
47th
BENGAL
ENGINEERING
COLLEGE
ANNUAL.

B E C A

A BENGAL ENGINEERING COLLEGE STUDENTS' UNION

TECHNICAL PUBLICATION (1980-'81)

47th ANNUAL PUBLICATION

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CHIEF MINISTER
WEST BENGAL

I am pleased to learn that the students of the Bengal Engineering College, Sibpur, are going to bring out shortly their Annual Technical Journal. I hope that the publication will be informative and interesting

My greetings to the students of the B. E. College and good wishes for the success of the endeavour.

January, 1981

Sd/- Jyoti Basu

EDITORIAL

My hands stammer, my pen quivers but making desperate attempt to write by my muse.

At the commencement of nineteenth century industrial revolution proclaims the advancement of technology which now-a-days seems to be of most significant to discuss about It is superfluous to mention that engineers are inseperably related to society. So when running out of lashing of conscience we see that the decadance of our present surroundings is the result of the super abundance of the industrialists at the cost of indescribable poverty of common people. So we affirm solemnly against the generations of exploitation. Scythe and hammer raise their slogan against the deception. Our soul startles by the corruption and vice.

And we the engineers are forced to bear the interests of those who are the sharers of bliss or affiction of a few people, for eight hours and the rest sixteen is snatched away by the pop art, thriller novels and whiskey bottle. Surely it may not be the only natural. If this is so, the coming history will not forgive us. Should we be dominated and debased by the dictates—the point where the distinction between man and animal arises. Our instinct, our intelect, humanity are invased today—the downfall of ethics makes the world langous.

Should we be floated by this inflow of tide ? No—never.

So we may succeed, let us pray
we shall overcome someday.

Prof. A. K. SEAL
PRINCIPAL

BENGAL ENGINEERING COLLEGE
HOWRAH-711 103

11th February, 1981

MESSAGE

I am delighted to know that the students' Union of the College is bringing out its Annual Number-BECA-1980-81, to synchronise with the three-day 47th Re-union Celebrations of the College commencing from the 13th February, 1981.

The BECA has been popular with the alumni and the undergraduates of this College for its rich and varied contents and I have no doubt that the present issue, not unlike its predecessors, will enlighten and entertain its readers with its rich harvest of contributions from students, alumni and members of the faculty. I for one would like the BECA to grow in size and variety with contributions from old alumni on their reminiscences of their college days and articles with positive and meaningful suggestions for the betterment and well being of the institution. Like all self-financing journals, the growth of this magazine has perforce been restricted to its present size because of the prohibitive prices of printing and stationery as well as the dearth of advertisements. Let us hope that this is only a passing phase and future editors of BECA will see better days and work with lesser constraints around them.

I conclude by congratulating the editorial board of BECA for their laudable efforts in publishing this Annual Number in time and take this opportunity to reach my students, old and new, and wish them all the best in the days ahead.

Sd/- A. K. Seal
Principal
Bengal Engineering College

B. E. C. S. U.

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সভাপতির অভিভাষণ

ঊনবিংশ শতাব্দীর প্রথমভাগ। ইতিহাসের সাবলীল গতি এসে থমকে দাঁড়াল। সমাজটা একটা প্রচণ্ড ধাক্কা খেল—টালসামলাতে না পেরে গুঁড়িয়ে গেল। ওপর দিয়ে হেঁটে চলে গেল এক নতুন সমাজ ব্যবস্থা, ঘটল শিল্পবিপ্লব। সূচনা হল ধনতান্ত্রিক সমাজব্যবস্থার। যদিও আজ সেই সমাজ ব্যবস্থার গায়েও ইতিহাস বাতিলের তকমা মেরে দিয়েছে, যদিও সেই ধনতান্ত্রিক সমাজব্যবস্থা তার ক্ষয়িষ্ণু রূপ বারবার আমাদের সামনে আড়াল করে রাখার ব্যর্থ প্রচেষ্টা চালাচ্ছে তবু আজকের দিনে দাঁড়িয়ে একথা যথেষ্ট সন্দেহাতীত ভাবে স্বীকার করা যায়—সেদিনের মানুষ সভ্যতার অগ্রগতির দিকে আরো একটা পদক্ষেপ রেখেছিল। 'ধ্বংসই সৃষ্টির নতুন বীজকে বহন করে নিয়ে আসে'—মনিষীদের এই কথাকেই সমর্থন জানিয়েছিল সেদিনকার ঘটনা। ধ্বংসপ্রায় সামন্তবাদী সমাজব্যবস্থা বহন করে এনেছিল নতুন সমাজব্যবস্থার অঙ্কুর। মানুষ দেখেছিল অনেক আশার অঙ্কুরোদ্গমের সম্ভাবনাকে। যদিও শিল্প ও বিজ্ঞান মানুষকে অগ্রগতির পথে অনেকটা ঠেলে দিয়েছে, যদিও আকাশবাণী আমাদের শুনিয়েছে পরিবর্তনের অনেক প্রগলভ বাণী, তবু বিংশ শতাব্দীর শেষভাগে এসে এই প্রশ্ন কি করা যায় না, যে, এতে রামপুরের রামের বা রহিমগঞ্জের রহিমের কতটা উপকার হয়েছে? তাদের লাভের খাতায় কতটুকু কলম চলেছে? তারা যে তিমিরের লোক সেই তিমিরেই রয়ে যায়নি কি? পরিবর্তে আমরা দেখি, আমাদের মতো দেশে এক ভঙ্গুর অর্থনীতি, পচনধরা সংস্কৃতি সম্বলিত জীর্ণ শীর্ণ রূপ নিয়ে বর্তমানটা আত্মপ্রকাশ করছে। চারিদিকে চলেছে এক দমবন্ধ করে আটকে মারার প্রচেষ্টা—ভাগলপুর, মোরদাবাদ, কোন বিচ্ছিন্ন ঘটনা নয়। চলবে ক্রমাগত এইসব ঘটনা ঘটানর প্রচেষ্টা। আমরা আতঙ্কিত—গৌহাটির নাম ভয়ানক দায়িত্বজ্ঞানহীনতার পতাকা যারা তুলে ধরেছিল তারা ছাত্র, আমরা চিন্তিত—শারদীয়া আগমার্কা বিপ্লবীদের আর সমাজবাদের বুলিওয়ালা প্রতিক্রিয়াশীলদের অধিকাংশই ছিল ছাত্র।

কাজেই এই প্রত্যাশন্ন ঝড়ের মুখে দাঁড়িয়ে প্রশ্ন করি, 'আমরা কি নিজেদের হারিয়ে ফেলব?" আমার কথা নয়, সরকারী পরিসংখ্যান অনুযায়ী আমরা সেই দুইশতাংশের মধ্যে পড়ি যাদের কাছে এক দুর্লভ সুযোগ এসে ধরা দিয়েছে, এসেছে উচ্চশিক্ষা লাভ করার সুযোগ। আমরা শিক্ষালাভের উদ্দেশ্যে যা ব্যয় করি সরকার, ব্যয় করে তার ছয়গুণ। যেহেতু সরকার এক কল্পতরুর মালিক নয় সেহেতু সামান্য চিন্তাই আমাদের বুঝিয়ে দেয় এই অর্থ আসে করের মাধ্যমে দেশের সকল জনসাধারণের কাছ থেকে। কাজেই এই আশা করা কখনই অতিরিক্ততার দোষে দুষ্ট হবে না যে, আমরা শিক্ষিত ছাত্র সমাজ, সমাজের এই জঘন্য অবস্থাটাকে কাটিয়ে তোলার কাজে সাহায্যের ডালি নিয়ে এগিয়ে আসব। আসবে অনেক বাধা—আজকের দৃঢ় অঙ্গীকার, সেগুলিকে ডিঙিয়ে যাব। আজকের প্রতিজ্ঞা, আমাদের দিয়ে যদি কোনদিন খাঁচায় বন্দী পাখীর মতো 'যুগ যুগ জিও' বলানর চেষ্টা করা হয় আমরা প্রত্যাখ্যান করব, আমরা শিক্ষাকে ছাড়া আর কিছুকে কখনও 'যুগ যুগ জিও' বলব না। আজকের শপথ, সুন্দর এক স্বপ্নের ভবিষ্যত গড়ে তোলার কাজে আমরা, 'বি, ই, কলেজের, ছাত্ররা অদ্বিতীয় হয়ে উঠব।

গৌতম রায়

REPORT FROM THE GENERAL SECRETARY OF B. E. C. S. U.

In the last B.E.C.S.U. election students of B. E. College have once again expressed their opinion against autocracy and non-political bankruptcy. I, on behalf of the students' union disclose some of the achievements which we have had inspite lot of difficulties. A generator set (50 K. W.), a long felt demand of the students, has been installed. Steps have been taken to increase the total capacity of generetors to 210 K. W. to meet the 'peak hour demand' of the college. A recurring grant students' amenities is expected to reach the college shortly.

But only a little could have been done regarding problems of staff shortage and lack of equipments in laboratories and workshops. To meet up staff shortage at lecture level introduction of teacher fellowship' scheme was suggested.

I like to take this opportunity to extend an open invitation to all the alumni concerned to take part in any project rendered to glorify the name of this age old Alma-mater.'

My best wishes for the success of the Re-union celebrations.

INDRANATH SINHA
Gen. Secy.
B. E. C. S. U.

কলেজের কিছু কথা

গৌতম রায়

বিংশ শতাব্দীর শেষ প্রান্তের দোরগোড়ায় এসে দাঁড়িয়ে বি, ই, কলেজের প্রাচীনকে একটু নাড়াচাড়া করার বাসনা হলে একদিকে দেখি, পাশ দিয়ে বয়ে যাওয়া স্রোতস্বিনীর তরঙ্গের সাথে একই লয়ে তরঙ্গায়িত হয়ে তার গৌরবোজ্জ্বল ঐতিহ্যকে পৃথিবীর সকল কিনারে ছড়িয়ে পড়তে ; আবার অন্য প্রান্তে উঁকি দেয় তার বহু সমস্যাসঙ্কুল পথ, যাকে পায়ে পায়ে মাড়িয়ে আজ আমরা বর্তমানের কাছে আশ্রয় নিয়েছি।

খুব বেশী দিন আগের কথা নয়, যখন বি, ই, কলেজ ছিল শিক্ষার আকাশে এক সর্বোজ্জ্বল জ্যোতিষ্ক, যার কিরণে মুকুলিত হয়েছে ভারতবর্ষ তথা বিশ্বের বহু সম্ভাবনা বহু অগ্রগতির অঙ্কুর। যদিও এর বর্তমানটা পশ্চিমান্তে ঢলে পড়া সূর্যের সাথে তুলনীয় নয়, কিন্তু একথা দুঃখের হলেও সত্যি, যে আজকের বি. ই, কলেজ বহু সমস্যার নাগপাশে নিজেকে আবদ্ধ করে ফেলেছে। একাধারে ছাত্র, শিক্ষক, কর্মচারী বৃন্দ সকলেই সমস্যা জর্জরিত অবস্থার মধ্যে বিরাজ করছি।

আছে স্টাফ-ঘাটতি—একজন দুজন নয়, ৩০-৩৫ শতাংশ পোস্ট অপূরনীয় অবস্থায় পড়ে আছে। ভয়াবহ লোড শেডিঙের সম্মুখীন হয়ে আমরা বহুদিন ধরে দাবী করে আসছি একটা জেনারেটারের। আমাদের ছাত্রদের হোস্টেলে বা ক্যান্টিনে কোন সাবসিডি নেই, নেই লাইব্রেরীতে বইয়ের সুব্যবস্থা। ভ্যাকেশনাল ট্রেনিং এখন এসে দাঁড়িয়েছে এক নিয়মরক্ষার পর্যায়ে। অর্থাভাবে এডুকেশনাল ট্যুর ইত্যাদির প্রায় বিলোপ ঘটার জোগাড় হয়েছে। আর বি, ই, কলেজের ছাত্র, শিক্ষক, কর্মচারী কেউই সমাজ বহির্ভূত নয়। কাজেই সমগ্র দেশের অর্থনীতির আকাশে যখন কালো মেঘের ঘনঘটা দেখা দিচ্ছে তখন আমরাও তার ছায়ায় ধীরে ধীরে আচ্ছাদিত হচ্ছি। এর উপর 'কাটা ঘায়ে নুনের' মত আছে শিক্ষাশেষে কর্মসংস্থানের অনিশ্চিয়তা।

আর যদি পাশাপাশি ইনজিনিয়ারিং শিক্ষায়তনগুলির দিকে তাকান যায় তবে দেখা যাবে তারা আমাদের চেয়ে অন্ততঃ তিন থেকে চারগুণ বাৎসরিক অনুদানে পুষ্ট। সুতরাং অবশ্যাম্ভাবী ফলস্বরূপ বি, ই, কলেজের গৌরবোজ্জ্বল অতীত আজ অনেকটা ক্ষয়প্রাপ্ত, অনেক ম্রিয়মান।

কিন্তু বর্তমান বি, ই, কলেজের চিত্রাঙ্কনে তুলির টান এখানেই শেষ হয়ে যায় নি। আজকে কলেজের সবচেয়ে গৌরবময় সম্পদ হল একাধারে তার ছাত্র, শিক্ষক ও কর্মচারীদের আত্মসচেতনতা। আজ আমরা যেমন আমাদের দায়িত্ব ও কর্তব্য সম্বন্ধে সচেতন, তেমনি আমাদের দাবী ও যোগ্যতা সম্বন্ধেও সচেতন। আর এই চেতনাই আমাদের মধ্যে জাগিয়ে তুলেছে শিক্ষার জন্য সুস্থ পরিবেশের জন্য, সুস্থ সংস্কৃতির জন্য আপোষহীন সংগ্রামী মানসিকতা। একথা দায়িত্ব সহকারে বলা যায় যে আমাদের উপর অন্যায়ভাবে চেপে বসা অশুভ শক্তির বিরুদ্ধে আমরা যেমন লড়েছি, সেই শক্তি যদি আবার মাথা চাড়া দিয়ে ওঠার চেষ্টা করে তবে আমরা দৃঢ়তার সঙ্গে তার প্রতিবাদ করব। আমাদের ক্ষমতা অসীম নয়, তবু ওই সামান্যকেই সঙ্গী করে আমরা বিগতদিনেও যেমন কলেজের উন্নতি সাধনে আন্দোলন করেছি, ভবিষ্যতেও তার থেকে বিপথগামী হব না এই আশা রাখি।

