same field and returned 1969 after doing some theoretical work and part of the experimental work in the Technical University at Braunschweig. He completed his Ph.D. Thesis by Pursuing some more experimental work at the then newly constructed Structural Engineering Laboratory.

His views on Students going abroad

He is not at all against students going abroad for advanced studies but wants them to come back and serve the country. The feeling of patriotism is absent or negligible among the students of today and this feeling must be inculcated right from one's childhood. The man cause of the problem is the present state of our educational system.

About CE Courses

The courses and the methods of teaching at I.I.T.,Madras are of a very high standard. More importance must be given to design oriented subjects and drawings.

About GATE

I.I.T. students generally do not fare well in the GATE mainly because they are not very much interested in pursuing their studies in India and majority of the students either want to go abroad for higher studies or join management institutes.

About B.Tech. Projects

Students do not devote enough time for their projects (This is true with all the departments). The time allotted is too much and not utilised properly. Maximum amount of work on the projects are done only during the end of the semester.

About Computers in Civil Engineering

The use of the computers is inevitable in these days but one should not be a slave to it. It should be used as a tool - more imoortance must be given to the experimental studies as Civil Engineering is a practical one.

Prof. RRK says that we should think of Structure as having Life - Stresses in structures being anologous to the stress in life.

CAD IN BUILDING TECHNOLOGY

Dr. M.S. Mathews.

ABACUS is the computer group of the University of Strathalyde, Scotland. ABACUS is widely regarded as one of the foremost research units concerned with the development of computer-based techniques for appraising many aspects of building design and performance. Even though ABACUS has developed a number of packages, this article briefly reviews the E.S.P. package only.

E.S.P. stands for Environmental Systems Performance, and is a result of over 10 man-years of research and development effort at ABACUS. ESP is probably the most advanced simulation model of the energy flow processes associated with building performance. It is used on a day-to-day basis by many of the worlds leading building research laboratories - yet it is simple to use - and is proving to be an essential design tool to an increasing number of consultants, architects and local authorities.

The high predictive accuracy of the program has been demonstrated in a number of U.K, U.S and EEC validation studies; ESP is also used by the EEC as their reference model for the appraisal of hi-tech passive solar design.

When can one use ESP?

ESP can be used at any stage of the design process.

ESP enables the designer, for the first time, to develop an indepth understanding of the complex, inter-relationships between fundamental design criteria and the cost effective, energy conscious, performance of the resulting building.

ESP is being successfully applied to predicting the environmental (thermal) performance of a growing number of major constructional projects both in the U.K. and Overseas. ESP is not restricted to new sophisticated, highly stressed, high technology buildings but can be economically and successfully applied to simple retrofit projects and energy audit tasks.

What questions will ESP answer?

1. What, and when, are the peak building or plant loads and what are the rank ordered causal energy flows?

2. What will be the effect of some design change, such as increasing the wall insulation, changing the glazing type or distribution, re-zoning the building, re-configuring the plant or changing the control regime?

3. What is the optimum plant start time or the most effective algorithm for weather anticipation?

4. How will comfort levels vary throughout the building?

5. What is the contribution (to energy saving) of a range of passive solar features?

6. What is the optimum arrangement of constructional elements to encourage good load levelling and hence efficient plant operation?

7. What are the energy consequences of non-compliance with proscriptive energy regulations or, conversely, how should a design be modified to come within some deemed to satisfy performance target?

How can one use the ESP?

ESP is user friendly and provides efficient data entry methods. A vast array of recoverable information can be presented in graphical, tabular, synoptic, statistical, histogram and 3D visualisation forms.

ESP can operate in either 'expert' or 'interactive' mode. The 'expert system' mode is particularly useful as inexperienced users simply select a function such as 'comfort', 'plant sizing', or 'energy consumption estimation'. The system will set up and perform the required simulations, analyse the results and generate the appropriate information answering the design question.

The 'interactive' mode enables special analyses to be conducted or additional investigations to be undertaken. In this mode the user defines the problem, selects a path through the various program modules and then interprets the simulation results.

Use of ESP under Indian conditions

To the best of my knowledge ESP has not been used for the Indian conditions. So the first problem would be to validate the ESP for Indian conditions. The problem of dividing India into precise climatic zones, validating the ESP under the different zones and evolving criteria for comfort in the various zones can form the basis for a comprehensive research project in Building Technology involving laboratory work, field measurements and computational work.

INDIA'S POOR PROJECT IMPLEMENTATION RECORD

JOJU.M.MICHEL
4/4 B-TECH

Although our country spends billions of rupees in its development effort, its track record in implementing major projects is abysmal. The projects which are supposed to be over decades ago are still going on, draining a significant portion of citizens' savings in the process. It is now estimated that 264 union government projects for which an original cost of Rs.42,935 crores had been budgeted, will now cost Rs.64,448 crores - an aggregate cost overrun of staggering 50.1%. Why does this happen? The once prestigious salal hydro-electric project may be the best example showing this sorry state of affairs.

The salal project was planned to be the first in a series designed to exploit the rich hydro-electric potential of chenalb river, estimated at more than 3 million kwh per annum. The project was cleared by the Central Government eighteen years ago, with an estimated cost of 55.15 crores. Although the original completion date was 1978, it is yet to produce a single unit of electricity. The current estimated cost of the project is about 568 crores.

