

Development – The Otherside of the Coin

Dr. Ananda Ranasinghe (President, Institution of Engineers, Sri Lanka)



Dr. Ananda Ranasinghe holds a B.Sc. Eng. Degree from the University of Ceylon, Peradeniya, and Masters Degrees in Construction Management and Structural Engineering. He holds a PhD in Building Economics and has completed a Masters Degree in Law. He is a Corporate Member of the Institution of Engineers - Sri Lanka, the Institution of Civil Engineers – UK and the Institution of Structural Engineers - UK. He is also an Attorney-at-Law and served as Brigadier in the Sri Lanka Army

Keywords: *Environment, engineering, specifications, projects, claims, variations.*

1. INTRODUCTION

Thomas Tredgold's definition of Civil Engineering, may be one of the oldest definitions of Civil Engineering, states that, "*Civil Engineering is the art of directing the great sources of power for the use and convenience of man*". During the old days, the role of the Engineer was considered extremely important as Engineers reduced the need for human labour and at the same time satisfied some basic physical and social needs in a hostile environment. This attitude eventually developed and the general public believed that the age-old troubles of starvation, disease, floods etc. could be overcome by the proper use of engineering and to some extent it was achieved by the construction of engineering structures such as dams, reservoirs, drainage schemes, communication and road networks.

2. SOCIAL PERSPECTIVE TO ENVIRONMENT

Due to the vast destruction of the environment by our own brothers and sisters, as professional engineers the social perspective towards engineers has changed with time. It has come to a stage where society did not wish to judge finished products solely on engineering criteria. Sometimes, as civil engineers, when we construct a dam and inundate a large area, there will be so many social problems that we have to think of and assess carefully. A Civil Engineer may deal with bricks, concrete and steel whereas an Electronics Engineer might deal with microwaves, satellite communication etc. Whatever we do, we should bear in mind that we, the engineers, are the custodians of the environment. Therefore we have a great responsibility of protecting the environment.

3. SUSTAINABLE DEVELOPMENT

As engineers did not give much consideration to the aforesaid issues, people started looking for professionals who were concerned about the environment, economy etc., who focussed on different

perspectives. Therefore, the trend of evaluating the end product or the finished product has completely changed during the past three decades, and the general public sought such professionals to look after their interests while accepting the fact that development should also take place.

Consequently, the professional approach to an engineering problem has now diverged into commercial, social and financial aspects. The commercial aspect simply means that they should provide the client what he desires, and therefore there is a presumption that the client knew what he wanted. Hence, when delivering a product to the client, it is common practice for manufacturers to carry out consumer surveys in order to find out what is required by their clients. The professional engineer also has to play a role to satisfy the requirements of the client, but at the same time he has to also evaluate the other aspects of a product such as its effect on the environment, the society, the long term benefits, the cost etc. Therefore, when considering the engineering aspects of a project, one should bear in mind that it is secondary to the social aspects which I have described above.

Coming back to the engineering aspects, I would like to discuss some of the engineering issues which I have come across as a practising Engineer and Arbitrator.

I was involved as an Arbitrator and Adjudicator in several construction projects during the last 15 years where I have especially concentrated on construction dispute resolution rather than pure engineering. Some of the problems that I have faced in the past, looking at it from different perspectives as a person who sometimes has to defend the Contractor or the Employer depending on who my client is, as described below:

4. INVESTIGATIONS AND SURVEYS OF A PROJECT

In most of the road projects that I had the opportunity to work in, due to lack of preliminary investigation quite often vitiations had to be done. The amount of work in a major road project is so large even one variation could cost a lot of money. For example, if the soil properties are not analysed and therefore stability of embankments are not done the consequence of it would be unstable slopes. Therefore there is a strong possibility of landslides during construction and after construction. As you know when a land slip occurs the amount of additional work to be done becomes an unknown quantity and so there is an effect on the environment. I had an opportunity to sit as an arbitrator in a project at Kandy where the State Authority was constructing power lines and the earthwork quantities had been increased by four times (quadrupled) due to land slides. The consequence of this would be increase in the cost of excavation, time delays, additional costs due to overhead etc. In one instance due to land slips the Contractor's machinery had been buried. Therefore pulling out the machinery and the cost of damages also will contribute towards the increase in prices.