আমরা মনে করি বি, ই, কলেজের সিলেবাস, বেশ কিছু ক্ষেত্রে অবৈজ্ঞানিক সূত্র অবলম্বন করে এগিয়ে চলেছে। আমরা এর সংশোধনের দাবী রাখি এবং এই উপলক্ষে এক পরিবর্ত সিলেবাস ও প্রস্তুত করি। এরপর প্রাণোজ্জ্বল সেমিনারের মাধ্যমে বিশ্ববিদ্যালয়ের প্রাক্তন ও বর্তমান উপাচার্য্যের, বহু শিক্ষক মহাশয়ের এবং প্রায় সকল ছাত্রের সমর্থন লাভ করি। এবং বর্তমানে এই সিলেবাসে প্রথম বর্ষের ছেলেরা পড়ছে। এর পরই আসা যায় জেনারেটর প্রসঙ্গে। গভর্নিং বডিতে জোড়াল বক্তব্যর দ্বারা আমরা জেনারেটর আনার সিদ্ধান্ত করাই। কিন্তু সেই আমলাতান্ত্রিক গাফিলতি এবং কর্তৃপক্ষের অপটুতার জন্য এটাও চূড়ান্তভাবে অবহেলিত হয়েছে। বর্তমানে এটা ওয়ার্কশপে সাপ্লাই দিচ্ছে রিভিউ কমিটির রিপোর্টের ভিত্তিতে ভাকেশনাল ট্রেনিং, এডুকেশনাল টুর এবং ক্যান্টিন সাবসিডির জন্য অনুদান আদায় করার পথে আমরা অনেক দূর অগ্রসর হয়েছি।

কিন্তু সেই সনাতন সমস্যা স্টাফ ঘাটতি, ল্যাবোরেটারী, ওয়ার্কশপের দুরবস্থা এখনও সেই অন্ধকারের জগতেই পড়ে আছে। এই সকল সমস্যার সমাধান কল্পে আন্দোলনকেই সঙ্গীরূপে বেছে নিতে হবে, এই সিদ্ধান্তে আমরা উপনীত হয়েছি।

একজন ইনজিনিয়ারের যেমন সমাজের উন্নতিকল্পে নিজেকে নিয়োগ করতে হয়, একইভাবে সমাজের ইনজিনিয়ারদের প্রতি কিছু দায়িত্ব ও কর্তব্য আছে। অর্থাৎ ইনজিনিয়ার সমাজজীবনের বাইরে পৃথক কোন অস্তিত্ব নয়—সমাজের উপরই নির্ভরশীল। কাজেই একথা বলা বাহুল্য আন্দোলনে সকলের সহযোগিতা আমাদের একান্ত কাম্য।

বর্তমান ও প্রাক্তন ছাত্রদের মিলনোৎসবের মুহূর্তে এই আন্দোলনকে সাফল্যমণ্ডিত করার জন্য, বর্তমান ছাত্রদের তরফ থেকে প্রাক্তন ছাত্রদের প্রতি আমার সবিশেষ অনুরোধ রইল। তাদের প্রতি আমার সবিনয় আবেদন, আপনারা আমাদেরই কলেজের প্রাক্তন ছাত্র, কলেজের সমস্যা সম্বন্ধে আপনারা অবগত আছেন, কলেজের এই স্তিমিতাবস্থা আপনাদের নিকটও বেদনার আর কলেজ তার শ্রেষ্ঠতর অতীতকে আবার ফিরিয়ে আনতে পারলে আপনাদের নিকটেও তা গৌরবের।

ভবিষ্যত ইনজিনিয়ার হিসাবে, একথা আমরা অনুভব করি যে আমাদের দেশের ইনজিনিয়াররা, টেনকোক্র্যাটরাও বহু সমস্যার সম্মুখীন। কাজেই আপনাদের সাথে ঐকান্তিক ভাবে জড়িয়ে পড়ে তালে তাল মিলিয়ে নতুন সম্ভাবনার দিকে এগিয়ে যাওয়ার বাসনা রাখি।

CONTENTS

The Students and staff members of B. E. College deeply mourn the death of our beloved teacher

SRI BINOY CHATTOPADHAYA

May his soul rest in peace

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FACTORS INFLUENCING THE CHOICE OF MIX PROPORTIONS IN CONCRETE

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Introduction.

Since the beginning of the Century, concrete has become the predominent construction material in our civilisation, being used for construction of residential houses as well as institutional buildings and industrial structures of all kinds including off-shore drilling platforms. It has been estimated that between 25-35% of the plan outlay is being spent for pure construction sector in India and about half of that can be attributed to the use of concrete in different forms. Since the fundamental constituent of concrete is cement, the strength of concrete depends very largely on the quantity of cement used per unit volume. It is of prime importance to use cement in the most economical manner in any concrete. Selecting the proper design mix of concrete for a particular requirement is one of the major duties of the Design Construction Engineer of large projects. This is all the more important as cement is generally supplied from different plants, sand and aggregates are normally of varying grades depending on the sources and location during the entire construction period. It is always uneconomical to get a concrete of specified strength by using more cement than is structurally required. This paper gives in a nut shell the various points which may be looked into while considering the factors influencing the design mix under usual working conditions for large projects in India.

The fundamental requirement of a good concrete mix is that it should be satisfactory both in the fresh as well as in the hardened state, possessing certain minimum desirable properties like workability, strength and durability. Besides these requirements, it is essential that concrete mix is prepared as economically as possible by using the least possible amount of cement content per unit volume of concrete with due regard to the strength and durability requirements. Since concrete is produced by mixing several discrete materials, the number of variables governing the choice of mix proportions are necessarily large. However, continuous research work in this field by various investigators, has helped us to identify the significant parameters controlling the proportions of ingredients in the mix.

Compressive Strength.

The primary requirement of good concrete is the satisfactory compressive strength in its hardened state. Many of the desirable properties like durability, impermeability, abrasion, resistance etc. are highly influenced by the strength of concrete. For the purposes of mix design, the strength of concrete can be considered to be solely dependent on the water/cement ratio for low and medium strength concrete mixes. In the case of concrete mixes having higher strength, the aggregate/cement ratio, workability of the mix, the type and maximum size of aggregates influence the selection of water/cement ratio for a desired strength of concrete. The difference between the design strength and the minimum working strength depends upon the degrer of quality control to be exercised at site during implementation of work. The strength of concrete also depends upon the type of cement used and the method and duration of curing employed since the rate of hardening of cement of different types vary considerably. As the site working conditions vary widely in India. it is essential to fix up these variable parameters by suitable laboratory tests, before taking up construction work. This needs to be checked and updated, whenever raw materials from different sources are utilised for making concrete.

Workability

The workability of a concrete mix is mainly determined to suit the type of construction, placement conditions and the means of compaction available at site. The properties of fresh concrete, amount and location of reinforcement and

the shape and size of the mould are important factors which control workability. For heavily reinforced sections, more workable concrete should be used than in the case of massive construction. The main factor affecting workabiliiy is the water content in the mix. Other parameters influencing workability are the maximum size of aggregate, its grading, texture, shape and the mix proportions. The proportion of finer fractions of the aggregate controls the cohesiveness of the mix. It is essential that the mix is cohesive so that compaction will result in a uniform and void-free mass without seggregation. For the purposes of mix design, the degree of workability may be specified as slump, compacting factor or vibrating time of the fresh concrete mix. In most of the mix design procedures, one of these factors is invariably used as a measure of the workability.

Type size and Grading of Aggregate.

Good concrete can be made by using different types of of aggregates like rounded and irregular gravel as also crushed rock which is mostly angular in shape. The maximum nominal size of the aggregate to be selected for a particular job depends upon the width of section of the structure and the spacing of reinforcement. According to the Indian Standard Code of Practice Is—456, the maximum size of the aggregate is restricted to 5 mm less than the minimum clear distance between the main bars for heavily reinforced concrete members such as of main beams. The grading of of aggregates is a major factor, influencing the workability of a concrete mix. The grading of the aggregate should be such as to ensure that the voids between the larger aggregates are filled with smaller fractions and cement mortar so as to achieve maximum density and strength.

Aggregate/Cement Ratio.

The various factors involved in selecting the aggregate/cement ratio of a mix are the desired workability, size, shape texture and overall grading of the aggregates. The aggregate cement ratio affects the strength of concrete in the high strength range to a significant degree. This is one of the reasons for considering the design of high strength concrete separately from concrete upto M—250 grade. It is important to note that mixes with very low water/cement and aggregate/cement ratios, having an extremely high cement content of the order of 450 to 550 kg/m3 exhibit retrogression of strength, especially when large size aggregates are used. The reduction of strength is attributed to the loss of Aggregate-cement bond due to stresses induced by shrinkage of concrete. But similar concrete with smaller sized aggregates (as is generally used in precast prestressed concrete transmission line poles or railway sleepers) has not been found to show such loss of strength.

Durability.

Concrete made from suitable ingredients, with proper compaction is durable under ordinary conditions of exposure and loading. In such cases the mix is designed by selecting the water/cement ratio on the basis of strength and workability rather than durability criteria. If the conditions of exposure are such that high durability is essential, the mix has to be designed by limiting the values of the water/cement ratio depending upon the type of exposure. In cases of severe exposure to cycles of freezing and thawing, concrete mixes have to be designed with suitable air entrainment. It is also essential that frost resistant concrete should have a low water content, low absorption and low permeability. The choice of the type of cement is important, when concrete is exposed to chemical attack by sea water or strong industrial effluents, and sulphates present in the soil. For concrete to be used in spillways of dams and airport runways, resistance to erosion and abrasion is important. This can be controlled by using hard coarse aggregates like flint gravel or granite and compacting the mix to achieve maximum density. The resistance of concrete to fire can be improved by using natural aggregates like dolerites, basalts, limestones and the manufactured light weight aggregates like foamed slag and sintered clay. Where heat resistant concrete is required high-alumina cement with crushed brick or fire brick aggregates has been successfully used.

Material Requirements.

The different types of cements commonly used for making concrete have been developed to suit the strength, durability and other properties needed for a variety of jobs. There are other types like high alumina cement, super sulphate cement, expanding cements and special cements, mainly used for specific situations in oil industry etc. The salient properties which are usefnl in selecting a particular

type of cement for a specified job are the rate of its strength development and heat evolution, drying shrinkage, resistance to cracking and inherent resistance to chemical deterioration. Ordinary Portland cement is by far the most common type which is admirably suited for use in all general concrete construction, when there is no exposure to sulphates in the soil or in the ground water. Low heat Portland cements are preferred in the construction of massive structures like dams, retaining walls and bridge abutments mainly to control the amount of heat generated at tolerable levels. Rapid hardening portland cement is of great advantage in the mass production of precast structural concrete elements while the sulphate resisting and High alumina cements are ideally suited to resist sulphate attack in marine constructions. At the moment about 80 percent of cement produced in India are of pozzolana type. As such selecting the proper design mix for usual structures by using the pozzolana cement instead of ordinary portland cement is of special significance. Since, the early strength development of concrete by using pozzolana (fly ash) cement is lower than by using ordinary portland cement, the design mix is to cater for extra amount of cement, specially for quick precasting work for better utilisation of steel moulds and other associated infrastructures like steam curing.

Grading Requirements For Aggregates.

The grading or particle size distribution of aggregates is a major factor determining the workability, seggregation, bleeding, handling, placing and finishing eharacteristics of the concrete. The grading of fine aggregate has been found to influence the properties of fresh concrete more thah that of the coarse aggregate. Although good workable concrete can be made with various gradings of aggregate, there are identifiable limits within which a grading must lie to produce a satisfactory concrete. But these depend upon the shape, surface texture and type of aggregate as well as the percentage of flaky or elongated material in the aggregates.

ecific Gravity, Bulk Density And Void Contents Aggregates.

In the process of mix design, a knowledge of the cific gravity and bulk density of aggregates used is essential to set out the proportions of material by weight and volume. This also helps to compute the quantity of aggregates required for a unit volume of concrete. Standard tests are available to ascertain these properties for a given representative sample of aggregate to be used in the mix.

Bulking of Fine Aggregate.

Due to the presence of moisture in the fine aggregates to the extent of 3 to 10 percent, the volume of the aggregate increases by as much as 10 to 20 percent. The magnitude of bulking depends to a large extent on the fineness of the grading. The mix proportions are usually designed in terms of the weight or volume of dry aggregates and during mixing operations, adjustments have to be made for the amount of water contained in the aggregates. If weigh batching is adopted the weight of aggregates have to be increased to allow for the weight of water contained therein and the amount of water added to the mix, should be correspondingly reduced.

The Relation Between mean And minimum Strength.

In the design of concrete mixes, the average strength to be aimed at should be appreciably higher than the minimum if the quality of the concrete is to comply with the requirments of the specifications. Since the ultimate strength of concrete depends upon the placement and vibrating conditions, getting good results of cube strength from the concrete at the batching plant only does not guarantee the satisfactory achievement of results from the design mix.

Conclusion.

Since the concrete mix can be designed in various ways to achieve a certain strength for a specified structure, a number of methods and procedures are followed for the same. Various cement companies and construction agencies utilise different methods for finalising the design

mix. The Indian Standard Institution (ISI) at the moment is busy in finalising the draft code on the desigh mix so that it helps to formulate a standard procedure for achieving concrete strength with optimal use of available cement in this country. IS 456-1978 lays adequatr emphasis on adopting proper design mix concrete in place of nominal mix proportion. It has been estimated that the cement content in the mix can be lowered by about 10% when the mix proportions are arrived at after trial mix rather than on nominal mix basis. The present system of laying excessive reliance on 28 days' cube strength to indicate the comprehensive strength and overall quality of concrete that goes in the structure is unjustified. Since in many instances, like sub-structures of bridges or columns of high rise buildings, the full design load does not act till a much later date.

In similar cases, production of high strength concrete at a much earlier date than required can be dispensed with and the required strength can be specified at say 84 days or so. This would naturally lower the cement content of the design mix by about 5-10 percent and also allow use of blended cement which would result in further economy of this scarce material.

Design of concrete mix is a dynamic and on-going process throughout the construction period. Due to the current shortage of cement in the country (which is likely to persist during the foreseeable future), many projects are getting delayed. As such whenever a consignment of cement reaches the construction site, it is generally put to immediate use, without waiting for the test results of cube strength or making any fresh field trials. Thus the tendency persists to use cement in the concrete mix in the conservative side, to take care of variability in quality of cement. It is necessary to evolve design mix at site on a continuing basis, depending on the qualities of various ingredients, specially the cement. A number of research programmes are taking place with CRI, New Delhi and other institutions to indicate the accelerated strength test of cement and concrete without much loss of accuracy. Once these test results are known and accepted it would go a long way in saving the quantity of cement, which also is another form of saving energy which is the need of to-day

The present tendency in this country is to produce about 80% pozzolona cement. The cement requiement in India is going to increase from 26 million tonnes in 1981 to about 100 million tonnes in 2000 A.D. The cement industry has to achieve this target by increasing the capacity of the existing plants, setting up new and larger plants and also by use of blended cement by utilising industrial wastages like slag, burnt clay, fly ash, rice husk, magnesium, blast furnace slags, kiln dust etc. These energy-saving methods would no doubt increase the overall cement production but will also pose new problems for achieving design mix for the future constructors and designers. On the other hand, this would also give more freedom for action for the designers as the gamut of quality of cement at their disposal would be much wider than it is today. In the present context of huge construction programme that is going to be taken up during the current plan and future plans, the economical method of design mix would help us in effecting better use of the cement and concrete in our country.