This fate was evident right from the beginning. Although some work on the development of intra structure such as to smoothen the rocky roads to the project site in the lower reaches of the pir panjal hills 80 km north of Jammu, began by 1970, work at the main site of salal did not begin till eight years later. The reason was purely a diplomatic one. Until an agreement was negotiated with Pakistan on the key question of the sharing of waters of the Indus and its tributaries, which was finally accomplished in 1978, the project was inviable. This lead to a lot of criticism about the utter lack of foresight on the part of Union Government, which could well have set about executing the project while simultaneously negotiating an agreement with Pakistan on the river waters question.

In 1978 the project was handed over to National Hydro Power Corporation Ltd (N.H.P.C.) which was set up in 1975. This had not at all improved the situation. Choosing to go it alone the N.H.P.C. encountered numerous geo-technical problems and even the basic design of the main dam could not be finalised before 1980. Compounding this were N.H.P.C's ambitious plans which aimed at increasing the first stage from the original 270 mw to the current 345 mw. As a consequence, key features such as 2.1 km long tail race tunnel and more pen stocks began to emerge at this late stage, which proved disastrous for the completion schedules of the project.

Even the N.H.P.C. managers do not hesitate to admit that the magnitude of geotechnical problems they encountered in the project, was something then were ill prepared to tackle. For example, only after the complete stripping of the foundation for the concrete dam was completed, did the experts find it necessary to review the design for the main dam.

Although N.H.P.C. officials point out that as of date, nearly every component of the project is completed. Save the tail race tunnel, fresh problems keep emerging. An over abudant monsoon in 1985 and 1986 resulted in flash floods which damaged the power houses and the turbo generators which were installed there in. When the preliminary testing of the dam was conducted in April 1986, heavy seepages created serious doubts on the capabilities of the 113 meter high dam to withstand pressure. As for the tail race tunnel the lack of pretunnelling geological work as well as modern tunnelling techniques have resulted in bringing work to a stand still.

The failure of salal project is an eye opener in many ways. There has always been much criticism on the country's inability to exploit its considerable hidel reserves. But it is this project which has prompted the government in the preference for thermal power stations over hydro-electric power stations.

Whom to blame for this sorry state of our development plans? Public sector managers argue that fault doesn't lie with the project but with the 'system'. Funding is cited as a case in point. The approval of planning commission is not considered an investment approval from the government. Further, the funding is in the form of a year to year allocation. So they are unable to arrive at a long term planning. Project managers are thus helpless, runs the argument.

Another argument advanced is that delays are inevitable due to the complicated system formulated by the government for the clearance of the project. It involves a plethora of appraising agencies, which examine the project from various angles. Then only Public Investment Board (P.I.B.) give the final clearance. But not even a single proposal has been modified drastically while being cleared by these agencies. So it is obvious that all these exercies are just a waste of time. The example of Gandhamardhan bauxite project will make it clear. The proposal was cleared by the union forestry ministry, but stalled by environmental department - The case is curious, because it was the same secretary who acted on behalf of both the departments.

But there is a glimmer of hope. The dismal state of project implementation has forced the present administration to create the one-of-its-kind ministry of programme implementation. The role of this ministry has been stated by its first minister in-charge, Mr. Ghani Khan Choudhury like this: 'The programme implementation ministry plays a catalytic role by monitoring various projects, identifying the slippages and keeping the concerned ministries and the government at the highest level informed so that necessary action can be taken by the concerned ministries and later this action is followed up'.

We can see that this new initiative is the oasis in the desert, which give us a hope of a well planned, well developed tomorrow.

(Main source: Business World, March '87)

'ACTIVATED CARBON IN PHYSICO-CHEMICAL TREATMENT UNITS'

Mr. K. Gopalakrishna

The legislations regarding effluent standards though mandatory, have their own limitations when implementing on a small industry. The constraints for the industry would be the availability of funds and required technical manpower. An example could be the cluster of small chrome tanneries in Madras which has resulted in heavy ground water pollution.

In these instances we can encourage collective treatment systems which are constructed and maintained by the industries from the less collected. We can also go in for biological treatment units after addition of nutrients from municipal waste water. However, wherever we are not able to supplement the nutrients we may have to go in for more expensive physico-chemical units after recovery of recoverable products. Physico-chemical units generally include chemical coagulation, carbon adsorption and filtration.

Activated carbon can be prepared from various materials such as peat, lignite, coal and charcoal from wood or coconut shell. The widespread process for the preparation of activated carbon is thermal activation. To begin with, the raw material is carbonized to obtain a coke with which steam is made to react at 900°C to 1100°C in order to enlarge the pore volume. In the chemical activation process dehydrating products such as $Zncl_2$ are used to abstract the water from the carbohydrates of the starting material. Carbonisation is performed at 400° to 500°C and activation is carried out in the absence of air at 500°C to 700°C.

The internal surface area of activated carbon in usually expressed on the BET [Brunauer Emmet and Teller] surface in m^2/gm. There are two types of activated carbon generally used in practice granular activated carbon used in adsorption column, and powdered activated carbon used as solution in batch processes. The surface areas of activated carbon, which may vary between 10^3 m^2/gm to 10^7 m^2/gm, is measured by porosimeter measurements with Hg, I_2^{o} or phenol adsorption. Powdered activated carbon is normally used when the concentration of impurity to be removed is small, and is added directly to the aqueous liquid to form a batch slurry which is agitated and sedimented. The remaining dispensed carbon is then removed by filtration. Granular carbon is used solely in the form of packed beds or columns as deep as 3 to 10 m, through which effluent is passed either in upward or downward direction. The upward flow bed can be either packed or expanded bed type. A good activated carbon should contain less than 8% incombustible ash. The moisture content should be less than 10% by weight. Hydrated carbon is generally corrosive to steel.

