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**Autor:** Lonkar, Suresh

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## Continuing Engineering Education in the Design Office

Formation continue en génie civil au bureau d'études

Fortbildung im Bauingenieurwesen im Ingenieurbüro

**Suresh LONKAR**  
Add. Chief Eng.  
Gammon India Ltd.  
Bombay, India



Suresh Lonkar, born in 1937, got his Dr.Sc Techn. degree from ETH, Zurich, after earlier education in India. He has worked on marine and industrial structures for his Company, and simultaneously on software development for bridges and other application areas.

### SUMMARY

The author discusses the need to continue engineering education in the design office. Some amount of formal training is proposed, and its scope as well as the areas to be covered in the program are defined. The methodology is next described with the help of an actual example. The process of informal day to day education in the office is mentioned. Finally, relevant management issues are defined and their importance discussed.

### RÉSUMÉ

L'auteur souligne l'importance de poursuivre la formation au bureau d'études. Il propose quelques directives formelles en vue de définir l'objectif et les domaines à couvrir par un programme approprié. Il en décrit la méthodologie à l'aide d'un exemple d'actualité. Il fournit un processus informel de formation au jour le jour pouvant avoir lieu au bureau d'études. Il termine enfin son exposé en examinant les problèmes essentiels de gestion.

### ZUSAMMENFASSUNG

Der Verfasser diskutiert die Notwendigkeit für Fortbildung im Bauingenieurwesen im Ingenieurbüro. Dazu wird ein zweckmassiges Programm vorgeschlagen, und die Gebiete, die es umschliessen soll, werden definiert. Die Methodologie wird an Hand eines praktischen Beispiels beschrieben. Informelle Ausbildung, die während der normalen Tagesarbeit im Büro stattfinden kann, wird erwähnt. Zum Schluss werden die wesentlichen Management-probleme diskutiert.



## 1. INTRODUCTION :

A young civil engineer in India fresh from an academic institution joins a typical design office in the country at an age of twentythree to twentyfive. He is initially asked to assist a senior level engineer in the project that he is handling, and is expected to learn things on the job itself. In his spare time, he can read available technical literature. Site visits would be possible after a couple of years of work. After another five years, depending upon performance, he would get some level of managerial responsibility. Such process of career growth would continue till the end of the individual's working life with the organisation.

This situation prevailed till about 1980. Subsequently, the pattern needed a change because of advance of technology and increased competition. The use of personal and mini computers in civil engineering analysis and design increased substantially. Secondly, newer and more sophisticated construction techniques were adopted on many projects carried out in the country. Thirdly, an ambitious young engineer entering the job market found it necessary to get some exposure to the principles and practise of management. There was therefore a sort of information explosion, which the individual sometimes found difficult to manage within his constraints.

It was then realised that a design office or organisation could play an active role in offering its young engineers a reasonable level of additional educational opportunities using its own human and other resources. As a return on this investment, it was likely to get people with a drive and equipped with the skills to make a greater contribution to the organisation's work effort, production and profits. Some amount of formal training is required for this purpose, and it should follow a carefully worked out plan.

## 2. PROGRAMME PLANNING :

If the organisation has a human resources development department, it can become the prime mover of the training activity. The starting point of the planning process is a clear definition of the organisation's objectives in building up its engineering cadre and the technical and managerial skills it expects from it within a certain period of time.

The next step is to demarcate the areas that are to be covered in the training programme. For each area, a detailed chart of activities can be prepared. The faculty and other assisting staff can be finally nominated after ensuring their availability and willingness to spare the time required for the purpose.

The basic idea of providing training facilities to the staff needs to be approved by the chief executive of the organisation before the planning process begins. After the costs are worked out, the budgetary sanctions can be obtained. The author thought it necessary to mention these things for the sake of completeness.



### 3. SUBJECTS TO BE CONSIDERED :

When the design office is a part of a larger construction organisation, like in the author's case, the following list of themes may be proposed :

#### 3.1 Bidding for national and international projects

Marketing is the basic activity for the sustainance and growth of the construction business. The young engineer must gradually become familiar with the company's systems and procedures for bidding, and the choice of strategy according to the prevalent market conditions.

#### 3.2 Analysis, design and drafting

These are the bread and butter work activities of the design office, and the engineer will deal with them everyday. He would probably be keen to know to what extent computer hardware and software can be used in his work environment.

#### 3.3 Design and detailing - special issues

There would always be some special issues to which the office might like the engineer to pay special attention. These might be, for example, design to meet servicability criteria, stress corrosion in tensioned cables, detailing of joints in precast concrete construction, or foundation settlement problems. Through case studies such points can be illustrated.

#### 3.4 Construction techniques and plant

A budding designer must have some idea of how temporary structures can be conceived and appropriate schemes worked out to realise the main structure at the job site. He must also know what kind of plant is available for this purpose.

#### 3.5 Project Management

The project managers at construction sites can come to the design office and from their experience highlight for the engineers the important points to note in order to achieve the planned rate of progress and cost economies in construction at site. Information on monitoring systems will also be useful.

#### 3.6 Construction in harmony with the environment

The civil engineer must be made aware of the individual and social responsibilities about this important issue. Man builds to satisfy his needs and to fulfil his higher aspirations. This should be achieved while maintaining a proper balance with the environment. Reckless commercialism tends to ignore this factor resulting in ecological disasters. For this reason there are controversies about some hydel and other projects in India.