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সমাজ-শিল্পায়ন-প্রযুক্তি বিজ্ঞান

অমিতাভ রায়

সমাজ-সভ্যতার সমৃদ্ধি-শ্রীবৃদ্ধি সম্পূর্নতঃ বিজ্ঞান তথা প্রযুক্তি-বিজ্ঞানের উপর নির্ভরশীল। প্রকল্প-বিকল্প, যুক্তি-তর্কর মাধ্যমে প্রাপ্ত বিজ্ঞানের নবলব্ধ তত্ত্ব কিছুতেই প্রতিষ্ঠিত হতে পারে না যদি না তা পরীক্ষিত হয়। বৈজ্ঞানিক তত্ত্বকে বাস্তবায়িত করার দায় সমাজের হলেও দায়িত্বটা প্রযুক্তি-বিজ্ঞানের। প্রযুক্তি-বিজ্ঞানের সহায়তায় সমাজ-সংস্থার উন্নতির গতি-প্রকৃতি স্থির করার দায় সমাজ-নিয়ন্ত্রকদের ; আবার প্রযুক্তি-বিজ্ঞান শিল্পায়নকে সময়োচিত করে তোলার দায়িত্ব এড়িয়ে যেতে পারেনা। সমস্ত সমাজেই সমাজ-নিয়ন্ত্রকেরা শিল্পায়ণের নীতিটি নির্ধারণ করে থাকেন ; শিল্পায়নের নীতিকে রূপায়িত করার করার লক্ষ্যেই প্রযুক্তি-বিজ্ঞানের যাত্রাপথ সূচীত হয়। সমাজ নিয়ন্ত্রকদের মর্জি-অনুযায়ী শিল্পায়নের ফলে সমাজের সামগ্রিক উন্নয়ন যেমন সম্ভব ঠিক তেমনি বিপরীত ঘটনাটিও অসম্ভব নয় ; অর্থাৎ শিল্পায়নের মাধ্যমে সমাজের সামান্য কিছু মানুষের হাতে স্বর্ণ-বৈভব-ঐশ্বর্য্যর চরমতম শীর্ষে পৌঁছে দেওয়ার চাবিকাঠি তুলে দেওয়াটাও সম্ভবাতীত নয়। মানব-সমাজের অভিজ্ঞতাকে স্বীকার করলে এই ধারণা ভাবনার বিরোধিতার কোন সুযোগ থাকে না।

অন্যান্য সমাজের মতই ভারতীয় সমাজেও শিল্পায়নের ক্ষেত্রে এই নীতিরই অনুসরণ ঘটেছে। সমাজ-নিয়ন্ত্রকেরা কখনও নিরপেক্ষ হতে পারে না ; সুতরাং এদেশে শিল্পায়নের ফলে কৃষিভিত্তিক, গ্রামকেন্দ্রিক ভারতীয় সমাজ এতটুকুও উজ্জল হয়ে ওঠে নি। কারন, ভারতীয় সমাজের লাগামটা তাদের হাতে যারা স্বল্প সংখ্যক মানুষের সুখ-দুঃখের অংশীদার। অষ্টাদশ শতাব্দীর শেষভাগ থেকে অর্থাৎ ভারতীয় শিল্পায়নের আদিযুগ থেকেই এই ঘটনা ঘটে আসছে। যার ফলে ভারতীয় সমাজে প্রযুক্তি বিজ্ঞান আধুনিকতম পর্য্যায়ে পৌঁছেও, সম্যক সামাজিক উন্নয়নে ব্যর্থ হয়েছে। গঙ্গার দু-কূল ধরাবর চটকল স্থাপনের মধ্য দিয়ে যে ভারতীয় সমাজ নতুন পথের সন্ধান পেয়েছিল, অথবা ১৮৫৪ খ্রীষ্টাব্দের ১লা সেপ্টেম্বর যখন প্রথম রেলপথে হাওড়া থেকে পাণ্ডুয়া পর্যন্ত সংযুক্ত হয়ে নতুন যুগের উদ্বোধন করল কিংবা আরও কিছু পরে দামোদর নদের উপত্যকায় কয়লা নিষ্কাশনের মধ্যে দিয়ে ভারতীয় সমাজে হঠাৎ আলোর ঝলকানি দৃষ্ট হল বা পশ্চিম ভারতীয় অঞ্চলে পুরানো-প্রচলিত রীতি পরিহার করে যান্ত্রিক উপায়ে বয়ন শিল্প উৎপাদন চালু করে যে ভারতীয় সমাজ তার চিরকালীন গণ্ডীবন্ধন কাটিয়ে এক নূতন পথের সন্ধান পেয়েছিল, সেই ভারতীয় সমাজেরই সামান্য সংখ্যক মানুষ চমক-লাগানো চটকদারিতে পোখরানে আনবিক বোমা বিস্ফোরণ ঘটিয়ে অথবা মহাকাশযান উৎক্ষেপণের ব্যস্ততায় প্রযুক্তি-বিজ্ঞানের যথার্থ ব্যবহারে সামাজিক উন্নয়নের প্রসঙ্গ একেবারে বিস্মৃত হতে দ্বিধা-কুণ্ঠা-ইতস্ততঃ বোধ করেন না। উন্নত সভ্যতার কাছ থেকে নিত্য নতুন যন্ত্রপাতি, বৈজ্ঞানিক কলাকৌশল, মহার্ঘ বৈদেশিক মুদ্রার বিনিময়ে সংগ্রহর মাধ্যমে প্রচলিত শিল্পগুলির বারংবার সংস্কার সাধনের মাধ্যমে উৎপাদন বৃদ্ধি করা যায় ঠিকই কিংবা উৎপাদিত পদার্থর মানোয়ন্নন সম্ভব হলেও ভারতীয় সমাজ তাতে কিঞ্চিৎ উন্নতও হয় না। জার্মানীর সীমেন্স-এর সহযোগিতায় আরও বেশী ক্ষমতাসম্পন্ন জেনারেটর ভেল-এর কারখানায় তৈরী হলেও অথবা ফরাসী সহযোগিতায় টাটা কোম্পানীর গাড়ীর মান ভারতীয় গাড়ীর জগতে নূতন যুগের সৃষ্টি করলেও তাতে জগুবাজারের মেছুনী অথবা দলগাঁও-এর চাষীর জীবনধারায় কোনও পরিবর্তনই আসে না। আসলে গলদটা রয়েছে একেবারে গোড়াতেই। ভারতীয় সমাজ শিল্পায়নের জন্য নিত্য নতুন প্রাকৃতিক সম্পদ ব্যবহারের প্রচেষ্টা চালালেও এই সমাজের শ্রেষ্ঠ সম্পদ সুবিশাল জনবাহিনীকে ভারতের শিল্পায়নের কাজে সুপরিকল্পিতভাবে ব্যবহারের প্রয়াস চালানো হয় নি। ভারতীয় সমাজে অধিকাংশ কৃষিযোগ্য জমি যাদের কুক্ষিগত ছিল অথবা আছে তারাই অতি দ্রুত অর্থবৃদ্ধির আকাঙ্খায় উন্নত সমাজ থেকে প্রত্যক্ষ ও পরোক্ষভাবে উন্নত যন্ত্রপাতি ও কলাকৌশলগত নৈপুণ্য আমদানী করে এদেশে শিল্পায়নের ব্যবস্থা করেছে। সরকারী পদ অলঙ্কৃত করে যারা এই সমাজের প্রত্যক্ষ নিয়ন্ত্রণের দায়িত্বে সেই বৃটিশ আমল থেকে আজ পর্যন্ত বহাল আছেন তারা শিল্পায়নের ব্যাপারে সমস্ত রকম সুযোগ সুবিধা নানান পদ্ধতিতে সেই সুখভোগকারী সামান্য সংখ্যক পরশ্রমজীবিশ্রেণীর মানুষের মধ্যে বিতরণেই ক্ষান্ত হন নি, প্রয়োজনে সরকারী অর্থের ঝাঁপি তাদের জন্য উজাড় করে দিয়ে দুহাতে স্বর্ণ-সংগ্রহর সুব্যবস্থা করে দিয়েছেন। রাষ্ট্রীয়করণের নামে রুগ্ন শিল্প অধিগ্রহণের মাধ্যমে তীব্র অর্থনৈতিক সংকটকে কিছু লাঘব করার প্রচেষ্টায় অন্যান্য সূত্র থেকে সংগৃহীত রাজস্ব বিনিয়োগ করা হয় ; আবার উন্নত যন্ত্রপাতি-সাজসরঞ্জাম-কলাকৌশল সমৃদ্ধ প্রযুক্তি-বিজ্ঞানকে আমন্ত্রণের মাধ্যমে বহুজাতিক বাণিজ্য সংস্থাগুলির শোষণ-লুণ্ঠনের প্রয়াসকেও সুরক্ষিত করা হয়। রং-বেরঙের পরিকল্পনায় সুলভ শ্রম ব্যবহারের প্রয়াস থাকে ; থাকে না শ্রমশক্তি শ্রম সম্পদে পরিণত করার বিন্দুমাত্র প্রচেষ্টা অর্থাৎ সব মিলিয়ে ভারতীয় সমাজের শিল্পায়ন-নীতি, সব সময়েই সামাজিক পরিস্থিতিকে বাদ দিয়ে, জন-সম্পদকে উপেক্ষা করে, সর্বোপরি সামগ্রিক অর্থনৈতিক উন্নয়ণের জন্য সচেষ্ট না

হয়েই এগিয়ে চলেছে। শিল্পায়নের নীতিতে পরীক্ষা-নিরীক্ষার অভাব না থাকলেও দেশের উন্নতির জন্য প্রয়োজনীয় কাজে আন্তরিকতার অভাব আছে। কাঁঠালের আমসত্ত্ব বা সোনার পাথরবাটি বানাবার নীতিতে ভারতীয় সমাজের প্রাক্তন ও বর্তমান নিয়ন্ত্রকমন্ডলী এতই বিভোর যে তারা নিজেদের বাঁচাতে কি করে এক বছরে একশ-একবার এক-হাজার-এক রকমের শিল্পনীতির কথা আওড়ান তার হিসাব রাখতে গেলে মস্তিষ্ককে যথেষ্ট কষ্ট পেতে হয়।

ভারতীয় সমাজের জন্য প্রয়োজনীয় গণমুখী শিল্পায়নের নীতি প্রয়োগের মাধ্যমে প্রযুক্তি-বিজ্ঞানের বিকাশ না হবার ফলে ভারতীয় অর্থনীতির মূল ভিত্তিভূমি গ্রামগুলির দুঃখব্যঞ্জক চেহারা আজও বর্তমান। উন্নত কৃষি যন্ত্রপাতি, রাসায়নিক সার, উচ্চফলনশীল বীজ প্রভৃতির ব্যবহারে 'সবুজ বিপ্লব' হয়তো সম্পন্ন হয়েছে, কিন্তু সবুজ বিপ্লবের শ্যামল ফসল সোনায় রূপান্তরিত হয়ে সেই সমস্ত ভদ্রজনদের ঘরেই স্থান পেয়েছে যারা বিপদে-আপদে সাংঘাতিক চড়া সুদে, অসংখ্য কড়া কথা শুনিয়ে সামান্য কর্জ দিয়ে গ্রামবাসীদের কৃতার্থ করার আনন্দ উপভোগ করেন। মহাজনী আদবকায়দার ব্যাপকতার বাস্তব দৃশ্য দেখতে অভ্যস্ত চোখে 'ব্যাঙ্ক জাতীয় করণ' নামক ঘটনাটি একান্ত ভাবেই তামাশা বলে প্রমাণিত হয়। অথচ এই সমাজে প্রচলিত শিল্পগুলিকে আধুনিক প্রযুক্তি বিজ্ঞানের যথার্থ প্রয়োগে অত্যন্ত লাভজনক করে তোলার সুযোগ ছিল ; এই সুযোগের সদ্ব্যবহার হলে গ্রামে গ্রামে কর্মহীন মানুষের সংখ্যা বৃদ্ধি পেত না, অথবা গ্রামগুলির এত সংকটজনক অবস্থা নিশ্চয়ই পরিলক্ষিত হত না, জীবন-জীবিকার নূন্যতম সীমানায় অন্ততঃ অধিকাংশ মানুষ পৌছাতে পারত। মানুষ নিদেন পক্ষে মাথায় উঁচু করে দাড়িয়ে স্বীয় স্বাতন্ত্র্যকে বজায় রাখতে পারত। পরিকল্পনার ব্যর্থতা বলে যারা এহেন ঘটনাবলীকে প্রতিপন্ন করতে চান তাঁদের জেনে রাখা উচিত,—পরিকল্পনা যেহেতু শ্রেণীস্বার্থ-বিহীন নয়, সুতরাং যারা আজকের ভারতীয় সমাজ নিয়ন্ত্রক বিগত পরিকল্পনাগুলি তাদের স্বার্থের পরিপন্থী কখনই হয়নি, হবেও না। মোট জাতীয় উৎপাদন বেড়েছে বলে অর্থনীতিজ্ঞ পরিসংখ্যানবিদরা উল্লেখিত হলেও আদতে ঘটনা যে অন্য, সেটা আবার জানা ; ব্যাপারটা অনেকটা প্রথম শ্রেণীর ছাত্রদের সাথে তাদের বৃদ্ধ শিক্ষকের বয়সের গড় নিলে যা দাঁড়ায় সেইরকম। একথা সত্য যে দেশের ভূমিব্যবস্থার পূর্ণবণ্টন ব্যতিরেকে দেশের অর্থনীতিকে ঢেলে সাজানো তথা যথার্থ প্রযুক্তি-বিজ্ঞানের প্রয়োগে সঠিক শিল্পায়নের নীতি-নির্ধারণ অসম্ভব। আর এই প্রয়োজনীয় কাজটি সম্পন্ন করাটা অত্যন্ত সহজ নয়। বিনা যুদ্ধে সূচাগ্র মেদিনী দিতে কেউই আগ্রহী নয়। তবে সীমাবদ্ধতা-নিয়ন্ত্রণ-বন্ধন যতই থাক না কেন তার মধ্যেও কিছু কাজ অন্ততঃ করা যেত। ভারতীয় সমাজের দু-তিনটি অঞ্চলের বিগত দু-তিন বছরের কার্যাবলী দেখে এই সিদ্ধান্ত নেওয়া যায়।