The process of carbon adsorption becomes very expensive if the spent carbon is wasted without regeneration. Particularly in India where the cost of production of activated carbon is likely to be high, an efficient regeneration system for the reuse of spent carbon is necessary.

Regeneration involves two consecutive phases, the desorption of the matter fixed on the carbon and the so called reactivation, i.e. restoring as much as possible the internal surface and the pore structure. Biological regeneration: Under aero ic conditions bacteria are able to mineralise organic compounds adsorbed by the carbon. This involves the aeration of the spent carbon in a separate vessel for the required decomposition of the adsorbed compounds. Obviously this is limited to bio-degradable organic compounds. Chemical regeneration involves several washings of the spent carbon. For example desorption of phenols with caustic soda. This technique is oriented to industrial applications in which the desorbed substances are recycled into another process.

In thermal regeneration, water and volatile organic matter adsorbed are evaporated and the remaining organic products are carbonised. This involves heating of the carbon in a furnace under a controlled atmosphere, so that organics are volatalised without combustion of the carbon. The gases are burnt. Multiple hearth furnace or rotary kiln could be used for this purpose. The temperature of carbon is gradually increased to 950°C with steam injection.

It can be concluded that activated carbons could be used as a very good adsorbent in the physico-chemical treatment units of industrial and municipal waste waters in this country, as they are simple and reliable in their use. Hence if proved economical it can take its place in the arsenal of weapons to be used in the fight to control water pollution problem.

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'A MODIFIED FREE SWELL PROCEDURE FOR THE CLASSIFICATION OF EXPANSIVE SOILS'

by A Sridharan+ , M S Rao+ and Sanjeev Joshi*

(To be sent to Geotechnical Testing Journal, ASTM, USA)

ABSTRACT:

Sridharan et al (1985) proposed the use of free swell tests for the classification of the soil's swelling potential. They defined free swell index as the sediment volume in cc/gm occupied by a unit weight of oven dried soil in water under no external constraint. In another paper, Sridharan et al (1986), the same authors developed the differential free swell test comparing the sediment volumes in water and carbon tetra chloride to represent swelling potential. The scientific basis for the various methods used in classification has been examined by Sridharan and Rao (1988). In spite of these contributions, limitations exist in the use of free swell tests for classification of soils for their swelling potentials. Soils with high colloidal fraction cannot be identified by the differential free swell test, because of long duration (even upto two weeks) required to settle down.

To overcome this difficulty, series of free swell tests were conducted on 15 natural soils of liquid limites varying from 43% to 124% with 0.01% to 1% of Nacl by weight, to study the time taken for equilibration of sediment volume. The sediment volume with various percentages of Nacl has been

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compared with that in distilled water. It has been found that the sediment volume with 0.025% Nacl is essentially the same as that obtained with distilled water. Further the time duration for equilibration drastically reduced to less than 24 hours with 0.025% of Nacl.

Hence it is proposed that the free swell test could be carried out with 0.025% Nacl as an additive to obtain reliable results. With this change, the free swell technique becomes a viable, simple and fast technique for quantifying swelling potential. The tests were also conducted with the U S B R Specifications in an oedometer to study the swelling potential of compacted samples and has been compared with free swell results. The agreement has been found to be good.

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THE SIGNIFICANCE OF DEFORMATION IN SOIL PROBLEMS

PROF. T.S.RAMANATHA IYER

The general concept in most soil mechanics problems such as foundation, stability of slopes and embankments etc. centres around the factor of safety against failure of the soil mass. However soil deformations well below working loads are equally important and methods of evaluating them to a reasonable degree of accuracy are required in a number of cases, as mentioned by Roscoe in his Rankine lecture in 1970. The case of limiting settlement (total and differential settlement) is only one example of this requirement.

In the conventional design of structures, it is customary to adopt limits of total and particularly differential deformation criteria for various types of structures based on their uses and materials of which they are made of. These deformations may be immedi te (contact) or delayed (consolidation). It is possible to reasonably predict these, as a function of time.

The majority of problems involving soil-structure interaction such as pressures behind a retaining wall need the concept of strain. In the case of design of retaining walls, the use of active pressure involves the assumption that a strain of approximately 0.3 °/. is mobilised at every point in the assumed failure wedge and consequently the top of the wall should move away from the backfill by an amount which will mobilise this strain. If it does not, the pressure for which the wall is to be designed is not the least (active pressure) and much larger design values are required. This concept of limiting deformation is even more important in the case of passive pressure development. A strain of the order of 4 °/. is required if the full passive pressure is to be mobilised. Design of anchors for prestressing beds, dock structures etc. are particularly governed by this. Even though adequate factors of safety may be available against ultimate failure, the deformation at the top of the structure may be so significant as to defeat the purpose of the structure.

A typical example of this situation was brought to light during the design of a pretensioning bed for manufacture of electric lamp poles. The end anchors were designed as retaining walls on sand. The depth of the walls was decided on the basis of adequate factor of safety against passive resistance and the bed was put in operation. During the operation of the bed, significant loss of prestress was observed and the bed had to be abandoned. As the prestress is acquired by the tendons on the basis of calculated stretch of the ends firmly before concreting, the yielding of the top of the retaining walls on the application of loads, resulted in loss of prestress. The anchorages of the prestressing bed were then redesigned with well foundations taking them to very large depths, so that the movement of the top was negligible. This example highlights the fact that structural designers have to be fully aware of these implications.

