

**ROYAL ACADEMY  
REDEFINING THE DESIGN TEAM: THE NEED FOR SYNTHETIC THINKING  
BETWEEN ENGINEERS & ARCHITECTS  
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## Introduction

The reason I have been asked to say a few words at this meeting on Redefining the Design Team is, first, to announce my own personal indebtedness to engineers and at the same time to help proclaim to a wider audience that Art is an essential ingredient of all good design, although that art has, and is still, so often buried beneath an avalanche of the architectural taste of the day.

It was Buckminster Fuller who once said that most architects are simply good (or bad) taste purchasing agents (ie. they're experienced at selecting from catalogues).

## Architects, Engineers & Construction Industry Culture

To enjoy the company of engineers, economists and those in the construction industry is a privilege, but for me they must be more than just concerned with their own world. They must be sensitive human beings, who have a personal philosophy about life in general. This is often too rare, or rarely apparent, but I have been fortunate to have met and worked with a few, and there is no doubt in my mind that they deserve public recognition (even if they don't seek it) on an equal basis to those architects they have worked with.

What these people have in common is confidence, and an intuitive sense of sharing an experience, where the job is the goal, not their job.

Numbers, (says John McLeish in his recent publication) "are not a sadistic conspiracy devised by one half of society for torturing the other half. Instead they are evidence of our inventive genius, and understanding them is one of the most important characteristics that distinguish us (as animals) from other animals."

If we add culture to numerical literacy, then we really do create the medium of invention. Today this culture, at a personal level, between individuals, can often begin with estranged collaborators, all of whom have to be capable of shedding their protective skins to enable a barrier free exchange to take place - this is the primary move to allow cultural fertilisation and innovation to take place.

This approach is no different in a larger context. History is full of nations and peoples developing philosophies and techniques which have, through mixing, produced the context for extraordinary creativity.

An exhibition is essentially about cultural exchange - the Royal Academy is such a venue. In 1992, an exhibition - Art of the Structural Engineers, had the themes of concept, form, materials, connection and construction - these are no different from the essential components of architecture, sculpture, even music, which is why there should and must be common ground between those of us who are fortunate to be entrusted with a major role in creating our built environment.

The true artist searches for the essence in things and then seeks to express it. It may be in the properties of a material, or how one part interacts with another. When brilliantly expressed it is inevitably controversial, i.e. it makes us rethink.

Engineering is a domain which should seek essence.

Engineering is much more than a quiet service industry to architectural egos, but perhaps it is too provocative to suggest that without engineers, Architects would collapse.

## Synthetic Thinking between Engineers, Architects & Designers

### A short historical preamble

The profession of civil engineering and its offspring - structural engineering, has its roots in the discipline and hierarchical nature of imperial armies acting on behalf of certain western countries. Here were born the tenets of economy and efficiency.

Economy and efficiency are the historic buzz words of engineering design for the traditional engineer. When used by visually illiterate engineers as the only design criteria, they have led to a great number of 'aesthetically' unsatisfactory structures. However, it is the attitude and lack of design skills rather than these tenets themselves which have produced these results. There is no reason to suppose that we cannot make economy and efficiency subservient, without denying their crucial importance in the design process and eventual artefact.

During this "colonial" period the architect became the engineering decorator, with a rôle to camouflage - arguably carried out in the interest of urbanity, architecture or simply making the engineering publicly acceptable (e.g. Tower Bridge).

This division has existed for nearly two centuries. There have been enlightened engineers (Brunel, Telford, Eiffel, Nervi) who have produced exceptional engineering works which are not only structurally inventive, but go beyond the material domain to create notable public space. These engineers clearly had an awareness of the civic importance of some their works.

Masonry, as the main engineering material, marked most of mankind's achievements up to the 19th century. Then, with the advent of wrought iron (1799, the 30m span Coalbrookdale Bridge by Abraham Derby), wrought + cast iron (1820 Thomas Telford's 177m Menai Straights Suspension Bridge, Paxton's 1851 Crystal Palace), iron + steel (Gustaf Eiffel's work, 1884, notably the 178m steel arch of the Garabit Viaduct) and then steel in cable form, structural engineering with steel has become more and more specialised.