অর্থনৈতিক সংকটের তীব্রতা সমাজজীবনে যথেষ্ট ভাবে প্রতিফলিত হচ্ছে। গ্রামের কর্মচ্যুত মানুষ শহরে চাকুরীর উমেদারীতে ইতস্ততঃ বিক্ষিপ্ত ভাবে ঘুরে বেড়াতে বাধ্য হয়। গ্রামের অশিক্ষিত কর্মহীন ব্যক্তিটির কাছে শহরে শিল্পের সাথে সংযুক্ত হওয়াটা পরম লক্ষ্য হিসেবে স্বীকৃত হয়। ফলশ্রুতি সমাজটা ভাঙে। আবার একই ঘটনা শিক্ষিত সমাজেও দৃষ্ট হয়। এখানে মানুষ বিজ্ঞান তথা প্রযুক্তি- বিজ্ঞান পাঠে বিশেষ আগ্রহী নিতান্তই বৃত্তিগত কারণে। কারণ, বিজ্ঞান তথা প্রযুক্তি বিজ্ঞানে রোজগারের সুযোগ বেশী। অনেকটা শ'দুই বছর আগেকার মানুষদের ইংরেজী জানবার মত। কারণ, সেযুগে ইংরেজী জানলে ইংরেজের 'হৌজে' চাকুরীর সুবর্ণ সুযোগ থাকত। বিজ্ঞান পাঠই হয়, বিজ্ঞানকে জীবনের সাথে মিশ্রিত করার কোন চেষ্টাই থাকে না। ফলশ্রুতি বিজ্ঞান পাঠ এবং পদব্রজে তারকেশ্বর যাত্রা একই সাথে ঘটে। অন্যান্য সামাজিক মূল্যবোধগুলিও অচিরেই ভেঙে পড়ে।

এই প্রসঙ্গে এ দেশের প্রযুক্তি বিজ্ঞানের উপর কিঞ্চিৎ দৃষ্টিনিক্ষেপ অপ্রাসঙ্গিক হবে না। ভারতীয় সমাজে এহেন শিল্পায়ন নীতির পটভূমিকায় প্রযুক্তিবিজ্ঞানের পাঠক্রম স্বাভাবিক কারণেই সমাজ-বিচ্ছিন্ন। প্রযুক্তিবিজ্ঞানের ছাত্রদের সমাজ উন্নয়নের স্বার্থে প্রযুক্তি-বিভাগ ব্যবহারের প্রয়োজনীয়তা সম্বন্ধে শিক্ষা দেওয়া তো দূরের কথা সমাজ সম্বন্ধে ভাবনা-চিন্তারও সুযোগ দেওয়া হয় না। উপরন্তু সমাজ বিচ্ছিন্ন ব্যক্তিকেন্দ্রিক এক ঝলমলে রঙ্গীন জীবনের প্রতিচ্ছবি প্রযুক্তি বিজ্ঞানের ছাত্রদের সামনে তুলে ধরে তাদের সমাজ নিয়ন্ত্রকদের সেবাদাশে পরিণত করার পরিকল্পনাটি সার্থক করা হয়। আমদানীকৃত যন্ত্রপাতি দ্বারা কেবলমাত্র প্রচলিত শিল্পগুলির রক্ষণাবেক্ষণের প্রয়োজনীয়তাটুকু মেটাবার জন্যই এদেশের প্রযুক্তি-বিজ্ঞানীদের সাধারণতঃ ব্যবহার করা হয়। গবেষনা ও উন্নয়নের স্বার্থে কিছু সংখ্যক প্রযুক্তি-বিজ্ঞানীকে ব্যবহার করা হলেও তাদের গবেষণালব্ধ ফলদ্বারা সেই একই কায়দায় সামান্য কিছু লোকের ধনসম্পদে আহরণের প্রচেষ্টায় কিঞ্চিৎ ত্বরণ সৃষ্টি করা হয় মাত্র। আর আছে বিদেশের হাতছানি। সমাজের মূল প্রবাহ থেকে বিচ্ছিন্ন করে দেওয়ার প্রচেষ্টা তাই প্রতি মুহূর্তেই প্রযুক্তি বিভাগের ছাত্রদের উপর চালান হয়। কারণ সমাজের উৎপাদিকা শক্তির অন্যতম মূল স্তম্ভ হল প্রযুক্তি বিজ্ঞানী। সুতরাং প্রযুক্তি বিজ্ঞানীকে স্বর্ণ-রৌপ্যের জারকে জারিত করে, পুত্র-কন্যা সহ চার দেওয়ালের মধ্যে যাবতীয় পার্থিব সুখ সম্পদের বন্ধনে আবদ্ধ করতে পারলে, তার পক্ষে সমাজ সম্বন্ধে চিন্তা তো দূরের কথা সমাজের দিকে দৃষ্টিপাতও সম্ভব নয়।

কিন্তু শেষ কথা এটাই নয়। ইতিহাস অভিজ্ঞতা অন্ততঃ তাই শিক্ষা দেয়। সুতরাং গতিশীল পৃথিবীতে যারা সমাজ-সভ্যতার অগ্রগতির বিরুদ্ধে রুখে দাঁড়াতে চায় অথবা তাদের সহায়কশক্তিরূপে কাজ করে পিছিয়ে দিতে চায় সামাজিক প্রগতি, তাদের বোধ হয় এবার চিন্তার কারণ ঘটেছে। কারণ, অর্থনৈতিক সংকটের তীব্রকশাঘাতে ব্যক্তিকেন্দ্রিক মানুষের দল ক্রমশঃ হতাশ-নিরাশ হয়ে পড়ছেন। আর আগামী দিনে যখন সমাজ নিয়ন্ত্রকের শ্রেণী পাল্টাবে তখন এই সব সমাজ বিচ্ছিন্ন মানুষগুলি সমাজ সংস্থা-সংসারের প্রগতির গতির স্বার্থে তাল মিলিয়ে চলতে পারবেন তো ? রাষ্ট্রকাঠামো যখন নড়বড়ে, সমাজ যখন ভঙ্গুর তখন ব্যক্তিজীবনে স্থায়িত্ব-নিরাপত্তার আকাঙ্খা বাতুলতা নয় কি ?

Bio Medical Engg. A New Area of Scientific Endeavour

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The tremendous capabilities of engineering are attested to by its indispensable role in many of mankind's most spectacular achievements, as in the application of nuclear physics, missile research and development, and the development of electronic computers, none of which would have been possible without engineering technology. To support the assault at present being made on the nation's health problems, it is not only essential now but in the next decade a sufficient and adequate portion of our engineering capabilities should be directed to exploring, obtaining and applying knowledge about life itself and to meeting the common everyday health needs of men and women.

The areas of interaction between the engineering sciences and biology and medicine are undergoing vigorous development at the present time. Since Second World War there has been increasing support for biomedical research, and the work in this area has accented the accumulation of basic knowledge about life processes. At the present time we are moving into a period characterised by a rapidly increasing population, rising expectations and a need for the development of more adequate techniques for the prevention, diagnosis, and treatment of disease and for the development of more adequate systems for the delivery of health services. Coupled with this are rapidly rising medical costs, all too apparent manpower shortages in the biomedical area, and pressures for a more extensive and efficient application of our present knowledge and technologies for the tangible improvement of health care. The application of the principles and practices of engineering science to the bio-medical area is important not only because it provides an opportunity to increase our knowledge and understanding of living systems but also because it is a most promising vehicle for expediting the conversion of knowledge to effective action.

Biomedical engineering is a relatively new area of scientific endeavour that is just emerging from a somewhat chaotic beginning and which to date has provided only a hazy definition of its purposes. It is possible to set broad goals for biomedical engineering and to pursue them by a variety of specific missions. These goals include :

(1) the establishment of effective mechanisms for the growth of the field ;

(2) an increased understanding of how living systems function ; and

(3) the succesful application of biomedical engineering capabilities to a variety of social needs.

Within these broad goals, some of the missions that can be indentified are the development of—

(1) strong training programs at all levels ;

(2) an information system that will expedite the utilisation of knowledge as it accrues and encourage mutation of the field as new goals and missions are indentified ;

(3) a strong data base ;

(4) a more satisfactory mathematics for the manipulation of biomedical problems ;

(5) new materials for biomedical use ;

(6) new computers and computer languages specifically oriented to biomedical problems.

From the point of view of those dealing daily with clinical problems in medicine there are a variety of instruments, devices, and systems that are urgently

needed at this time. There is an important manpower aspect to successful instrument innovation in the clinical areas. To date doctoral training programs stressing the interaction of engineering with biomedicine have largely concentrated on the relationship of engineering to biology. Once the utility of an instrument is established the designs are transferred to manufacturing facilities for low—cost production and widespread dissemination.

An important aspect of biomedical engineering lies in the fact that, as we consider the content of the field and the opportunities inherent in it, we are forced to re-examine what we have been doing conceptually and in practice in many areas of biomedical research and health care. What is particularly apparent is that there is an increasing need to define more concisely the impact of engineering science in three general areas that are essential to the development of health research and the improvement of medical care. They are :

1) Physical biology : the extension of engineering concepts and technology along with the physical sciences and mathematics into scientific inquiry into biological phenomena as a basis for advancing the understanding of biologicalsystems.

2) Engineering development : the utilisation of engineering concepts and technology in the development of instrumentation, diagnostic and therapeutic devices, artificial organs, relevant to the solution of major problems in the areas of biology and medicine.

3) Social Engineering : the application of engineering principles and practices for the development and further evolution of complex social structures, such as those that deliver medical services and operate hospitals or related health service units.

As the interaction between engineering and the life sciences to date has been spontaneous, natural, pragmaticand ratherunstructured, to capitalise further in this area it will be necessary to assess this interaction more systematically and to layout appropriate short and longrange goals for biomedical engineering.

Currently the area of interaction between the engineering sciences and biology and medicine is undergoing rapid expansion and the establishment of biomedical engineering centers in the next decade is important in order that (1) the application of the fundamental principles of engineering sciences to biomedical research, to the design and development of instrumentation, devices and systems pertinent to the further advance of preventive, diagnostic, and therapeutic medicine, and to systems for thedelivery of he health services be unreaised without undue delay, and that (2) unique oportunities arising from this interaction can be singled out and obstacles to their realisation be identified and overcome.

Lastly it can be said that biomedical engineering should find its own place in the sun and not be submerged as part of life science or engineering departments. Such an identification can best be achieved by arrangements where research and training can successfully be merged to achieve this, it will be necessary to develop a more systematic and integrated overall programme for the area.

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Our Ancient Civilisation

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In these days when advancement of civilisation and increased technological skill has left us exalted of our achievement, it is very difficult to believe in a story telling us of an advanced civilisation that had existed thousand of years back and was destroyed subsequently by natural cataclysm. In fact stories of lost continents have haunted the minds of many for centuries. Leaving aside what existed in other parts of the globe, the stories of the Ramayana and Mahabharata often stirs our thoughts and we wonder if they had any existence at all or are mere myths. We could have altogether disbelieved these dramatic stories and frowned at their tellers had there been no tell-tale mark which stood the test of time and cannot be set aside by a person possessing a logical trend of mind.

It was Plato, the famous Greek philosopher of the fourth Century B. C. who in his famous dialogues "Timaeus" and "Citrias" mentioned of a civilisation that existed in the lost city of Atlantis. It is believed that the story was told to him by Solon, the wisest of the seven sages of Greece and a distinguished poet and a statesman who collected the story of the island of Atlantis from the Egyptians. It is believed that the Atlantis was an island continent submerged in the middle of the Atlantic Ocean. A reputed American hypnotist, clairvoyant and a healer Edgar Cayce (1877-1945) had his 'visions' of Atlantis where a civilisation possessing advanced knowledge of science, technology and spiritual achievements existed around 20,000 B. C., a date that also roughly fits with Plato's version. According to him, the Atlantis did exist between the Gulf of Mexico and the straits of Gibraltar and was destroyed due to nuclear explosion. Some investigators also Connect the mysterious happenings of the Bermuda Triangle with some underwater force field generator located around the region under the ocean where the lost Atlantis once reigned supreme. It is believed that the inhabitants of Atlantis knew the various methods of harnessing power and also had the clear know how of the mechanism of lift and propulsion. Modern archaeologists of to-day have gathered convincing proofs of a sunk island in the eastern Mediferranean where a splendid civilisation did exist. The theories that were put forward from time to time in connection with the historical Atlantis is so immense in nature that in 1882, a new subject was opened in the name of 'Atlantology' which used all existing tools of science—archaelogy mythology, linguistics, ethnology, geology, zoology, botany etc. Volumes have already been published suggesting the possibilities in explaining the riddles of the Atlantis and we may have to wait in absence of a unique solution or a conclusive reply in this respect.

The Indus Valley Civilisation which once flourished in the region now covered largely by Pakistan and partly by India consisted of skilfully planned cities with sophisticated drainage system and thrived at least in two great cities namely Harappa and Mohenjodaro. As it appears to-day, the civilisation was at its height by 2400 B. C. and came to an end by probably 1600 B. C. In 1856, when the East Indian Railway track was in progress between Karachi and Lahore, the persons in charge of the work searched for a place wherefrom the ballast for the railway track can be had and thus come to an ancient

ruined city called Brahminabad which opened the doorway of the discovery of an amazing urban civilisation in the Indus River Valley. Harappa is situated near the old course of the river Ravi, a tributory of the Indus while Mohenjodaro is on the bank of the old course of the Indus. Both of these cities cover several hundred hectares and over more than 50 years of intensive excavation has revealed the nine metre wide streets crossing one another at right angles and a grid arrangement of the cities which appears to be planned entirely before construction with a hillock to the west giving the location of the citadel which was the administrative and religious centre of the cities. Fireclay was the major material in the making of everyday goods such as pottery, ritual objects, toys etc. and its wide use suggests the existence of an organised factory. The thing that deserves mention for the civilisation is its sewerage system which consists of a grided network leading to a central covered sewer. There is evidence that this remarkable civilisation had been declining before it came to an end, the cause of which is still a matter of research. One theory suggests that the flood of the river Indus often broke in before it changed its course finally while the other theory puts forth the view that an Aryan invasion around 1500 B.C. was the course of the degeneration. The inscriptions and the seals obtained from the relicts have not yet been successfully decoded thus bringing us to a halt in drawing the final conclusions regarding the many riddles of the lost civilisation.