In the case of pile design as well, the consideration of strain is important. It has been established that the ultimate skin friction resistance is mobilised at a strain of approximately 1 °/. of the diameter of the pile and the base resistance is reached at strains of about 10 %. diameter (Whitaker and Cooke 1966). This means that the design of the piles for structures of restricted settlement must be properly proportioned apart from factor of safety against failure. Enlarged bases for piles and Caissons will provide increased bearing capacity only at larger settlements and the shaft adhesion is fully mobilised at working loads and lower strains. The efficiency of soil anchors is also dependent on the level of strains in the soil. The movement of a tied back wall should be monitored so that the stretch of the anchors are evaluated to ensure that stability of the cut face is maintained.

Contact pressure distribution below foundations is also dependent on the strain mobilised at the interface and naturally varies with the type of foundation, rigid or flexible. It may also be of interest to note that in the case of rafts on sand bed overlying thick layer of soft clays, the stress distribution may change with time due to consolidation and the reinforcements to be provided will have to satisfy both short term and long term settlement.

In the problems involving stability of slopes also the influence of strain will have to be accounted for, especially in composite dams. The cohesion and friction parameters to be used are not the ultimate values as cohesion is mobilised at very low strain and friction at larger strains. An alternative method is to go in for finite element analysis which again requires a reliable stress strain relationship of the constituents over a wide combination of stresses. Large shear strains can also cause a lowering of the friction to the residual value, a factor which has to be taken into consideration in the analysis of long term stability of slopes in area subjected to shear movements.

There is thus great need for knowing the stress strain characteristics of soils under a wide range of stress and strain paths for prediction of soil behaviour. Unfortunately natural soil is a material which does not have a unique stress-strain relation. Among the many sources of inaccuracies in estimating deformations in soil mechanics are the differences between stress conditions existing in the field and the laboratory tests and the effect of disturbance on the stress-strain properties of the soil.

There are also cases where unpreditable changes may occur particularly in clays due to which unexpected deformations may occur. They may be due to environmental changes and changes in usage of the structure . Only by examining the reasons for such changes will it be possible for any remedial measures to field damages to be undertaken.

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WATER PLEASE!

Oh What a wonder
When I hear of thunder
Hope rain would come under
But not a tiny drop
Even for the whithering crop
Cows chew dry hay
No greens all the way
Lakes and ponds look dry
Pumping water make hands cry
Flood's fury frightens North
Drought's eerie dance in South
Fate started laughing loud
Find the way you could
Sending man in cloud
Is not enough it said
Weeping wasted forty years
Link the mighty rivers
With their southern sisters
Let them garland for ever
India our beloved mother.

By

S. SHANKAR PRASAD
H.S.S.S. MADRAS-5

(WE THANK DR. N. INDRASENAN FOR CONTRIBUTING THIS POEM)

TORNADOES

Dr.K.Srinivasan

The history of earth's surface is comprised of combined series of 'evolutionary' and 'revolutionary' processes. Evolutionary' processes are usually gradual and prolonged in nature. On the other hand 'revolutionary' processes are sudden and catagrophic which lead to deaths of millions of people and loss of billions worth of property. Tornadoes belong to the latter catagory.

A tornado is a very rapidly rotating air funnel hanging from a cumulonimbus cloud. It is usually observed as a funnel-shaped cloud. It is the smallest in size and greatest in speed of rotation among all the formations with vertex motion in the atmosphere. The tornado cloud is cery often accompanied by a thunderstorm, hail and heavy downpour of strength and size. This originates under synoptic conditions, mostly along the line of the fronts of warm and cold air currents. On an average, the tornado clouds will be 5-10 km in length, 5-15 km in height. Large tornadoes willhave a cloud width of 30-40 km and length 50 km. The base is flat, dense and horizontal, with distinct protruberances of funnels from it.

Structure of Tornado:

The tornado consists of three parts:

i) Horizontal vortex in the parent cloud
ii) Funnel
iii) Auxiliary vortex

The funnel is the main component of the tornado. It has a spiral vortex consisting of very rapidly rotating air. Since water and dust are entrained in the air, usually the funnel can be seen clearly. Whenever, the air is clean without water, dust or smoke, the tornado is invisible.

The wall of the funnel is sharply defined, smooth and dense. The internal cavity in hurricanes is of the order of a few hundred metres. This resembles the 'eye of the storm' of hurricanes. The movement of air inside the cavity is directed vertically downward and often attains great speed. It causes the formation of the cascade and facilitates the movement of hurricane. In the walls of the tornado, on the contrary, the movement of air is directed upward in spiral form and often attains unusual speeds of upto 100-200 m/s. Dust, debris, other objects, people and animals are lifted into the walls of the tornado. The cavity is usually empty. The rotational speed of the funnel (the wind speed in its walls) determines the main properties of the tornado. It often exceeds even the speed of sound in air (332 m/s). Hence, accurate and direct measurements of the wind speed in tornadoes are difficult. The speed of rotation in the funnel is very high and changes considerably. The lower part of the funnel rotates considerably faster than the upper part. In the formation of a tornado, the parent cloud and the funnel assume the main role. The auxillary vortex originates at the base of the funnel, does not rise high but often rotates around the funnel and reaches the cloud. The auxiliary vortex gives rise to cascade and envelope. The weight of the funnel of the tornado is more than half a million ton. The weight of the parent cloud would be immeasurably more. Tornadoes occur frequently in USA, Western Europe, France, Alpa Valleys, Sweden, Germany, Switzerland, North Vietnam, Japan, China Australia and Africa. A few other places have also experienced tornadoes, but less frequently.

Cloudbursts often accompany the tornado and the resulting stream of water causes pits 5-6 meters wide and more than one metre deep. Also, hailstones of about 30 cm circumference have been observed along with the tornado cloud at many places in the USSR & USA. Sometimes even air-planes are frozen as to form the hailstone nuclous.