In the context of light and architecture, Paxton's extraordinary achievements and others in the mid-19th century - removing the entire solidity-opacity associated with buildings, has seen a renaissance in today's architecture.

The Innovation of reinforced concrete led to many advances (Auguste Perret, Eugène Freyssinet in France and Robert Maillart in Switzerland who, 1901, designed the 38m span

hollow box arch form Zuoz Bridge) and this material has seen tremendous advances since, through a better and better understanding of the nature and quality of the materials involved and how they behave together. The engineer can now bring to this knowledge, yet more powerful analytical models to test ever more complex solutions.

### Now?

Architects, who have recently been in the vanguard of structural inventiveness in their architecture, have been so only because of the support of engineers, yet the public's appreciation of the engineer has been severely limited by the media's sole promotion of the architect.

In the late 20th century, structural engineering inventiveness requires the support of rigorous analytical method(s). It has not always been so, but we have experienced an ever increasing tendency towards this position as a result of material research, technical development and application of new materials. Architecture is as much a witness to this as is engineering.

There have always been individuals who, either ignoring or defying professional boundaries were capable of pan-professional action (e.g. Eiffel, Nervi, Fuller etc). Of course this behaviour attracts envy and creates jealousy from traditional professionals. It is rare today for an individual "engineer-architect-designer" to be capable of thoroughly analysing inventive structural engineering proposals without the support of specialists. He may appear to have a broader perspective within which to design, but this can be less than the horizons imagined by a collaborative team of creative individuals who come from different disciplines (e.g. Rice Francis Ritchie), yet who can also continue to develop individually within their own field.

Imagination - creativity - intuition, material understanding - analysis - design - economics, and an understanding of the political and social role of the process through which we realise projects are all ingredients in the making of architecture, and the urgent need to dissolve the intellectual boundaries between professionals is a fundamental necessity if we are to realise more intelligent and responsive architecture.

### **Professional Barriers**

Psychological barriers only occur in the minds of men, and like any theory constructed by man these barriers can be deconstructed and replaced.

"Barrier absence" requires a way of thinking and attitude which is no longer territorial because respect and trust exist, which in turn encourages confidence with humility between people. Professionals should be as capable of realising this as anyone else, and in terms of their influence on society and the physical environment, should have a moral obligation to do so.

I know from my own experience with Peter Rice and Martin Francis, and the way our office in London functions with individual engineers and economists, that territories do not have boundaries, they are simply different landscapes which require different skills to negotiate well, but also through which, with one's collaborators, one can be supported and supportive.

In an architectural practice which has at various times included engineer, naval architect, artist, anthropologist, photographer, landscape architect, poet, where none are regarded as technicians or draughting people, we are accustomed to the absence of barriers as we are to the absence of hierarchy. Since a small office cannot always sustain this diversity, we frequently collaborate with other professions in the usual way. It is important to do this with people who share the same objectives - for example design quality, and similar values. Thus we have, over the years, established working relationships with a selected number of consultants.

Mutual education and reorientation is necessary when a job comes to us with another consultant already attached to it by the client, and there is a "heat" period necessary to melt the engineering and architectural boundaries.

### **Collaboration**

The kernel of creative collaboration contains several crucial ingredients:

- Each must take time to listen to the other, and suspend prejudices. Not only does this allow mutual respect to grow, but without it, the synergy of mutual creativity cannot flourish. The process is like brainstorming, in which nobody can quite remember where the solution came from
- The commonality of aims is usefully complemented by a diversity of expertise
- No barriers = no defences. There are those who feel threatened when another profession speaks their language and questions their assumption.

[It is a shame we have these languages and hide behind them at times.]  
This is inhibiting to any free exchange.

These principles of collaboration apply at all stages of a project; initially with a client and consultants, and later with a builder or fabricator. Differences of orientation can generate conflict, or can be harnessed creatively. The trick to helping this process to move in a constructive direction is often found by sticking rigorously to an open-minded approach where everyone's preconceptions - especially our own - are questioned, and we demonstrate a willingness to receive other's ideas and modify our own, whilst at the same time refusing to compromise our design principles and values. Those ideas that survive this process of challenge are the stronger for having stood up to scrutiny, and the process is exciting.