An awe-inspiring civilisation might have sprung in the Nile Valley as early as in 4000 B.C. or how could the technological skill and the amazing perfection lead to the construction of the magnificient and legendary monuments like pyramids to the planning of which many a modern and sophisticated construction dwarf into insignificance. As known from the early Arab writers, a king incribed all the Egyptian knowledge of mathematics, geograghy, astronomy etc. inside the pyramids apprehending that the end of the world was drawing nigh. Though many of the structures have been reduced to nothing more than mere heaves, three of them built at Giza, a few kilometers from Cairo, have defied the ravage of time and stand to confound us with their grandiose architectural expressions. In the ancient Egyptian civilisation, attempts were often made to protect the tombs of god-kings and to safeguard the royal corpse. After much experimentations, pyramids were thought best, the building of which was begun at about 2780 B.C. The period of stability in the economic hnd the political fronts lasted about 5 centuries in the Egyptian civilisation after which the absolute power of the pharaos was being questioned. It is now believed that pyramids which was the centre of a vast rectangular enclosure with the boundaries of a 15 hectare area were built primarily with the intention of displaying the varity of royal kings and also to be used as tombs to safeguard the bodies of the kings with the spiritual aspiration of continuing living in an after-life backed by the then belief of immortality through the process of bodies being preserved and provided for. Normal human tendency is to explain the unknown often streching the imagination beyond the common logic providing a mystic veil and curious speculation and naturally therefore the pyramids have beon explained by some scholars as symbolic representation of world science interpreted by the priest-hood displaying geometric knowledge of a highly advanced nature. To-day in many of the western countries, scaled models of pyramids are told in the market to demonstrate the mystic observation that foods and other animal proteins are less affected by natural decomposition if they are preserved at the region of of the centre of gravity of the pyramids. Does it explain how the mummies were preserved through centures ? It is also said that the blunt weapons are sharpened automatically if they are exposed to the centroidal region. Does a special concentration of the gravitational force field take place at the centre of gravity of the pyramids ? Possibly we will need a second Einstein to get the reply. Apart from the substantial labour force and the building skill that were needed to erect the gigantic monuments if the special significance of geometry attributed to these

structures is proved beyond suspicion, we should bow down with profound regard to the achievements manifested by this lost civilisation in the distant past from this twentieth century.

Justice will not probably be shown if mention is not made of Mayan cities in the heart of central America located at the southern tip of Mexico. What is the origin of Mayan civilisation ? Theories have been put forth that it had originated outside the Americas but whether it came from India, Israel, Greece or China—archaeologists are not sure about it but the relics and heiroglyphic scripts make us sure that the Mayas were monumental builders and skilled craftsmen and the intellectual brilliance that they exhibited in the remote New Stone Age baffles the scientists and explorers even to-day. The greatest difficulty posed by the Mayan civilisation is that no definite relation has yet been established between the Mayan era and the Christian era even with the carbon—14 dating. Though the Mayas were very meticulous in incribing the dates of their major creations as have been read out by deciphering the heiroglyphic scripts but it has got only relative value. It is now believed that the Mayan history starts about 1000 B.C. and though the glamour of the civilisation had vanished long since, their descendents still live in Yucatan. The Mayas constructed gigantic structures and used a type of roof called corbelled arch or false vaulting. They however used to live in an unhealthy climate and on poor soil surrounded by encroaching forest on all sides. Remarkable development in the field of astronomy and mathematics took place and they had the concept of zero about 2000 years ago while the Europeons had to wait for another 1000 years to get it. They were worshippers of time and on special dates victims were sacrificed before gods. Probably the external conquests brought the Mayan civilisation to a halt and the Mayan world finally ceased in 1441 at Mayapan in Mexico.

The lost city of the Incas, perched in the peruvian Andes, confused the explorers for more than 300 years who searched in vain the spot to find the remains of the city till Hiram Bingham, a young Assistant Professor in Latin American history discovered it near the mountain Machu Picchu. The city was a masterpiece of construction and was a large hanging garden in the hills as in Babylon. The city was constructed by gigantic granite blocks that were moved uphill without the aid of any wheel. The Incas were the worshippers of the sun, moon and the stars and the beautiful girls of the city were framed to assist the nobilty in performing religious rites. What happened to the fate of the city remains still a mystery in absence of any script.

The science of archaeology was born in the eighteenth century when the excavation of the lost city of Pompeii was made. Pompeii was the summar resort of wealthy Romans near the Bay of Naples which was wiped out when Mount Vesuvius erupted on August 24, AD 79. In the mountains surrounding the valley of Mexico a most brilliant pre-columbian civilisation did flourish between 200 B.C. and 700 A.D. Modern excavations of the city called Teotihuacan have revealed only the ruins but have not answered who were the builders. No positive reply has yet been received regarding the raising of Megaliths, building of stonehenge, erection of massive stone figures in Easter Island nor we do know about the unresolved problems of the mythical Eldorado. Should we make ditto to the theory of Daniken that gods from other world visited this planet in pre-historic days and kept their footprints ? Is the unsolved mystery of UFO connected to all these ? According to Jeane Dixon, the reputed American soothsayer, most of the predictions and theories will be coming to light at the end of this century. So we may not have to wait for more than one or two decades to know the facts if of course our civilisation is not endangered by this time, the remains of which will be waiting to be discovered by unknown explorers in future days. It is the love for the mystic and imagination which often help to find the truth. As Albert Eintein wrote in 1930—"The most beautiful thing we can experience is the mysteterious ; it is the source of all true art and science.

He to whom tnis imagination is a stranger who can no longer pause to wonder and stand rapt in awe, is as good as dead, his eyes are closed."

Help has been taken from the books—

1. The World's Las Mysteries.
2. Strange stories, Amazing facts.
3. The Bermuda Triangle.
4. The Mystery of Atlantis.
5. Secret of the Ages.
6. Diving into the past.
7. Invisible Horizons.

"Liquid Nitrogen"—Tower of Achievement

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Nitrogen, one of the chief constituents of air, does neither burn nor supports combustion. That may sound to one that it is less useful than oxygen and hydrogen for our utilisation. A gas has three parameters—pressure, volume and temperature by controlling which one can change the state of the gas. Without going into the details of a liquid nitrogen plant, it would be more useful in this context to expose its wide field of applications in science and technology.

Temperature is an indication of the state of biological system. For a healthy man it is between 34°c—35°c. if the normal temperature of a body increases or discreases this indicates state of illness. But often it necessiates to produce low temperature to store foodstuff, medicine, blood, milk, fishes for an appreciable period. There are several methods of cooling and refrigeration—out of which liquid nitrogen containers are increasingly becoming popular. Liquid nitrogen contracts on cooling and one would be amazed to know that it contracts 500 times that means 1 cc. of liquid nitrogen when heated would occupy 500 cc. Thus a huge volume of nitrogen can be stored in a relatively small dewar vessel. The specimen can be easily stored in the empty space above the liquid surface in suitable trays. In some cases it may also be immersed in liquid nitrogen.

In all big cities fishes are kept under ice and is sold to the consumers at high prices. The method is crude and in the process the taste of the species is totally lost. Export packings of prawns are now cooled by freeze-drying and some other processes but the sophisticated European market has started rejecting them on the same ground. If the fishes are kept in liquid nitrogen, then the taste is fully regained when they are put into water again. If we do not switch over to that latest method we may lose huge foreign exchange.

Storage of semen is also very useful and sometimes beneficial for human being. Specially in animal husbandry, it can go even to increase our total milk production per annum. Before that, we should like to discuss a few points about animal reproduction. Normally, testicles in the male specimen produce sperms along with certain secretion—the fluid is called semen. During sexual union, the fluid goes to the uterus of the female through the vagina. The fertilisation takes place when female egg cells, ovum react with sperm to produce zygote.

The female then conceives and the faetus is held in the uterus for a few months. Normally, this is the natural process occuring everywhere in animal kingdom. We know that after the delivery of the calf milk can be obtained from it after a gap of a few months. The lactating period and the duration can be quiet easily controlled by artificial insemination,

Actually bulls (especially Australiar, Danish) are imported from outside and are maintained in standard conditions. The semen is collected in sterilised pots and then transferred tosmall capillaries —the small capillaries are kept over liquid nitrogen (—196°C). These containers can now be sent from centre to centre where the semen is injected back to the cow's uterus. The cow then conceives— similarly, the natural ovum fluid of a cow can be collected from her menstrural flow and can similarly be stored in liquid nitrogen. The sperms and the ovum cells become active again when they are brought from —196°C to the room temperature. Thus a cow can be made to conceive no of times more than it can conceive in the natural process. Naturally her milk output increases. The author had the opportunity in visiting one frozen Semen Bank in the out skirts of Bangalore where a large no of bulls and cows are kept under standard conditions. A small liquid nitrogen plants serves the Bank.

Liquid gases have a good role in space research. In the liquid state nitrogen has higher heat content and this heat can be utilised as a space fuel in its later stage journey. That is why liquid nitrogen plants are now a part of space research. Nitrogen is preferable because the chance of fire is less as it is neither combustible nor supports combustion. Liquid nitrogen run motor engines have been desired but its high cost still keeps it confined in encyclopedia. In medical research, the liquid nitrogen is being tested to check the growth of cancer in human tissue.

Cryogenics (Low temperature physics) is going storing to help of industry. One of the reasons for its less popularity is the cost of liquid nitrogen plant. On an average a liquid nitrogen plant costs about 8 lakh rupees. The price is sometimes too good for a mediocre educational and research Institution. Uninterrupted power supply is essential. The installation will be practically useless in some of the states where there is an acute power shortage. One point may not be irrivalent in this content. One High Vaccum Laboratory must be close to such Cryogenic Laboratory.

"Non Liner Applications of Liner I. C."

Subhasis Saha 5th year E. & T. C.

An OP-AMP is essentially a very high gain d. c. amplifier that uses feedback for control of response characteristics as is known to us. The designation OP-AMP was originally used for high performance d. c. amplifiers that formed a basic part of analog computers, These OP-AMPS are used to perform mathematical operations like summation, sealing, subtraction, integration, phase shift, V-I & I-V conversion, D.C. voltage follower etc. But todays I. C. OP-AMPS have a variety of linear and non-liner applications together with some special purpose applications. The linear applications include those cases in which input & outputs are essentially fine waves, waereas, the non-linear applications include those cases in which the input and output are essentially non-sinewave or where the output is drastically modified by the OP-AMP. Let us discuss very briefiy a few of those.

Let us first see, how we can design and construct an oscillator (Low freq. sine wave generator) using OP-AMPS. Since an OP-AMP has both +ve and +ve inputs as well as gain, it is poissble to use +ve feedback from the output to sustain oscillation. OP-AMP oscilletors are practically effective at very low frequencies where the high values of L & C reqd. make it impractical to use conventional Lc oscillators. Figure 'A' is the working schematic of an OP-AMP used as a low freq. sine work generator. The OP-AMP can be general purpose such as the Motorola 1741C. This ckt. is a parallel T oscillator. Feedback to the non-inverting input becomes +ve at the trequency indicated. Positive feedback is applied at all times. The amount of +ve feedback, set by the ratio of R_1 to R_2 is sufficient to cause the OP-AMP to oscillate. In combination with the feedback to the non-inverting input feedback to the inverting input can be used to stabilize the amplitude of oscillation.

The value of R_1 is approximately 10 times the value of R_2. The ratio of R_1 and R_2 as set by the adjustment of R_2 controls the amount of +ve feedback. Thus, the setting of R_2 determines the stablity of oscilletion.

The amplitude of oscillation is set by the peak to peak output capability of the OP-AMP and the value of zener diodes CR_1 and CR_2. The zener voltage should be approx. 1·5 times the desired peak to peak output voltage. The non-liner resistance of the back-to-back zener diodes is used to limit the output amplitude and maintain good linearity.

The frequency of oscillation is determined by the values of C & R. The upper freg. limit is approximately equal to the bandwidth of the basic OP-AMP. That is, if the open loop gain drops 3 ab at 100 K. Hz, the oscilletor should provide full voltage output upto about 100 K.Hz.

Derign Example :

We have frequency $\approx \frac{1}{6{\cdot}28\ RC}$

and $R < 2\ M\Omega$ and $R_1 \approx R_2 \times 10$.

Zener pt. of CR_1 and $CR_2 \approx 1{\cdot}5 \times V_{out}$.

Assuming that the ckt. is to provide 6v sinewave signals at 8Hz. Since R_2 is variable, the exacl value is not critical. We assume a maxm. value of 10 $K\Omega$ for R_2. Hence $R_1 = 100\ K\Omega$.

With a required 6v. peak to peak output the values (zener voltage) of CR_1 and CR_2 should be 9v. It is assumed that the basic OP-AMP is capable of 9v. peak to peak output.

The values of R and C are related to the desired freq. of 8 Hz. Any combination of R and C can be used provide that the combination works out to a frequeney of 8 Hz. For practical derign the value of R should not exceed about 2 M. We assume R=1 M. for simplicity with R=1 M, and a desired freq. 8 Hz. the value of C is $\approx \frac{1}{6{\cdot}28 \times 8 \times 10^6} \approx 0{\cdot}02 \mu F$.

This circuit can be modified to genrate variable frequency and also variable amplitude sine waves.

LOW FREQ SINE WAVE GENERATOR:

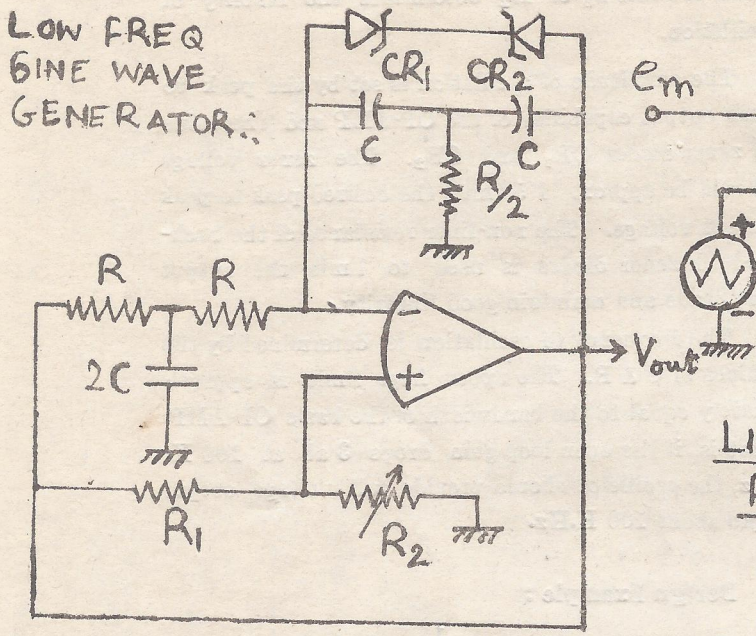
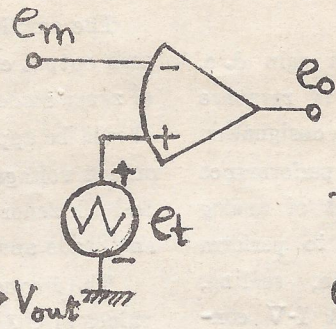


FIG. -'A'



LINEAR P.W.M.