There are also special forms of tornadoes such as Water Spouts and Fire Tornadoes. Tornadoes passing over the sea or large lakes are known as Water Spouts. They are accompanied by terrifying sounds. Water Spout is often stationary and the duration is generally 15-20 minutes. Many times it is not visible. Water Spouts seem to connect the water body forming significant cascades. On the other hand, Fire Tornadoes are always accompanied by enormous amounts of heat and they can be grouped under Volcanic Erruptions, fires and explosions.

Destruction Activity of Tornadoes

The causes of destruction of tornadoes can be broadly listed as: (1) the wall thrust by funnels (2) lifting and splintering in the air, (3) vortex motion in the funnel. The following incident giving an account of the destruction of the Irving bridge in USA (which was caused by the strongest and longest-lasting tornado 'Irving' (1897) named after the township), is an evidence for the power of the tornadoes.

The iron bridge was new. It was 75m long and the track of the tornado lay right across it. The funnel just touched it and lifted it up so fast that the stone pillars on which the bridge rested were not damaged at all. On one pillar even the top layer of cement was intact and from another only two stone blocks were removed. The funnel lifted the enormous steel structure into the air, and twisted it beyond recognition with exceptional strength. The entire bridge became a thick bundle of steel plates and cables, snapped and bent in a fantastic way. The bundly was so compact and of such small diameter that it totally disappeared in the water, though the depth of the river was only 1.5-2 m. The bridge blow off the pillars into the water in a few seconds: in this time, the complex beautiful solid structure became just a long bundle. Such was the strength of rotation in the wall of the funnel. Its speed was undoubtedly supersonic.

It is not possible to describe here in detail the hundreds of such tragic incidents which have occurred in the different countries over the years. However, a few of the most common effects of tornadoes which have been grouped and generalised from different incidents all over the world, are presented below:

Quite often, food grains, branches and thick knots of trees, heep of hay, quartz grains, gravel, jars, books and even silver coins from burried treasures have been lifted up into the tornado clouds and have been trasnported to distances of tens of kilometres intact. Sometimes, even a few storeys and roofs of buildings, big stones, automobiles tractors, heavy barrels, animals and people are lifted and transported to a few tens to hundreds of metres, resulting in complete, partial or no destruction in the process.

Rains with micro organisms is quite frequent if the tornadoes occur over fresh water pools or over the sea. They are sucked and lifted into the clouds and dropped elsewhere. Various insects, mollusks, shells, marine creatures, jelly fish and crabs are also often lifted up enmass into the clouds and dropped from the sky at farther places, along with the rain. Rains with frogs and fish are quite frequent as a result of tornadoes. Sometimes, even tortoises, toads and rats are reported to be dropped.

They have been many incidents where due to the suction of a few metres of water from the rivers and lakes, the beds have been exposed. The entire water in deep wells would be sucked up and emptied completely.

In conclusion, eventhough tornadoe is mainly a meteorological phenomenon, it is geographical as well, because of its ability to change various surface features of the earth in an unparalleled way.

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MICRO....MICRO....WATER....WATER..MICRO..WATER..
MICRO WATER

by Dr.N.Indrasenan

Advancements in micro-computer technology with in the last five years have been astounding. Log Tables...slide rules...ordinary hand-held calculators..programmable calculators...personal computers..XT (extended technology)...AT (advanced technology)..microField-T (microfield transputerised) so on and so forth...oh!...ya!! ..really astounding indeed!!!

Just consider PT Usha runs Olympics 100 metre in 10 seconds or so..may trun out to be a world record!. But imagine a guy in some other celestial body of our solar system runs the same distance in 0.1 second or even less time with whom we are unable to communicate as of present. Are not the micro computer technological achievements simply comparable to that of this guy's, considering its rapid stride in soft/hardware development in every nook and corner?. But then one must not forget that the hunger of micros is even more than that of an elephant's in feeding..are we satisfying this hunger?.. a moot point indeed.

Whatever the iseue may be; the micros have now certainly become a way of life and have oven turned out to be "micros for every one"!. Coming to our civil engineering guys (discussion is restricted to those B.Tech in our institute), the quick understonding and reaction of these guys to micro computer problems, associated software and problem solving etc. is simply noteworthy. This article is therefore primarily written to further enrich (further emphasized) their understanding.

Under the vagaries in our universal climatic system there are floods,..floods... in one season and droughts.. droughts..in one other season!....Alas! ..what a recurring menace indeed. While it is an established fact that areas adjoining a river, for eg: the Ganges always suffer due to recurring floods, the same areas also are infrequently vulnerable to droughts!. It can be quoted here that the holy Varnasi City had experienced acute water shortage problems sometime back. Many of us know that Tamilnadu is the régular receipient of drought. There is no vagary or doubt about it. Yet it is surprising that once our neighbor-hood area Narayanapuram (remember IIT's CRD site-office once was functioning there) had experienced intensive floods to the extent of even seeing the surface of Bay of Bengal from Velechery road. What an extreme flood and drought!.

So..in a nut-shell, while earth's climatic system gives us regular dosages of droughts and floods alternatively (unique decision of nature, hence there is no decision management etc. needed by nature), it is only floods in the case of micro-computer technological advancements both in software and hardware developments as one could perceive. In innumerable ways, the potential of micros is tested by our civil engineers. "Micro-computerisation" in many civil engi-neering disciplines is on the rampage. These small machines (but with greater potentials) are being extensively used as solution tools, remote terminals/controls, instruments and so on. Already in many countries "field computers" have come into existence. People now talk about....who will win? USA or Japan. But many of us are aware that small countries like Isreal and the Netherlands are making big head ways in micro computer developments and applications.