5. INITIAL SITE VISITS AND INVESTIGATIONS TO IDENTIFY PROBLEMS

In one of the projects where I was involved in a Dispute Resolution Process, the Contractor was making a claim for delays due to obstructions that existed in the ground preventing driving of piles. In the said Project the contractor was a piling contractor and while boring for piles he had encountered many obstructions such as foundations of an old building, concrete blocks etc. This type of information should have been revealed during the preliminary investigations by the Employer or the Consultant. The ultimate result is a delay in the Contract and additional expenses to the Contractor, due to idling of the Contractor's machinery.

6. ESTIMATION OF THE COST OF THE PROJECT

Proper Project Estimation at the time of planning of the Project is an extremely important factor. In a building project the Employer had had in his mind to have a Central Air-Conditioning System. However

this was not reflected properly in the Contract Documents. It is common practice among the Consultants to issue minimum drawings or details as possible during the "Tendering Stage". The reason could be either that the Consultant was not ready with the construction drawings or that the Employer/Consultant had given little importance to tender drawings. In the said Project the Contractor had bid for Split Type Air Conditioners whereas the Employer had assumed that he had specified Central Type Air-Conditioners. The ultimate result was that the Contract was terminated as a result of which the Contractor claimed a large sum of money from the Employer for unlawful termination.

I also would like to discuss another example of similar nature. In this Project it is stated in the Bill of Quantities that cabling has to be done from Point 'A' to 'B' which is about 500 metres in order to obtain 60 Amperes from the Main Grid. In the BOQ it was also stated that Single Core Cable should be used. The Contractor had laid a 4-core Cable which can carry a 3-Phase supply. There is a significant price difference between a Single Core Cable and a 4-Core Cable. The Employer is prepared to pay only the price of a Single Core Cable whereas the Contractor is claiming the cost of a 4-Core Cable. This dispute has gone for resolution and as of now the adjudication process is pending. The amount of the claim is around Rs. 22 Million. This dispute could clearly have been avoided had the Consultant given proper description at the time of tendering. Therefore, documentation is extremely important in contract administration. Hence, it is important to remember that missing an important statement could lead to litigation, the cost of which could be enormous. Apart from this the parties will also lose the good relationship that existed between them. Therefore, the Engineers have to play an important role in the preparation of contract documentation.

7. PROPER CONSTRUCTION DRAWINGS

At the time of tendering it is important that the Employer is ready with appropriate construction drawings. One cannot expect the Contractor to Bid on a certain set of drawings and thereafter proceed with construction on a different set of drawings. In another case in a Road Project, the depth of excavation had been given as 3 metres below the existing surface, which the Consultant may have decided upon the information available to him at that time. After proper investigation that had been commenced after the award of the tender, it was found that the required depth would be much more than 3 metres. The Contractor had already hired machinery which was imported from another country, equipped with a short arm which facilitated excavation only of around 3 to 4 metres in an efficient manner. However, when the excavated depth was increased to 6 to 7 metres, the Contractor had to either modify the existing machinery with a longer arm or hire a piece of equipment with the required arm length locally at different rates. Therefore, due to this lack of investigation at the correct time, the Contractor has lost time and money where all such costs have to be borne by the Employer.

8. RECONSTRUCTION ACTIVITIES

In congested areas, as well as in road construction projects, there are many reconstruction activities that have to be carried out by the Employer or the Contractor. There is however, certain information where it is not reasonable to expect the Contractor to have access to, as at the tender stage the Contractor has very little access to the construction site.

Sometimes relocating a water supply line might take several months. There are extensive telecommunication cables laid by the side of the road which should not be disturbed.

I remember an incident when I was working for the Roads and Traffic Authority in Australia where telecommunication lines had been laid from Sydney to Brisbane. The aforesaid line had been laid by the side of the main highway and this was located only at the time of construction which was a little too late. Relocation of this telecommunication line took about six months as the cable had to be especially fabricated. All these things will add to the cost of the project as the Contractor has to charge for idling resources, overhead costs etc.

Therefore, in construction drawings the location of existing services also should be identified accurately so that the Contractor is made aware in order that he may prepare himself in advance if relocation is necessary.

9. CLEARANCES FROM LOCAL AUTHORITIES

One also has to remember that by merely being a state authority it may not have unlimited powers to carry out construction work in a road project even though the land is acquired for the required lanes and reservations. There may be certain properties still belonging to the other state authorities.

I remember in a road construction project in Sri Lanka, the Employer believed that he could make use of the rock encountered during the excavation of the road. Unfortunately this was not the situation. In accordance with the statutory requirements, any authority should obtain a license or permission from the Geological and Mining Bureau in order to blast and use the rock. There had been a royalty charge also included and this cost had never been estimated in advance by the authority. Therefore the cost and the time had been increased in the project.