"After all, we all agree on that [collaboration]...But talking about it doesn't seem to have had much effect. One must somehow create the conditions which will allow such collaboration to take place, and one must educate members of the building team to see their own contribution not as an end in itself, but as a part of a common endeavour to create comprehensive, total architecture." [Ove Arup 26/10/72ICE]

### Ten Commandments for Collaboration

- 1 There has to be a moral commitment
- 2 There should be no preconceived idea and collaborators should be open to almost anything
- 3 Learn to really listen and to interrupt, and be ready to be interrupted
- 4 Ideas are shared - no one can claim them afterwards
- 5 Be altruistic, not competitive
- 6 Respect the minds of your collaborators, their individual skills will become valuable later
- 7 There is time together - synthetic time, and time alone - reflective time
- 8 All participants are equal, there are no bosses
- 9 You have to respect the common concept as being more important than what you could have conceived by yourself
- 10 Be prepared to improvise

All of our work has a public content, whether the entire building or just its facades. We rarely, if ever, construct with our own money for ourselves. We act as the group between the public and the client and together we have an obligation to both. When we work together and collaborate, some degree of friction always arises, whether it is over the money, the design or the morals, and has to be resolved in the end by the project itself. It is recognising the project as mediator which helps to solve them.

The collective idea which emerges is the first and most important thing. It is vital that all who are to collaborate on the design of a project come together at the beginning.

All design work is political in the ultimate sense in that we are trying to produce a world that is better to live in, where people understand more, where people are less oppressed and people live less dreary lives, where they have more control over their environment: this is the glue that brings us together.

The person who first receives a call from a client has to decide very quickly how and with whom they will work. It is often an architect or an engineer.

That person makes up their mind, but they also have some obligation as soon as they set up this wheel of collaboration, to inform the client.

The defining of issues between collaborators such as the nature of the contract, fee split, joint or separate insurance and responsibilities are very important to pin down early. Collaboration doesn't really mean anything until it is defined.

Some of the best concepts have come from people who are not "recognised designers", yet who are as concerned about our future environment as architects, engineers and landscape designers. These include geographers, urban planners, archaeologists, anthropologists, artists and poets. These people understand how environments work as well as architects.

For me, open collaboration where individual egos work together in the interest of the project and beyond, are those which are the most enjoyable.

Shotgun weddings are very difficult to manage.

I have tried to outline above a methodology, a way of working which can engage different kinds of people. I think the world of tomorrow will have problems that are more complex. Architects, engineers, designers and artists will have to find new ways of solving them with their clients.

We will all have to learn new kinds of methodologies to solve problems.

We approach each project with fresh eyes and minds to seek, with the client the best way to achieve the desired end result. Traditional forms of engagement, of construction contract, of collaboration are constantly being questioned by us.

### **Synthetic thinking in a more complex world**

While our designs have often explored the structural and energy performance of certain materials to help create spatial environments, one of our current concerns, as illustrated by the experimental greenhouse in Terrasson, is to create a less expensive architecture using material which is less and less processed by industry, while maintaining the pleasure of light in architecture. At the same time, we stay aware of research and developments in what I refer to as high technology, such as holographic films to help conduct and distribute light using far less transparent surface areas; molecular "replicating" spiders' webs, and nanotechnology (advancing in Saarbrücken at the Institute for New Materials, and elsewhere)

At the end of the 20th century we can recognise some of the environmental building follies of this century, such as air-conditioning. We can also see the crudeness of our industrial manipulation of the earth's resources into pretty basic building materials. Looking ahead, I can see much cause for optimism.

One need only investigate a tree.

They capture light, make energy, grow by processing CO<sub>2</sub> and water, support and are a home to other life forms, and they don't make a human audible sound, appear to waste heat or energy or waste anything else for that matter and are natural pollutant processors, they provide shade and they look great. If there are appropriate architectural forms, they are to be found in nature. But we need to understand their composition and mechanisms at the molecular level, not simply appropriate their forms for visual delight.

I would like to quote an exchange from the second reading of the Energy Conservation Bill.