For real time applications in natural systems, eg: river basin planning, micros monitor the states of river, its tributaries and the rainfall surrounding the areas for the collection of data to assist in the management of the river and to provide a research basis into the behaviour of the river valley. These micros are used to perform many tasks in river planning management like; sampling measurements, check the received data, convert the coded data, hold the data base, check the data against predefined limits, record the data in graphical form, punch a record on a paper tape, print the results on paper, enable changes to be made to the data base and display the data on the mimic diagram etc.

Micro's use as self-instructional aids is fast progressing in water resources disciplines. Now the situation is that while the so called fourth and fifth generation computers are performing their jobs silently, these micros are roaring and are violently dancing to the well-designs and ill-designs, whimsical and non-whimsical fashions of many of us. God only knows that one fine morning these micros may even keep a distance away from mainframes (ahead of them). Already computer guys have started talkingabout super micro computer establishment on desk-top. While the advancements in micro computer technology is far reaching, no one needs to have a (cyberphobia or worry as these machines will never replace the civil engineer but will only allow him to do his job much better and faster (due apologies to female civil engineers for not using 'her').

Now let's see the micros extensive usage in all the branches of water engineering.

(1) one dimensional open channel flow, (2) shallow water flow, (3) two dimensional shallow water dam break, (4) wave hydrodynamics, (5) shore-wave interaction, (6) surge structure wave interaction, (7) three dimensional waves-crossed seas, (8) sediment transport, (9) air entrainment, (10) groundwater flow, (11) instability in groundwater flow, (12) transport in groundwator (13) transport in surface water, (14) soil.groundwater interaction, (15) circulation in surface water, (16) stratified circulation, (17) stratified mixing, (18)watershed hydrology, (19) pipe-line hydraulics, (20) water hammer/ unsteady pipe flow, (21) hydraulic machinery, (22) Navier-stokes equation. Thus it could be seen that you can not see a branch left out of micro-computer treatment.

Specifically these machines have by far made much inroads in; (i) water and waste water fields-water supply regulation, operational control, process control for treatment plants, water network analysis, automation in billing process mapping and design, power usage optimisation and control, maintenance of plants etc. (ii) Reservoir simulation-micro mathematical programming reservoir rule curve model, reservoir optimisation, gaming simulation, meta-games command area water management, economics analysis model (iii) groundwater simulation and optimisation-well hydraulics, regional modelling and control, solute transport in aquifers, saltwater intrusion... the list goes on.

Let's see some of the elegant general purpose software, like Wordstar, Database management, Spreadsheet, Graphics and communications(in all these cases improved versions always follow suit immediately).

Wordprocessing (WS): designed for the creation and manipulation of texts.

Data base management (dBaso/dBIIplus): provides a system for filing and retrieval of data information or data transfer to other programs.

Spreadsheet (Worksheet) or Lotus 1 2 3: These are electronic matrix sheets in which text, numeric data, or formulas can be initially stored (the size of the matrix format is 256 columns by 8192 rows totalling 20, 97, 152 cell entries). The information can then be manipulated through the use of a wide range of mathematical functions available to the user. These spreadsheets are fast replacing the "conventional" Fortran or other languages. Unlike conventional programs, spreadsheet calculations are visible processors. The international famous Stanford Watershed Model costing $ 60,000 has now been written in Lotus 1 2 3.

Micro computers are now becoming even popular in pseudo-expert systems based on parameterised decision making, in specific knowledge-based systems engineering and decision support systems for water manager. Now the current research is in "super software development"..for everything there is a super Oh! what a tremendous achievement in micro's applications to civil engineering!!

With the technologies that are currently developed in micro computer exra, it is crystal clear that these small machines are universally set for a big explosion and will certainly turn out to be amazingly powerful productivity tools for civil engineers. Yes, we must rise up to the occasion to meet the challenge posed by these "hungry-micros".

-o-o-o-

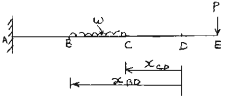
CANTILEVER APPROACH IN THE BENDING OF BEAMS

BENNY RAPHAEL, 3/4 B.TECH.

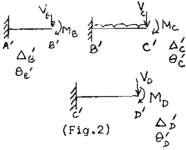
Calculation of the deflections is an important step in the analysis of structures. The usual method of finding the deflections is based on the moment area theorems. But this happens to be very tedious (At least an average student thinks so). One has to draw the bending moment diagram, find its area, moment of this area and so on. Is there any way of writing down the deflections by inspection, just like we find the bending moment at some section? Is it not possible to use some standard results to compute these quantities instead of dealing with geometric figures? Let me try to answer these questions .

a) DEFLECTIONS ON CANTILEVERS:

The deflections on cantilevers could be written down directly by inspection, by converting them into fictitious cantilevers, as shown below:



(Fig.1)



(Fig.2)

If we are interested in the deflections Δ_D and θ_D at the point D of the cantilever AE shown in Fig.1, the span AD could be divided into fictitious cantilever. A'B', B'C' etc. as shown in Fig.2. Consider the external loading acting on the corresponding parts of the fictitious cantilever. Also consider the shear and bending moments at the points B,C and D on the real beam acting at the points B',C' and D' of the fictitious beams. Due to the effect of these loads find the fictitious cantilever end displacements, $\Delta_{B'}$, $\Delta_{C'}$, $\Delta_{D'}$ and end rotations θ_B' θ_C' and θ_D' respectively for the parts A'B', B'C' and C'D'.