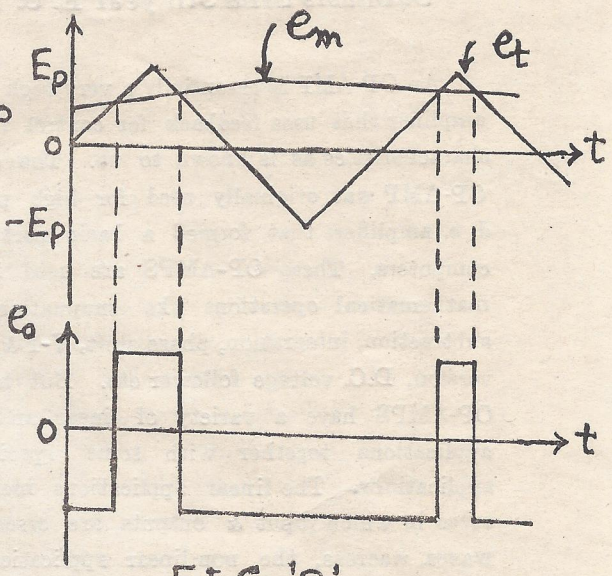
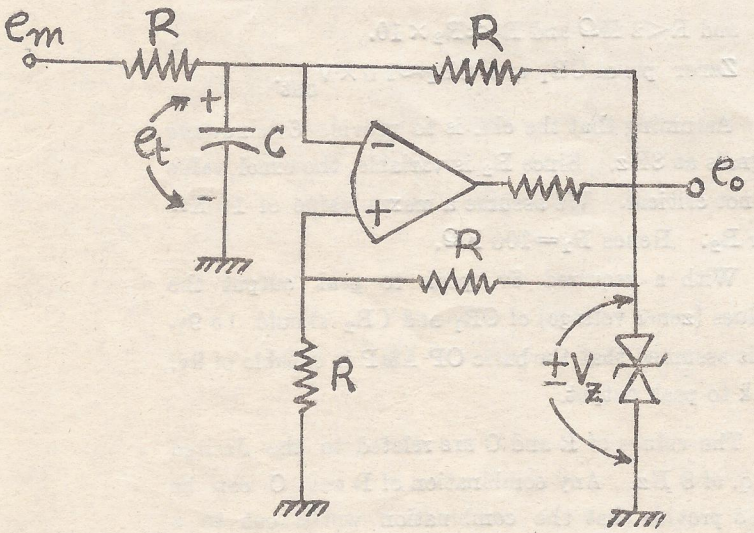
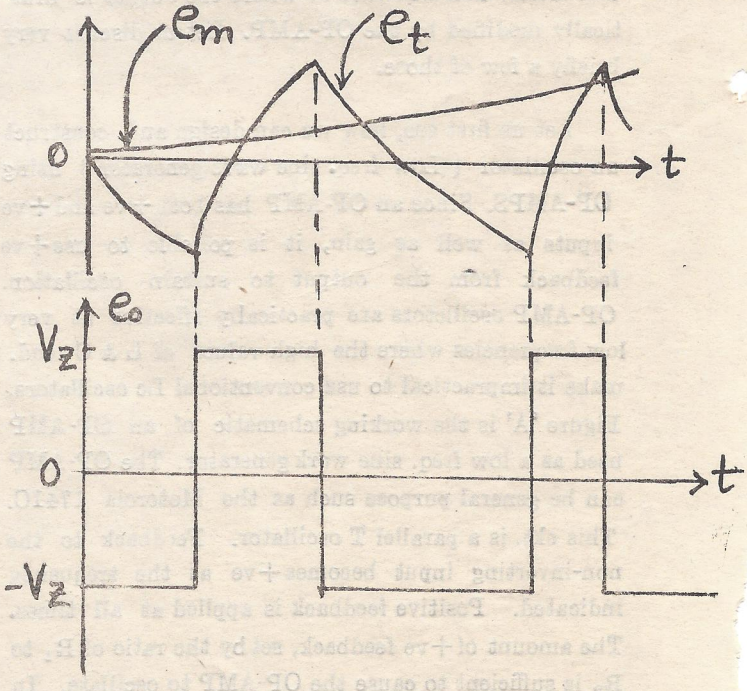


FIG-'B'



NON-LINEAR P.W.M.

FIG-'C'



OP-AMPS can also be used as square and triangular wave genrators. ramp and pulse genrators and so on.

As for another example, let us consider the modulated signal genrator. Signal genratos which have voltage control over some wave from characteristic produce waveforms which are modulated by the control voltage. Let us consider a pulse width modulation (PWM) genrator.

Simple circuitry and high power efficiency characterize pulse width modulation. Since the pulse is genrated by switching, control is simplified, and the modulator output is always either saturated or off for low power loss. Modulation control of the switching fixes the relative time intervals of the two output pulse states as described below.

Highly precise P.W.M. is attained with a triangle wave generator and a comparator as illustrated in fig 'B'. The triangle wave generator can be formed in any one of the conventional mean using OP-AMP. If the triangle wave is compared with the level of a modulationsignal, a +veoutput pulse is generated when the triangle wave is greater. When the modulating signal is zero, the triangle wave is greater one half the time so that the gererated pulse then has a duty cycle of one-half. As the modulating signal increases, it linearly decreases the interval of the +ve pulse, since the triangle wave is a linear function of time. The result is an output pulse train with an average value that is directly proportional to the modulating signal and with a duty cycle of 0·5 −em/2Ep, where Ep is the amplifude of the triangle wave. The linearity of this modulation is determined by that of the triangle wave. Any comparator switching delay will limit the extremes of the duty cycle range, but otherwise equal +ve and −ve switching times will have compensating errors.

By using the integrator/comparator configuration for a triangle wave generator, linear P.W.M. can be produced without a separate comparator. With this configuration, the modulating signal can be summed into the integrator input on a resistor. During a given cycle the addition of this modulation signal will increase the integration rate in one direction and decrease it in other direction. The result is an unsymmetical triangle wave and a corresponding modulated pulse output from the comparator. With equal integrator summing resistors, the duty cycle of the output pulse is equal to 0·5—em/$2V_s$ where $2V_s$ is the peak to peak output square wave amplitude.

Although non-linear, a. P.W.M. can be produced by summing a modulation signal into the single amplifier triangle wave generator. For feedback controllers the modulation non-linearity is overcome by the feedback, and this simple approach need not limit precision. Shown in figure 'C' is the result of this summation. The effect of the modulation signal is analogous to that just described above in that one integration rate is increased and the other is decreased to alter the duty cycle. Since the capacitor charging is non-li-near, the effect of em is non-linear as expressed by the duty cycle of

$$\text{Duty cycle} = \frac{\ln(1+2V_s/e_m)}{\ln(1-4V_s^2/e_m^2)}.$$

As always with this basic square and triangle wave generator, the operational, amplifier input impedance must remain high under overload. So that amplifier input currents do not affect capacitor charging.

Thus far we have discussed only two very simple applications of OP-AMPS. In addition an I.C. op-amp is well suited for use in Active Filters, as O.T.A.S, as angle generator, delay line equalizers etc. It finds tremendous applications insample-hold ckts, as peak detectors, temperature sensors, staircase generators, comparators, multiplexers & clamps, r,m.s. convertors, log and antilog amplifiers, QSM, multivibrators etc. Numrical special purpose circuits like transistor test circuits for gain measurement, breakdown and leakage testing, output resistance measurement, noise measurement, Measurement circuts like meter circuits for Frequency and phase measurement, controllers like on-off controllers, and other special purpose circuits like audio cts, A. G. C. ckts, are also implemented in pratice.

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7

CHOICE OF SUITABLE SHIELD
AND
MECHANISM OF SHIELD TUNNELLING
FOR CALCUTTA TUBE

Ajoy Mukherjee
5th year, Civil Engg.

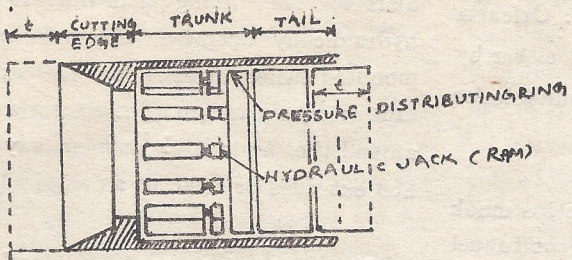
The Calcutta soil is suitable for fully mechanised operation. But a fully mechanised shield is, however, very expensive and unless the tunnelling work is considerable its economic utilisation is not possible. It is reported that the break even point for a mechanised shield is achieved only if the continuous drive is more than 2 kms. For the Dum Dum—Tollygunge rapid transit line, which will be done first, the length of tunnelling is only 945 metres. For this length of tunnelling, full advantage of mechanisation can not be availed of. As such, tunnelling work has started with an open shield but with partial mechanisation of the excavation operation.

The tunnel shield is a moving metal casing which is driven in advance of the permanent tunnel lining, to support the ground surrounding the tunnel bore and to afford protection during installation of the lining. Shield is a steel cylinder open at both ends, providing facilities at its front for the excavation of the soil and its rear for the erection of pre-rabricated lining. The shield is forced ahead in synchronisation with the progress of the excavation and erection work, always ensuring that the excavated hole remains properly supported, until the permanent lining is installed. A full cycle of shield tunnelling is depicted in the figure.

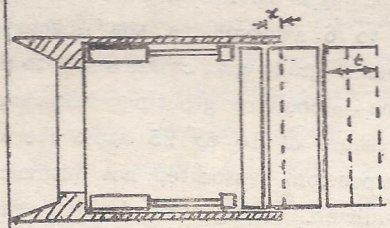
The excavation will be done by small hydraulic excavators which will be suspended from a transverse beam in the rear half of the shield. The L/D ratio of this shield will be about 0.87. Main operations connected with tunnelling under the protection of a shield comprise of :

(1) Excavation at the front face.
(2) Mucking.
(3) Advancing the shield by taking support from the previously created lining.
(4) Erection of tunnel lining.
(5) Grouting and caulking.

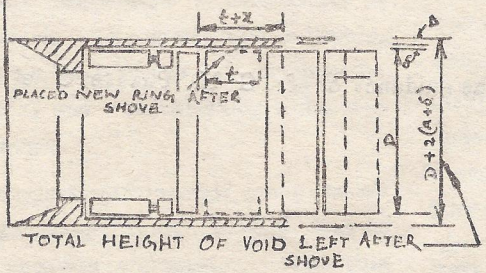
The most difficult part of tunneling work is excavation. The face may be stablished by [a] application of roof shield, [b] application of compressed air dewatering. This has a double effect because besides affording a uniformly distributed load supporting pressures on the face, it also stabilises loose and plastic soils by expelling water from their voids thus raising their shear strength, [c] Direct stabilisation by artificial solidification is accomplished by injecting chemicals through pipes driven ahead in a fan like arrangement and with an outward inclination around the perimeter of the face. This is a cumbersome



(a) BEFORE SHOVE



(b) AFTER SHOVE
SHIELD MOVED BY A DISTANCE t



(c) A NEW LINING RING IS INSERTED AND THE CYCLE IS REPEATED

PRINCIPLES OF SHIELD TUNNELLING

procedure because the excavation and solidification cycles have to follow one after the another, involving delays. For this reason indirect stabilisation is preferred in which solidification is effected from the surface or from an upper drift in order to raise the strength of the strata lying above the crown. Calcutta soil is not suitable for artificial stabilisation either by chemical grouting or by freezing, nor it is suitable for stabilisation by anchorage adits.

So far as mucking is concerned, effective muck haulage is one of the major problem of efficient tunnel driving. In the case of shield tunnelling it is performed in two stages. The first is the immediate removal of the solid from the shield body and secondly its conveyance to the working shaft. All loading and haulage equipments (belt conveyor, traction engines etc.) must make the smallest possible demand on space.

Usually special cars and locomotives are used and the track gauge should be 1/4th of the tunnel width and should range between 60 and 90 cms,

Accurate propulsion and direction of shield is a very delicate part of shield tunnelling, because it determines not only how far the designed alignment and gradient will be confirmed to, but it also seriously affects construction. As the propulsion is done by hydrauiic jacks, the first task is to ensure their uniform spacing along the shield perimeter and their perfect co-ordination during operation.

In the case of small tunnels, lining segments are placed in position by hand, but this is not possible in the case of bigger tunnels. In tunnels of larger diameter the lining elements are erected with a hydraulically operated erector arm which can be mounted either directly on the axis of the shield tail or on a platform. The erector arm can be rotated around the horizontal axis to any required position and extended or retacted as required.

Lining operation must be closely followed by the grounting of the space left behind the shield tail to ensure [i] establishment of a tight back fill [ii] water sealing and [iii] stabilisation of the surrounding ground, thus contributing a reduction of the ground pressure acting on the tunnel lining. The primary grouting is carried out, under low pressure of about 5 to 6 atmospheres, the injected material being cement grout with coarse sand, to fill the back space. The secondary grouting takes place under high pressure of 10 to 25 atmospheres using cement suspension, bentonite, hot bitumen or bituminous emulsion. The grout fs forced in through grout plugs 4 to 5 cms in diameter provided in the lining segments, which are kept closed at the time of erection. In each lining segments, four grouting holes are provided in a staggerd fashion. In less permeable grounds closer spacing will be required.

This report has been prepared under the guidance of Mr. G. N. Paadke, Chief Engineer, Metro Railway. Calcutta.

The Quest

Dr. T. N. maulik

Professor-in-Charge of Library,

Bengal Engineering College.

'It is with sincere regret that we record what had appeared to us to be lamentable indifference of our Government to this important educational Institution. Let us, however, hope that we are mistaken in our impression. On one occasion only the Hon'ble Minister of Education paid a visit to this College. That was one Saturday afternoon. That it was not exactly a surprise vissit was evident from the numerous gates erected in his honour ; but curiously enough the student of this College were kept absolutely in the dark about it until almost all of them had left the College on week-end holidays. The Hon'ble Minister was accompanied also by a very high official of the Education Directorate who incidentally had visited our College on one previous occasion and then also in the company of the then Education Minister. The Hon'ble Minister spent an hour at our College. He interviewed the members of the Staff in one batch, went around the College with the Principal in latter's car and then conducted to a decorated hall to address the students. Unfortunately the Hon'ble Minister could not meet more than twenty students and had only a large number of empty chairs to listen to him. Naturally exasperated, the Hon'ble Minister left the College. We wonder if his visit was at all actuated by the laudable motive of having first-hand knowledge regarding the essential requirements of this growing Institution and by his sincere desire to give the students an opportunity to represent their legitimate grievances to him many of which has not been possible for the College authorities to remove. If it was, than it was an unpardonable oversight on the part of the College authorities, there having been no official announcement of his visit until it was too late. The students of the B. E. College will be excused if they think that contact with them formed no part of the programme of the Hon'ble Minister's Visit. We cannot easily reconcile ourselves to this callous indifference of our College authorities, when dearth qualified engineers grimly faces the country to-day. We fail to understand how India will ever bo able to attain self-sufficiency in technical personnel if the "machinery" for producing them is thus neglected and uncared for. We appeal to our Government to shake off this lack of interest in our institution as this is likely to prove detrimented to ndia in near future, Let us hope that the day is not far off when this college will once again occupy the position of glory that it once held.