Engineers should also try to develop an aesthetic sensitivity and aim to design structures which will blend easily with the environment. For inspiration they can see some beautiful temples built in India many centuries ago.



#### 4. METHODOLOGY :

After the program has been outlined as described earlier, the methodology of training can be worked out. The main thrust should be on the proper collection and dissemination of information. It can be in the form of sharing one's practical experience and first hand knowledge of things, or by way of communication, clarification and elucidation of the subject after one has studied it from published literature or any other open channel of knowledge.

The training programmes can be of short (one day) to medium (three days) duration. Alternatively, they can be stretched over a longer period of about two weeks with lecture and tutorial sessions of sixty to ninety minutes per day. The program logistics in the form of preparation and timely distribution of the course material, selection of venue etc. should receive proper attention.

As far as the faculty is concerned, it is possible to locate within the organisation two kinds of people amongst the senior staff. The first may usually deal with problems involving some amount of mathematical or other kind of theoretical complexity. Others may possess greater skills in some specialised areas of project work. Both of them can cover different sides of the organisation's training activities, if they possess proper communication skills to make the presentations effective.

The batches of trainees should be small, limited to about ten to twelve in a group. Audience participation should be encouraged through question and answer sessions, discussions and exercises.

These days, apart from the normal audiovisual aids, it is possible to use PC's for computer aided learning or videocassettes for the sake of presentations. If conditions permit, these techniques can be profitably utilised.

#### 5. A PRACTICAL EXAMPLE :

The author of this paper had the opportunity to organise three training programs in his Company in 1990. Two of them are mentioned here. The first course was in the computer language Fortran - 77, and the other in matrix methods in static and dynamic structural analysis. Both the programs consisted of ninety minute lecture sessions every day during working hours spread over a period of two weeks. About fifteen engineers attended each of the courses.

The emphasis was on practical application. Appropriate examples from the design office were chosen to illustrate the points discussed in the lectures. The course on matrix methods was planned to bring out what goes on behind the graphic displays in software packages. The engineers were told why it is necessary to avoid using the computer blindly in a routine and mechanical manner. As far as could be judged from the feedbacks of the participants, the aims and objectives of the courses seemed to have been achieved.



The important point to note in this activity was that the facility was provided to the engineers in their familiar office environment. They indicated their preference for this arrangement as against expensive visits to seminars held in luxury hotels outside.

#### 6. INFORMAL EDUCATION :

A process of informal education goes on in the dialogues between the junior and senior level engineers in the day to day design activity. As long as the will to communicate and to share is present, these exchanges contribute a lot towards better understanding of the real life situation with its problems, and to evolve solutions.

The issues involved could be either technical or commercial. Sometimes a governing design code may be a little vague according to the wording of a particular clause. A proper interpretation is then required. The senior person can provide it. Similarly a clause in a contract document may give rise to some controversy between the owner and his consultant and the designer. In this case also the guidance of the senior person could be very valuable to the younger one.

In the detailing of reinforced concrete and other structures too, many problems demand a creative solution which require quite a bit of thinking from all. Here the dialogue between the senior and junior engineers and the draughtsman leads to a satisfactory result. The drawing board is always a happy place for a fruitful discussion. The introduction of computer aided drafting in its place will only change the technique of discussion, and various solution alternatives could be worked out speedily.

An engineer naturally learns many things at a construction site too. A discussion on this point will however require a separate article, and is therefore not presently attempted.

#### 7. MANAGEMENT ISSUES :

There is no doubt today that a young civil engineer needs to develop an awareness of the basic management principles and the issues that need to be addressed in the organisation for which he works. There is a severe resources crunch in the developing countries, and cost and time overruns on construction projects can have very serious implications.

The young entrant to the organisation needs to understand the whole gamut of problems involved. He can be helped in the process, if the firm gives him some amount of exposure on the issues involved. These could be broadly defined as follows -

- a) Awareness of the corporate objectives,
- b) Improvement in productivity and effectiveness,
- c) Better team spirit and work relationships,
- d) Professionalism and cost consciousness,
- e) Timely completion of projects,



- f) Project finance management, and
- g) The decision making process.

A suitable three to four day program could be prepared by the training wing of the company which will cover the points mentioned above. The faculty can be a mix of in-house and guest speakers. The company leadership can contribute to the individual's sense of involvement with the organisation by sharing its views and experiences with him.

#### 8. PERSPECTIVE WIDENING :

The civil engineer does not work in a society in isolation, and should therefore consciously strive to keep its broader issues before his mind. In this effort he could get guidance from the work of national and international leaders of the profession. As an example, the author would like to mention the very significant contribution of Prof. Dr. Jörg Schleich of Germany by his articles on the energy crisis facing mankind and its possible solutions. Some of them were published by IABSE in the past.

#### 9. CONCLUSION :

Engineering education is a lifelong process for the individual. The design office and the organisation for which he works can make a meaningful contribution to it. The idea is not to spoonfeed him with readymade work formulas but to promote his initiative and creative spirit which may otherwise lie dormant.

The additional effort required on the part of the company executives may be substantial. However, on account of their contribution, the cost would be less than that of any other alternative. Ultimately they will create assets for the organisation in the form of quality and cost conscious young engineers with a markedly professional outlook.

In this article the author has tried to share his ideas and experiences of a particular indian environment with fellow members of the IABSE fraternity. He looks forward to receive their views when an opportunity for discussion becomes available.

#### 10. ACKNOWLEDGEMENTS :

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