Then, the real rotation at D on the real beam is

$$\theta_D = \theta_D' + \theta_C' + \theta_B'$$

and the real displacement

$$\Delta_D = \Delta_D' + (D_C' + \theta_C' \times X_{CD}) + (\theta'_B \times X_{BD})$$

Where X_{CD} and X_{BD} are the distances of C and B measured from D.

On dividing the real beam into fictitious cantilevers

(1) each fictitious cantilever should be of uniform cross section.

(2) the standard values of deflections for the end shear, end moment, and the load in each fictitious cantilever should be known. (The resultant deflection would be the sum of the individual effects of end shear, end moment and load on the span).

The standard result are given below:

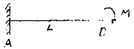


Fig.3

Due to a moment M acting on a cantilever span (Fig.3)

$$\theta_B = \frac{Ml}{EI}, \Delta_B = \frac{Ml^2}{2EI} \qquad ...(3)$$

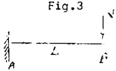


Fig.4

Due to a concentrated load V (Fig.4)

$$\theta_B = \frac{Vl^2}{2EI}, \Delta_B = \frac{Vl^3}{3EI} \qquad ...(4)$$

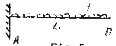


Fig.5

Due to a VDL of magnitude W (Fig.5)

$$\theta_B = \frac{Wl^3}{6EI}, \Delta_B = \frac{Wl^4}{8EI} \qquad ...(5)$$

(3) If there is some arbitrary loading on some part, its effect should be considered separately. Integration should be carried out for that load alone on the fictitious cantilever.

(4) If there are inclined members forming the cantilever, the relation between the real beam deflections and the end rotations and deflections of each fictitious cantilever could be got from the geometry of the structure.

Let me illustrate by an example (Fig.6)

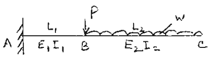


Fig.6

To find the deflections at the point C, divide the span into two parts AB and BC. On the part BC there is only a VDL, W and no shear or moment at the end C.

From equation – (5)

$$\theta_C' = \frac{Wl_2^3}{6E_2I_2} \quad \text{and} \quad \Delta_C' = \frac{Wl_2^4}{8E_2I_2}$$

For the part AB the resultant shear at B = $(Wl_2 + P)$ and resultant moment = $\frac{Wl_2^2}{2}$. From equations (3) and (4).

$$\theta_B' = \frac{(Wl_2 + P)\, l_1^2}{2E_1I_1} + \frac{\left(\frac{Wl_2^2}{2}\right) l_1}{E_1I_1}$$

$$\Delta_B' = \frac{(Wl_2 + P)\, l_1^3}{3E_1I_1} + \frac{\left(\frac{Wl_2^2}{2}\right) l_1^2}{2E_1I_1}$$

$\theta_C = \theta_B' + \theta_C' \ldots\ldots = \frac{(wl_2 + P)\, l_1^2}{2E_1I_1} + \left(\frac{\frac{wl_2^2}{2}\, l_1}{E_1I_1} + \frac{wl_2^3}{6E_2I_2}\right)$

The result and deflections at C

$$\Delta_C = \Delta'_B + \theta'_B * l_2 + \Delta'_C$$

$$= \frac{(W l_2 + P) l_1^3}{3 E I_1} + \left(\frac{W l_2^2}{2}\right) \frac{l_1^2}{2 E_1 I_1} + \frac{W l_2^4}{8 E_2 I_2}$$

$$+ l_2 \times \left[\frac{(W l_2 + P) l_1^2}{2 E_1 I_1} + \left(\frac{W l_2^2}{2}\right) \times \frac{l_1}{E_1 I_1} \right]$$

b) DEFLECTIONS ON SIMPLY SUPPORTED BEAMS:

Fig.3

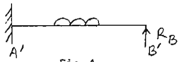


Fig.4

To find the end rotations θ_A and θ_B for a simply supported beam AB shown in Fig.3. Consider the fictitious cantilever A'B' (Fig.4) on which the same load acts. Replace the reaction at B by an equal force R_B. Find the end displacement Δ_B' and end rotation θ_B' for this fictitious cantilever. Then the actual end rotations are

$\theta_A = \frac{\Delta_B'}{L}$ and $\theta_B = \theta'_B - \theta_A$.

Note that the fictitious cantilever A'B' could further be divided conveniently to get standard cantilever parts as explained in the previous section.

If there is any over hang the loads on the over hanging portion could be replaced by the resulting moments at the supports.

c)

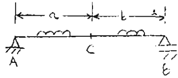


Fig.5

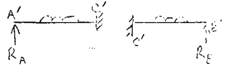


Fig.6

If you are interested in the deflections θ_C and Δ_C at the point C on the cantiliver simply supported beam AB (Fig.5). Consider the cantilevers A'C' and C'B' (Fig.6) on which the same loads act. Replace the reactions at supports by the forces R_A and R_B at the ends of the fictitious cantilivers A' and B' respectively. Find the ficitious cantilever end displacements $\Delta_{A'}$ and $\Delta_{B'}$ respectively. Then the rotation θ_C on the real beam.

$$\text{is} \quad \theta_C = \frac{\Delta_{A'} - \Delta_{B'}}{C}$$

in the anticlockwise direction the real displacement at C

$$\Delta_C = \frac{\Delta_{A'} \times b}{L} + \frac{\Delta_{B'} \times a}{L}$$

Let me take a simple example

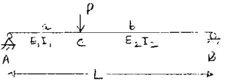


Fig.20

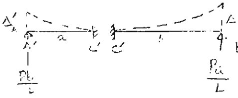


Fig.21.