Now before the readers pounce upon the present scriber, let it be assured that not a single word in the above paragraph was cooked up by them faithfully copied from the *Ninth paragraph of an annual BECA Journal's editorial written more than THIRTY years ago!*. Whal made it most fascinating is that one of the members of the Editorial Boord of this BECA Edition Is now let me say, one of the Chief architects of the Technical Education in the Covt. of West Bengal Thus, do we have to believe, that a man who has shared so bitterly a writing about the maladies of the situation prevailing at B. E Collage (which surprisingly remains at the same level even after a lapse of toirtv years) has been mellowed by the span of so many years? The answar is a clear emphatic "No" Because, the present scriber has seen this extremely workalcholic man at various capacities for the last 20 years. Thc scriber has also

seen his calmness and power of tackling a situation in the most volatile moment of the college when all rationalities were at their lowest ebb. The scriber has also seen him how with a motherly case he physically carried an unconcious examinee and rushed to a doctor from a go-at-free examination hall in the turbulent days of the college. The scriber has also seen how desperately this man is now trying to pull out the standard of the Technical Education of West Bengal alongwith the condition of the college.

Before some one jumps up to say, "YES, there has been a lot of change" and someone else to contradict, let us see what the then young would be engineers observed in their editorial more than thirty years ago and we quote below the seventh and eighth paragraph of the above mentioned editorial.

'Since the publication of our last issue in which we urged nationalization of industry, the Government of India has declared its policy regarding nationalization. The Government had shown hesitancy and indecision in tackling the problem seriously and this has caused anxiety in the ranks of labour. The increased production and output could only be achieved if all the elements were satisfied. Production could not be increased by giving one side concessions to capitalists, and expecting labour alone to be patriotic. Capitial was refusing to make sacrifices. The labour has no hand in the management of industry. True industrial democracy was only possible when labour was able to participate in control and management of industries, to an appreciable extent.

This brings us to the question of large-scale industrialization of India. To-day it is an admitted fact that large-scale industrialization is an unavoidable necessity if the standard of living of the toiling masses has to raised. But large-scale industrialization is hardly possible without well-trained engineers and technicians. A free India cannot afford for an indefinite period to go abegging for foreign experts to work her devolopment scheme. Therefore, on the National Government develves the responsibilities of producing suitable engineers in India. We feel there should be a changed outlook and the mode of teaching so altered as to make it possible for the technical colleges to turn out men competent to be leaders and not mere subordinates as they were meant to do by our foreign rulers. The whole system of education should be so re-orientated as to enable the students to develop a fuller and better personality than they are capable of doing at present. Students must be encouraged to develop that creative ability which alone can make them fit to play the role of makers of a new and better India. We, however, note with regret that nothing tangible seems to have been done in this respect, if of course, our college-the premier Engineering College of India-offers any proof of the activities of the authorities. We do not know if much-talked-of Development Schemes have been given a decent burial under the debris of files. The authorities have started admitting larger and larger number of students every year to meet the ever-increasing demand for engineers. But they seem to pay no regard to the lack of equipments, staff and class rooms in our College. A section of students wandering about vainly in search of vecant room for holding a class is a sight too frequent to be overlooked. Conditions of living in the Hostels can better be imagined than described. The fact is that the College unless substantially expanded and developed by additional building accommodation, epuipments and staff cannot cater for the needs for the large number of students admitted.

Don't the readers after reading the part of the editorial feel that such a long span of more than thirty years of time squeezed into zero, because the condition of the country as described there remains almost same ? Or, is it true that our country is an "Eternal India" of S. Wazed Ali ? Are we not as a whole country, running like a main performer who apparently showing an act of running, is not actually moving out an inch ? It is really astonishing to observe how beautifully a very young group of budding engineers described the condition of the country and the B. E. college so vividly. How shamefully and pathetically the situation remains the same if not worse ? What are the reasons behind ? Is it for our lack of self-confidence ?

Or, over-confidence amounting to self-cheating ? Lack of conviction ? Extreme, if not fanatical, sense of self-rightousness. Unabashed disrespect in the value of hard work ? Low cunningness ? Lackadaisical, if not comred-plete negative, outlook about life ? Extreme self-centness ? Woolliness in thlnking resulting in diametrically opposite views ? etc. etc. We do not know the answers. But then why should one at all bother to probe deep into these questions ? Just for some-one who may use these stuff while casually going through BECA some thirty years after from now. Will these questions above would remain equally significant as now ?

9

The Image on General Mass of Indian Scient and Technology Tody

Sandip Bhattacharyya.
Class=M.E. Section=B(x)
Roll No.=18, Year=1st

During 34 years since independence, we have undoubtedly progressed in industrialisation, standards of living and in the technological fields. But "Can all this advancement of man on scientific and industrial planes resolve the basic problems of humanity ?"—the question raised by Dr. S. D. Joshi (in the lecture on ' Positive orientation of Scientiffc efforts') is of deep concern. The Problem of poverty, hunger, unemployment remain as they were before. Still there are confusion and unhappiness increasing day by day. But why the Case is so ? The devlopment in the field of Science and Technology is not adequate ? or, there is some other thing missing ?

These failures are related to a totally incorrect view of the interrelationship of science, tcchnology and development in India. The Characteristies of the Nineteenth Century, and more so of the Twentieth Century, is the linking together of Science, Technology and Productivity. Development of Science leads to the betterment of technology resulting in higher Productivity.

Now-a-days, a blind following of whatever goes in the name of science and technology in So Called advanced countries seems to be the only pathway to be follwed, without keeping the point in mind whether the procedure is suitable here too. There is a sort of imposition of foreign policies in our science and technology, the interlink between them having been based on the lines of western styele of development. What is still absent, is the frequent use of Science and technology for the mass of Indians, in general.

But a little investigation into the history of Precolonial Science in India shows that there was no scarcity of reliance on experimentation and quantification in Science. India is a land who gave birth to many genius figures in the hisrory of the world. Aryabhatta, Bhaskara, Charaka—all used sophisticated techniques of mathematical and experimental procedures in their respective fields of investigation. Noble Lauriate Chandrasekhar Venkatraman, Sir Jagadish Bose, Dr. Meghnad Saha, Sir Satyen Bose etc. who got reputation in the world of modern Scientists are from no other country but India.

So, an alternative way is to be searched for. Indian Scientists and technologists are now in a Paradoxical situation of being involved in an activity that has its root in alien Cultures. Scientific activity is basically a social and cultural activity and Scientific knowledge, the product of the scientific activity is also a Cultural product. So, it would not be incorrect to say that proper scientific knowledge can be achieved if and only if, the person, who is to acquire this knowledge, is well-aware of social and cultural activity. The introduction of Western Style in technologies is biased against vast majority of Indians.

The only way to face this challenge may be a massmovement organised by the ordinary people, because it is they who will get the lion's share of the profit obtainable from an alternative approach. The duty on the part of the Scientists would be to make the common people feel that 'Science' is not something beyond his Capacity of think of, and to concieve that he too can command science. The folk-media is absolutely necessary here "Once India boasted of the Golden Age and Considerablc advan-

cement in astronomy, mathematies etc. But then what happened ?" This Question of Dr. S. D. Joshi is quite appropriate in the present context. It is really of no use keeping the knowledge upto a certain level and having the masses left behind. Scientists and technologists have to be conscious so that the improvement of the general people be possible in reality. It would have been possible for us not to lag behind from the march of advanced nations with the provision that the resource of man-power was used properly.

In conclusion, let us come back to the point of inter-linking of Science, Technology and Productivity. It is not that merely 'S-T-P' will serve the purpose, unless there is a bonding of moral element. Absence of the touch of morality, as suggested by Prof. D. S. Kothari (in the lecture of "Mind and Matter"), will only result in the Grief, Hatred and Delusion (G-H-D). With 'S-T-P' spiral there will be a 'G-H-D' spiral growing up. Then, what is the way out ? The solution is also provided by prof. D. S. Kothari— "Science and Ahinsa should naturallv go together".

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10

Perception of Urban Environment :

Prof. Deviprosad Mallik,
Asstt. Professor Architecture
Department of Architecture, BE College.

Of all the features that distinguish man from animals, the most striking and the most complex is his ability to make sense to himself and to others of the world around him. He perceives, learns, thinks, remembers and communicates in language and symbol to others.

Man receives information and understanding about the world around him through his senses. Human body is gifted with a wonderful collection of organs specifically suited and strategically located for the reception of particular ranges of environmental stimulation. Experts say that we have at least eleven senses of which the five primary senses are taste, touch, smell, hearing and sight. Our eyes bring us information in visual terms of what lies ahead of us. Ears brings us information in auditory terms while our nose brings us information in olfactory terms of the world around us. Our mouth is the taste receptor while the surface of our body is covered with skin which contains a series of different sensory receptors that lead to perception of touch (i. e. tactile sense) temperature, pressure and pain. Within the body itself lie sensory receptor in the muscles, tendons and joints forming the kinesthetic system. It tells us of our bodily movements and spatial position in cooperation with the vestibular system of the inner ear. Apart from these basic sense modalities our body further includes the sense of hunger and thirst and the sense of balance. Each of these senses supplies a different quality of information about our environment but they normally operate in harmony to bring us information about the world around us, information to which we respond in various ways. Our brain is the control centre and the nerves resemble message lines, transmitting information from our senses to our brain. Apparently, our active brains receive, process sorts the messages and filters out those that are of little or of no use to us. Messages coming down from the brain are called motor impulses and are directed to the muscles which go into action in response to these messages. So, not only is their a process of organization taking place within the brain but also a process of elimination and selection. The capacity for distinguishing the differences between variour stimuli is discrimination and is for Aristotle, the mark of the educated man.

By "perception" we mean the process by which we become aware of, interpret or identify the sensory experiences we receive from our environment.

Sensory perception of the urban environment must involve one or more of our various sense modalities. Physical stimuli of different kinds and intensities are received by specialised sensory receptors.

To a sensotive and receptive pedestrian the cities provide innumerable fascinating experience in sensory perceptior. If one takes interest the discoveries can often be rewarding

Parhaps the prime importance of vision in perception of our environment needs no further elaboration. It is indeed miracle to see the world around us with our own eyes. The images that our eyes receive, stimulate patterns on our retinas and we perceive the world of objects. Our eyes feed the brain with information coded into neural activity which create chains of elec trical impulses which represent objects Our brair actively stroggle to organise and unify these impressio of light to form an orderly, unified, multi-dimension impression of the physical environment around us. V need training in the rules of seeing which we normal obtain and master by years of trial and error duri

childhood but it is extremely useful for any one concerned with the visual arts to examine them and to see how they can help us to express our visual ideas in a form that can be easily perceived in the way that we intend. While we walk down a busy city street many thousands of pictures will have been flashed on to our retinas in the course of a walk, but only some will have been actually parceived and taken into consciousness. Some objects draw our attention while others do not. There are certain principles which operate in this aspect of perception. These determine whether an object is more likely to force or compel itself into our consciousness than another. An interesting urban environment must always offer possibilities of divarsity challange, discovery, wonder surprise fun and delight that does not denand good architectural forms only.

Our olfactory sense can bring many useful information regarding our urban environment that includes various odors, aromas, scents, as well as fumes gases and other olfactory effluvia. Others may not be so sensitive or so responsive to smells but they have always been particularly important to many of us, both in present perception and in the nostalgic recall of cities. Every city street and its various sections in particular have its distinctive smell. Smell of books, (old or new) stalls in College Street, Calcutta differ widely from Bowbazar Street packed with smell of furniture shops, or of fresh flowers at the crossing of Gariahat and Rash Behari Avenue. Every alley within the New Market has its own distinctive smell. Strong fishy smell beside the Beckland Bridge, Howrah creats the sense of arrival at Howrah Station. In course of time one lives or visits regularly in any particular area of the city, one become used to the characteristic odors in the locality near his residence or place of work. We may well recall the aroma of our favourite food or snacks at our known street-corners. While waiting for food to be served, the pungence of spices heightens our appetite and suggests the gastronomic delight ahead. Sudden scent of our familiar perfumes remind us of the associated places we had visited earlier. Our alfactory adoptation keeps our city environment tolerable. Although we may get used to some smell through our regular visit, we may find other unable to appreciate or even tolerate such local odour. The drabness of our urban iiving in long dry summer monthk are sometimes relieved by sudden break of nor-weater accempanied by rain emitting smell of wet earth.

Smell of hot boiling tar, coal smoke from Railwuy Engine, diesel fumes from truck and buses are some are same of the typical smell of big city streets. Cities of South India smell distinctively different to people from North characterised by small of coffee and cocoanut.

Sounds are obvious in their relation to the perception of urban environment and we cannot easily escape them. In CBD traffic notise emanating from automobiles, buses, trucks, motor cycles, trams and trains steamers, jetplanes blend with howkers yells, rumbling and roaring of industrial plant factory. In construction of building, large public development projects like tube railways commands our attention. Audible locally are the shouts or conversation of individual citizens, noisy burgains share market, protest slogan & marriage party, procession, film songs through radios or stereo loudspeakers from puja pandels. Often the sounds are unpleasant, disruptlve and nerve-wrecking. Who can enjoy the loud music or bomb explosions at mid night or say staying in a house with the rail road immediately on one side and noisy high-way directly on the other? But the distant song of a lonely boatman on river or whistle of a bird or train, solemn bell of a cathedral or lionsroar from The city zoo at midnight are for most persons pleasant, hypnotic and suggestive.

Each city and its different localities possess the most distinctive sounds which only its inhabitants are familiar with. Local music and languafe spoken in public areas create distinct flavour to the city's auditory climate. Birds, animals and type of trans-

port are also the contributory factors to it. Each street in the city with its typical design o fenclosure, quality of material (stone or brick wall) cmit a very special traffic noise which makes it so distinctive from others. The amplified traffic noise reverberated between the hard reflecting (canyon like) walls of Harrison Road, Strand Road and Brabourne Road very greatly from that of Chowringhee which is open at its western side. Sound of travelling over a bridge by train is any interesting experience to its passengers. This is perhaps very easily perceived by persons deprived of vision. If the Gramophone companies can publish a well chosen/edited and organised disc collecting ali the most distinctive and typically familier and popular sounds of Calcutta, through which the city will speak for itself, I am sure this is going to be warmly received by thousands of Calcuttans living abroad who are all the time missing their beloved city. No fare Similar sound eecords of every city in India with their distinetive sound may have great commercia prospect and will open a new horizon to compare between many urban auditory environments. I have heard one such disc "Marry Christmas from San Francisco"—a christmas greetives Card in sound that includes all the popular sounds of the city.