When a site is handed over to the Contractor he should be able to proceed with construction without any hindrance. In a road project near Kandy, the Contractor was awarded the contract to rehabilitate the road at a project cost of approximately Rs. 800 Million. When the Contractor was proceeding with the work the Forestry Department interrupted the work stating that the Contractor has to obtain approval from their department as widening will entail encroachment into the forest reserve. The outcome was that the Contractor had to carry out construction in patches as the encroachment had occurred in many places along the length of the road.

10. INCORRECT SPECIFICATIONS

When specifying an engineering project there should be clear and unambiguous specifications for each and every item that has to be performed by the Contractor. If these specifications are not definite the Contractor might have to face two serious problems. Firstly, he may quote the job incorrectly and secondly the Contractor might try to carry out the work as he has priced in his tender and not to the quality or the specifications that is required by the Engineer. This would lead to many problems such as disagreements between the parties, litigation, time delays etc.

There was a specification for the construction of a road where the Contractor was required to lay two layers of metal, and thereafter the gaps were to be filled in the metal with a smaller sized aggregate. When the Contractor commenced compaction in order to achieve the density requested, he was unable to do so as there was no interlocking of materials. The two layers of large size aggregates merely separated without forming a base course. In this instance the Contractor sought advice from the Engineer on how to proceed with the construction and the Engineer came up with many trial and error proposals. The final decision was to use a combination of hand-broken metal and machine crushed metal. Hand-broken metal in large quantities was not available for immediate purchase, and therefore the Contractor had to order hand-broken material and wait for many months until sufficient quantity of hand-broken metal was made available to him. This led to time delays and loss of production to the Contractor. At the same time, the Employer was not happy with the progress of the Contractor and he terminated the contract. Therefore, whatever you do at the planning stage in order to save time will be of no use with your project analysis arrived at with complicated software such as Microsoft Projects or Primavera, since the Planner has failed to look into the most important aspect which is correct specification.

11. DESCRIPTION IN THE BILL OF QUANTITIES

Most of the Engineers have a habit of filling a copied Bill of Quantity when he has to prepare such document. It is extremely important that one has to consider the sequence of events that would take place when an item of job is to be done. If he follows an existing BOQ blindly where the item of work would be different to that specified earlier, the Engineer will be misleading the Contractor. The consequence of misleading the Contractor by providing an improper description for the work item will lead to price variations. A Contractor would never carry out work which is different to the Bill of Quantities which he has quoted for. I remember when I started my career working for a Consultant, and we had to deal with Contractors who were even knowledgeable enough to interpret Engineering and contractual documents. A few decades ago such people were very rare and most of the Contractors were willing to do whatever the Engineer wanted. There are two reasons why the Contractor is obliged to carry out the directions of the Engineer. Firstly, during that time the profit margins of the Contractor were very high; it even ran up to 100%. Therefore the Contractor could make and break things without asking for extra payment as the only loss that he could incur is a little drop in the percentage of profit.

This environment has changed over a period of time. The Contractor's staff is sometimes better qualified than the Consultant's staff. The profit margins of the Contractors are now very low, and therefore if they have to do additional work they cannot simply afford to do so as it would cause a severe loss to him.

Recently, I was involved in dispute resolution where the Engineer was expecting the Contractor to carry out water proofing of a block of toilets before tiling. He has mentioned water-proofing in the BOQ before tiling, but the description does not say the rate of tiling is inclusive of water-proofing. The omission of this sentence has caused the Employer a loss Rs. 8 M as it was a hospital building where toilets covered a large area. Therefore, every work in a contract document has a monetary value, and at the same time every line that you draw in your structural drawing also has a meaning.

I would like to mention another case where, in a lump sum contract, the Contractor had failed to cost for a retaining wall although it is shown in two lines in the drawing. These are costly mistakes and therefore as Engineers I believe, apart from engineering, you ought to be very concerned about the things that you do, and one cannot lose sight at any stage.

Although I was discussing mostly matters that you may consider are not engineering, if you do not concentrate on these issues the industry will deprive you of your status and you will be the third or fourth person to be consulted and the other professionals will be far ahead of you. Therefore, you should never allow this to happen.

As I stated my speech I would like to further add that whatever we do to improve our infrastructure, we should not at the same time disturb the environment. As leaders of development we have a great responsibility to carry out our work in a sustainable manner. People now talk about rainwater harvesting, greenhouses, environmental pollution, recycling etc. Therefore, as custodians of the environment, with the limited natural resources available to us, we as engineers must try to protect the environment as much as possible. Continuously we use fossil fuel which might be depleted within the next 50 years or so. Therefore it is our challenge as engineers to preserve energy and at the same time develop energy from various other sources such as solar, wave, wind etc.