Let a force P acts on the SSB AB shown in Fig.20. To find the deflections at C. The fictitious cantilevers A'C' and C'B' are shown in Fig.21. Note that the only forces on these cantilevers are the reactions $\frac{Pb}{L}$ and $\frac{Pa}{L}$.

$$\Delta'_A = \left(\frac{Pb}{L}\right) \frac{a^3}{3E_1I_1} = \frac{Pba^3}{3LE_1I_1}$$

$$\Delta'_B = \left(\frac{Pa}{L}\right) \frac{b^3}{3E_2I_2} = \frac{Pab^3}{3LE_2I_2}$$

$$\theta_C = \frac{1}{L}\left(\Delta'_A - \Delta'_B\right) = \frac{Pab}{3L^2}\left[\frac{a^2}{E_1I_1} - \frac{b^2}{E_2I_2}\right]$$

$$\Delta_C = \Delta'_A \times \frac{b}{L} + \Delta'_B \times \frac{a}{L}$$

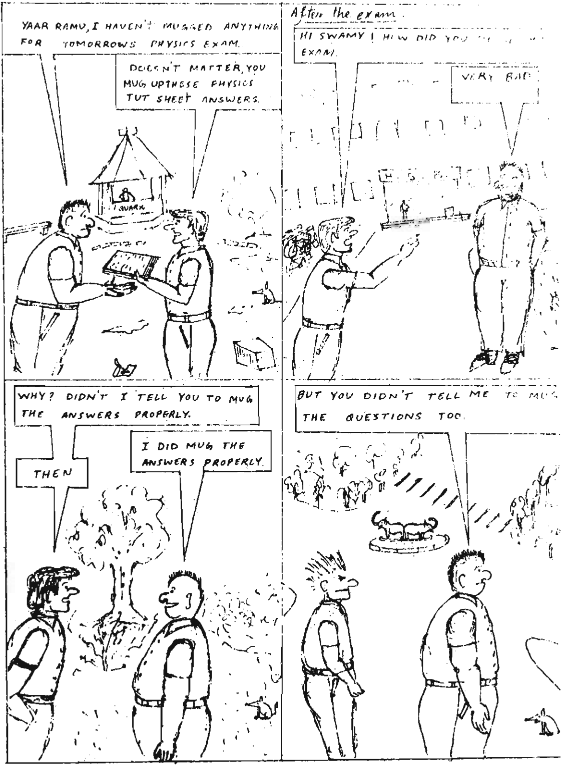
$$= \frac{Pa^2b^2}{3L^2E_1I_1} + \frac{Pa^2b^2}{3L^2E_2I_2} = \frac{Pa^2b^2}{3L^2} \times \left[\frac{a}{E_1I_1} + \frac{b}{E_2I_2} \right]$$

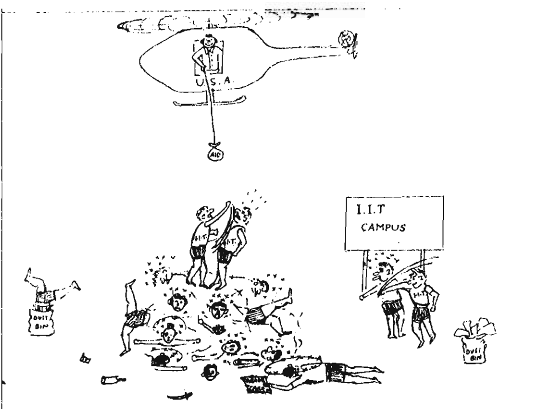
The proofs of these results are based on the moment area theorems.

This method could be very useful for finding the flexibility coefficients in the consistent deformation method or the absolute stiffness eoefficients for the moment distribution method, in the analysis of indeterminate structures.

I hope that this small work will be a convenient tool for calculating the deflections determinate structures.

xxxxxxxx


YAAR RAMU, I HAVEN'T MUGGED ANYTHING FOR TOMORROWS PHYSICS EXAM.
DOESN'T MATTER, YOU MUG UPTHESE PHYSICS TUT SHEET ANSWERS.
QUARK
After the exam.
HI SWAMY ! HOW DID YOU
EXAM.
VERY BAD
WHY? DIDN'T I TELL YOU TO MUG THE ANSWERS PROPERLY.
THEN
I DID MUG THE ANSWERS PROPERLY.
BUT YOU DIDN'T TELL ME TO MUG THE QUESTIONS TOO.


U.S.A.
AID
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CAMPUS
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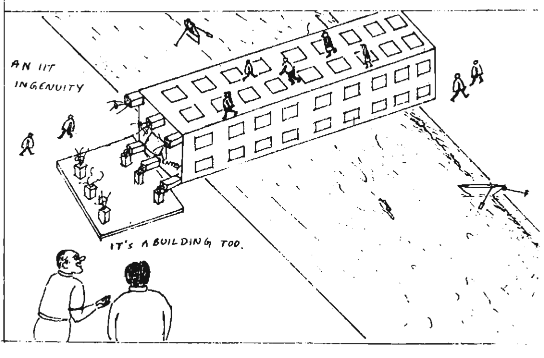
DUST BIN


AN IIT
INGENUITY
IT'S A BUILDING TOO.

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THE TRANSPORTATION ENGG. OFFICE,
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THE BUILDING TECHNOLOGY OFFICE
FOR THEIR EXCELLENT CO-OPERATION

NOT TO FORGET
THE PRINTING SECTION.

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