Ours sense recepters in the skin that lead to touch may also be very remarkable in environmental perception. People living in Cities with excessive high population density are accountomed to constant push and pull and shoulder-rubbing while travelling in public places and transport. A visitsr to Calcutta from any small town or village will remember the tactile memory of the crowded city after he will return to his original home. Calcuttans are well familier with peak our rush in puja festivals or the tragic accident of stampede at Eden Gardens, during football or Cricked matches or Musical functions. With regard to the exploitation of the eense of touch in urban design it may be noted that a pedestrian on street loves to feel some textures of materials (cool, and glossy, warm or grainy) in public places by mere touching. These raise certain emotions feelings amd distant memorise. Numerous variety in the design of floor-scape, paved courtyards and public plazas can be skillfully achieved by landscape designers to utilise this aspect of enAironmeutal preception.

Occasionally however, we can speak of tasting the urban environment with some justification. Somethmes we may come across certain odors that could literally be tasted as well as smelled.

Kinesthetic perception is felt in any hilly town like Darjeeling, Simla or Mount Abu. Whether we walk or ride. the continual change of level or position may be bo h delightful and exciting during sight seeing. This can also be experienced, in riding giant wheeis or ropeway, chairchar lift (Rajgir) or even climbing a atys fly over. People living in plain for a long time may occasionally feel the urge to rush to hills to overcome the boredome, through such kinesthetic experience as enjoy exploiting their movement sense through change of level. In design of new tounsor cities it may be a mistake to flatten out the undulating (contured) physical enviroment too completely so that no change in position is possible except along a horizontal plane. Kinesthetically as well as visually, hills and hollow allow explcitation of these senses in perceptually pleasant ways.

So far we were discussing only the sensory perception of urban environment. Environment can also be perceived intellectually. There are many different factors that influence our perception such as the surroundings, the experiences we have derived from the past, our inherited abilities we are born with and finally the many different motives, needs and desires at the moment of the perception. Awarenwss of our spatial environment is also dependent on one's formal behaviour upon age and mobility patterns, class and othnic background, socio-economic class, cultural and educational status and voluntary exposures to information. More recently we have incressingly come to know the environment through information so that there are changes in our knowledge due to messages provided by the media and other information systems.

Unlike the past, very much more is known about many more places. This may relate us to the term "congnition" which is concerned with the function of mind and has traditionally focused on ussues of symbolic knowledge, thinking, remembering learning and mental development. It is the psychological process through which people intellectually understand structure and leave the environment and use mental maps to negotiale it.

The new field of environmental psychology, sociology and anthropology have made many interesting contributions which can benefit the designers and planners to understand the present urban environment and also to assist them in the design of future urban environment.

All the giant Metropolitan cities invariably project two contradictory images. To a stranger or a lonely newcomer they appear like a night mare-being extremely crowded, (high density of population) hectic, heterogenous and couid, inhabited by all unfriendly citizens who lack social responsibility, being impersonal and superficial. But that does not tell the whole story. Obviously large cities have great glamour and appeal due to its variety, eventfulness, possibility of choice and options and the stimulating intense atmosphere that many individual find a desirable background to their lives. Where face to face contact are important, the city offers limitless possibilities.

The heterogeneity of the city population produces substantially greater tolerance about human behaviour, dress, and codes of ethics than is generally found in small towns or villages. Each city possesses marked differences in atmosphere of flavour, character, tone, pacing and textures of social encounters. Calcutta, in spite of its many grave predicaments marked in its dehumanised physical environment is unique in its diversity of vibrant social climate, size, pace and level of activity, its great variety offered through its cultural and entertainment opportunities and the heterogeneity of its population. Auy unbiased tourist may feel Calcuttans as extremely wordly and warm tolerant and permissive while Delhi citizens are aloof, formal cold and impersonal, if not ruthless. Some cities are observed to possess many civic amenities but its people may appear inhospitable, nasty and cold. But it must be pointed out that a person's impression of a different city depends on his implicit standard of comparison.

A person from Calcutta visiting Chandigarh may well describe that city Tempo as leisurely and sleepy while a man from Chandigarh will perceive Bombay as 'too hectic'. Perception of a city is also affected by whether the observer is a tourist, a new comer or a long term residence. A person born and brought up in Calcutta returning to his home city after a long period of living abroad can freshly be a victim of culture shock and perceive his home city as ugly and filthy. Further, the popular myths and expectation (pre conception) each visitor brings to the city will also affect the way in which he perceives it. Travel agents, Railways and Airlines posters greatly influence tourists to preconceive only those persuaded images of many cities.

A comparative study of behaviour profile of dwellers toward compatriots and foreigners may dig out many fascinating results if conducted in several large cities. According to the results of such an interesting study (by Roy feldman) some alluminating contrasts in public behaviors in three cities were revealed For example in Paris, taxi drivers overcharged foreigners significantly more often then they overcharged from patriots (this may sound similar in almost all cities of Italy and perhaps in New Delhi). But Parisians dealt foreigners significantly better being less greedy, more honest, and helping than of other cities like Athens and Boston.

Another importance of a city's atmosphere is its tempo or pace. It may be observed that higher the density of manikins the greater the number of collisions per unit of time. Patterns, variety and time of automobile traffic contribute to the city's tempo. The tempo of the city is expressed further in the manner in which

the pedestrian stand at busy intersection impatintly swaiting a change in traffic light makins tentative excursions into the intersection and frequently surging into the streets even before the green light appears.

Urban Scientists say that the city dweller carry their city map within their heads. This is termed as the "cognitive map" of the city which varies greatly from the geographical layout of the city. Mr. Kevin Lynch a pioneer in the cognitive-behavioural approach to the urban studies, in his book "The image of the City" had developed a cognitive map of Boston by interviewing its dwellers. It was observed that while certain landmarks as well as the path linking them were known to almost all of them, vast areas of the city were simply unknown to its inhabitants. Similar studies were undertaken by others on cities like Paris, London and New York that revealed almost the identical results. On the basis of the Lynch advocated that a good city is highly 'imageable' having many known symbols joined by widely pathways whereas dull cities are gray and non-descript.

In the study of urba environment the range of stimuli necessary for perception can be fairly well-specified and studied from a physical, a physiological and an anatomicsl point of view among other approsches bepending on the aim or purpose of the investigstion. Perhaps relatively more important for urban design is a paychological approach through personality study.

Every year hundreds of new comers are landigat our city airpots and railway station (tourists, students, businessman, foreign deplomats and professional consultants.) They come from diverse backgrounds and vary in age, sex and in metivation, Hereim lies an unique opportunity to study and assess their image of our city very shortly after they arrive. These persons would be studied again after say, a one month had gone by, then at six months, then a year or longer. A comparision could be made of lifelong residents of the community. This might shed some light on how the environment is perceived, how this perception changes with experience, what aspects are positive, what negative ? Such a study would give us a good deal of information on individual differences in environmental perception and might shed some light on the relative importance of the different sense modalities in determining the image of the city. Further, it would have the potentiality of providing base line data from which suggestions and implications for Environmental design (ranging from micre-to macro environment) could be drawn.

Dept. of Mechanical Engineering Section D (x)

Dept. of Mechanical Engineering Section D (y)

Dept. of Electrical Engineering Section C (x)

Dept. of Electrical Engineering Section C (y)

Dept. of Electronics & Telecommunication

Department of Metallurgical Engineering

Dept. of Architecture & Town Planning

Dept. of Mining Engineering

Dept. of Electronics & Telecommunication

Department of Metallurgical Engineering

Dept. of Architecture & Town Planning

Dept. of Mining Engineering

Dept. of Mechanical Engineering Section D (x)

Dept. of Mechanical Engineering Section D (y)

Dept. of Electrical Engineering Section C (x)

Dept. of Electrical Engineering Section C (y)

Dept. of Civil Engineering Section A (x)

Dept of Civil Engineering Section A (y)

B. E. College Workshop Staff

Our Office Staff

Dept. of Civil Engineering Section A (x)

Dept of Civil Engineering Section A (y)

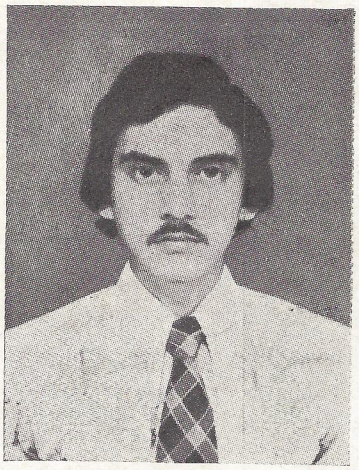
B. E. College Workshop Staff

Our Office Staff

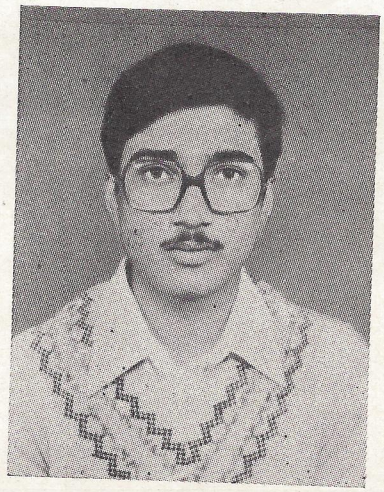
Athletic Club

B. E. College Library Staff

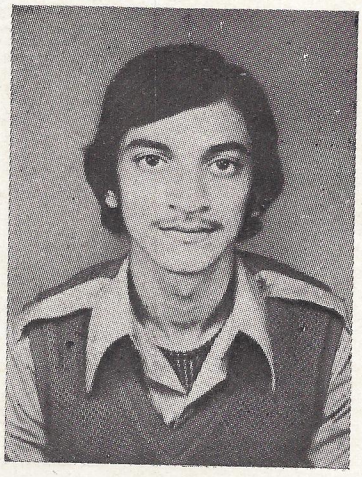
Captains of our Oval



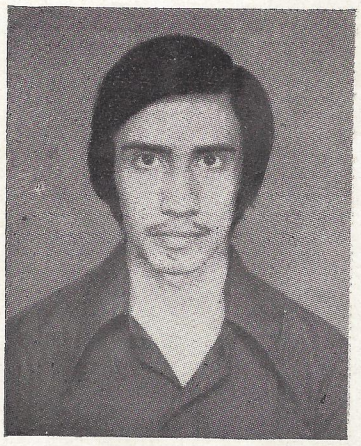
Dipankar Guin
Gen Secretary, B E C. A. C. & Badminton Section
"Recently industry finds him more important than B. E. C. A. C.



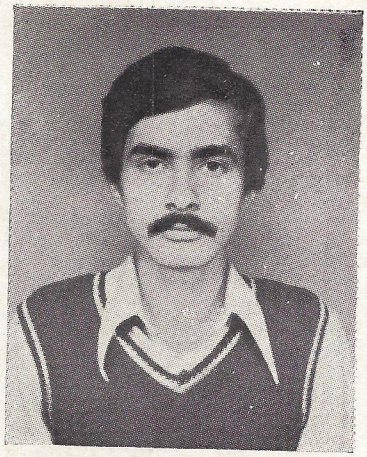
Abhijit Saha
Capt. Hockey Section
"His mouth is mighter than his hockey stick"



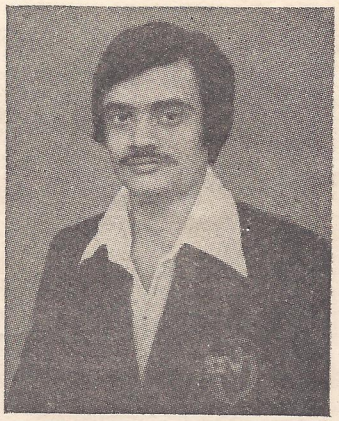
Partha Sarathi Guha Thakurata
Capt. Footboll Section
Our footballer, Athletes & Actor—Now makes it is a L..... ?



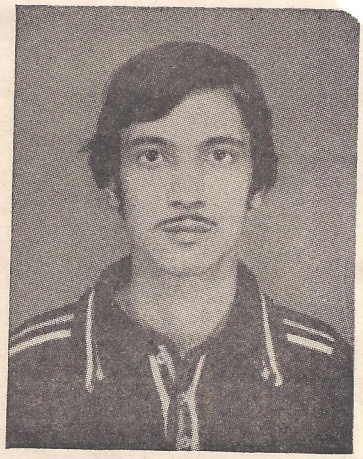
Soumitra Sarkar
Capt. Athletic Section
"Advice—Count – hundred before you loose your temper"



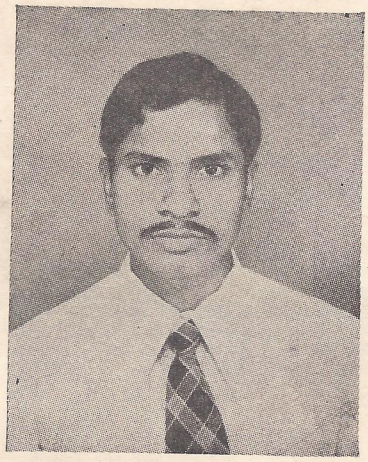
Susanta Roy
Capt. Basketball Section
"All of his shooting perfection comes from his moustache"



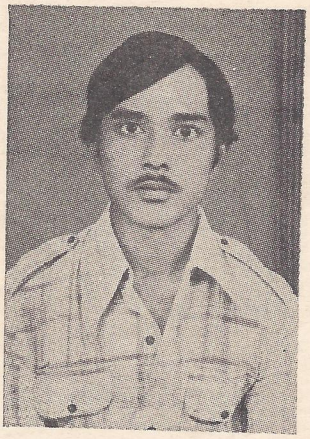
Kalyanbrata Dasgupta
Capt. Lawn-Tennis Section
"His temperament in the court reminds us that of Nastase"



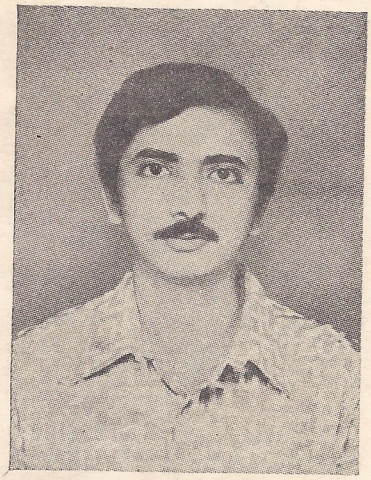
Jayanta Sengupta
Capt. Volyball Section
"Calm & quite, but the opponents don't think so"



Madhusudan Das
Capt. Gymnasium Section
"36—24—36"



Tuhin Nag
Capt.—Cricket Section
"Slow but steady wins the race, but not always."



Biswajit Sengupta
Capt. Swimming Section
"All photography and no swiming makes him a slow swimmer."