Let me quote from a speech made by Chief Seattle when he was asked to sell to the white man the land which he had been occupying.

His reaction was: *"How can you buy or sell the sky or the warmth of the land? The idea is strange to us. If we do not own the freshness of the air and the sparkle of the water, how can you buy them? Every part of this Earth is sacred to my people. Every shining pine needle, every sandy shore, every mist in the dark woods, every clearing and humming insect is holy in the memory and experience of my people. The sap which courses through the trees carries the memory of the red man."*

He further stated: *“The perfumed flowers are our sisters; the deer, the horse, the great eagle, these are our brothers. The rocky crests, the juices of the meadows, the body heat of the pony and man - all belong to the same family.”*

Modern man in his search for pleasure and affluence has exploited nature without any moral restraint to such an extent that nature has been rendered almost incapable of sustaining healthy life. Invaluable gifts of nature, such as air and water, have been polluted with severely disastrous consequences. Man is now searching for ways and means of overcoming the pollution problem as his health too is alarmingly threatened. He also feels that it is irresponsible and morally wrong on his part to commit the future generations to a polluted planet. If man is to act with a sense of responsibility to the natural world, to his fellow human beings and to unborn future generations, he has to find an appropriate environmental ethic today to prevent further aggravation of the present pollution problem. Hence, his search for wisdom and attitudes in a hitherto neglected area of knowledge namely, religion.

12. CONCLUSION

In the modern age man has become alienated from himself and nature. When science started opening new vistas of knowledge revealing the secrets of nature one by one, man gradually lost faith in theistic religions. Consequently, he developed scanty respect for moral and spiritual values as well. With the advent of the Industrial Revolution and the acquisition of wealth by mechanical exploitation of natural resources, man has become more and more materialistic in his attitudes and values. The pursuit of sense pleasures and the acquisition of possessions have become ends in themselves. Man's sense faculties dominate him to an unrelenting degree and man has become a slave to his insatiable passions. (Incidentally the sense faculties are in Pali *indriyas* or lords, because they control man unless he is sufficiently vigilant to become their master.) Thus man has become alienated from himself as he abandoned himself to the influence of sense pleasures and acquisitive instincts.

In his greed for more and more possessions he has adopted a violent and aggressive attitude towards nature. Forgetting that he is a part and parcel of nature, he exploits it with unrestrained greed, thus alienating himself from nature as well. The net result is the deterioration of man's physical and mental health on the one hand, and the rapid depletion of non-replenishable natural resources and environmental pollution on the other. These results remind us of the Buddhist teachings in the suttas discussed above, which maintain that the moral degeneration of man leads to the decrease of his life-span and the depletion of natural resources.

Moral degeneration is a double-edged weapon, it exercises adverse effects on man's psycho-physical well being as well as on nature. Already killer diseases such as heart ailments, cancer, diabetes, AIDS, etc., are claiming victims on an unprecedented scale. In the final analysis these can all be traced to man's moral deterioration. Depletion of vast resources of fossil fuels and forests has given rise to a very severe energy crisis. It cannot be emphasized too strongly that such rapid depletion of non-renewable natural resources within less than two centuries, an infinitesimal fraction of the millions of years taken for them to form, is due to modern man's inordinate greed and acquisitiveness. A number of simple ancient societies had advanced technological skills, as is evident by their vast sophisticated irrigation schemes designed to feed the fundamental needs of several millions. Yet they survived in some countries over 2000 years without such problems as environmental pollution and depletion of natural resources. This was no doubt due to validity of the philosophy which inspired and formed the basis of these civilizations.

“Whatever breathing creatures there may be
 No matter whether they are frail or firm,
 With none excepted be they long or big
 Or middle-sized, or be they short or small
 Or whether they are dwelling far or near
 Existing or yet seeking to exist
 May beings all be of a blissful heart.”

13. REFERENCES

Treadgold, T., Charter of the British Institution of Civil Engineers
<http://www.ukcivilengineering.co.uk/quotes.html>

De Silva Lily, (2005-2012), *The Buddhist Attitude Towards Nature*,
<http://www.accesstoinsight.org/lib/authors/desilva/attitude.html>

Chief Seattle, Suquamish Indians Tribe (1800), Letter to the President of the USA
<http://www.barefootworld.net/seattle.html>