(Mr Patrick Thompson) "...Concepts such as wind power, wave power, hot rocks and fuel cells are exciting, but, as my noble Friend said, the truth about energy efficiency is that it is boring, as it really only concerns property insulation and design."

(Mr. Brandreth) "I disagree with my hon. friend about energy efficiency being boring. I find that when I talk to people in my constituency about cost savings, they recognise that it is a case of enlightened self-interest and that they can help save the world, while improving the quality of their home life and enhancing their bank balance. Far from being boring, it is exciting."

### **The complex problems of tomorrow**

A new wider and more appreciative Europe is, hopefully not simply the creation in the coming years of the largest, most powerful single economic market that the world has ever seen, with its consequent energy growth demands, but a staging post, symbolic of a desire to achieve a more integrated whole world.

Monetary economics has so far failed to find a way of dealing with social costs or with renewable resources. The present western mania (indeed more and more global) for development based on a mechanistic and materialistic viewpoint, supported by the present inadequate economic methodology has led to increased pollution, both on a global and local scale. To most economists it appears that the social and environmental costs still remain intangible. One may think that the point of economics is to help us manage the world better, however I suspect that few economists see it this way. It seems inevitable that there must be a change in the current economic way of thinking. Man developed the present model, and our actions still maintain it. A sustainable economy means a more compassionate one, in the way we relate to each other and the planet. The earth owes man nothing. The global spread of the free market economy (so far leaving aside the polar regions) sucking the earth's wealth will probably lead our present concept of progress into oblivion. Excessive borrowing from each other and our children is wrong.

Exchange through discussion and openness of information is essential for understanding, and when this engages cultural exchange a major prerequisite for creativity is in place. This in turn makes creativity more accessible and maybe more democratic in a less competitive environment.

Competition has been and remains the conceptual trigger of our present economy and society. We do not believe that this is inevitable as is often argued. Collaboration, cooperation and indeed altruism is as common a natural inheritance as 'survival of the fittest'. This is a clue to redefining economic ethics, where the economy is seen not only to serve people in a material sense but to place it in a wider, more holistic context, where non-material issues are as important as material ones.

Quantum mechanics has shown that we are not observers, but participants in the world around us, and yet through our limited human perceptions, we continue to describe and prescribe as if our minds were still outside our own bodies and environment. The study of ecology has brought this into focus for us. Science has also shown us that the only certainty about certainty is uncertainty. These observations, which have undermined science's own imperious position, ought to be making us more tolerant and more ready to participate together in many more aspects of life.

Is not the art of living the ultimate art?

In the end, it is not the planet which is at risk but man's place (and existence) with it. Our present concern for the planet appears to be a reflection of our selfishness (e.g. Energy Conservation Bill debate illustrated above).

We hear and talk about the loss of the world's natural resources, plant and living organisms, both in our own country and across the planet, but more often than not in the camouflaged context of our human survival through nature's diverse resource for human welfare (medical, etc).

It is important to participate as an individual to express concerns about the wider issues which affect architecture. Like holography, in each part is the whole, but unlike the hologram, each part is important to the whole. Ideas popularized in the 60's, dematerialism (conceptual art), ecological awareness, spaceship earth - world citizen and the revolution in life-styles (sexual and religious taboos) have been slowly and discreetly absorbed and transformed by western society into more practical and vociferous views on how to begin solving world issues such as hunger, pollution, shelter and inter-cultural communications. (Some would argue that this is potentially another form of colonialism). Yet the economic model remains largely impervious to them.

In our urban environments, also spreading globally and 'home' to a larger and larger percentage of the earth's inhabitants, there is a danger that we are establishing an exaggerated and cocooned sense of our own self-sufficiency, which in turn will further alienate us from the essence of life on earth. Urban sprawl, a major world environmental issue was not even on the 1992 agenda of the World's first environmental conference in Rio de Janeiro.

The architecture we produce, and how we make our buildings is a reflection of our world view, or "how we walk on the earth". [Fluy, Herne, The Emplacement, Curragh] This is difficult for architects to assess in real terms, within a society still dominated by the culture of science and technology within the present economic model.

Access to hard facts on energy, labour, social impact, recyclability, and the renewability of materials used in construction is very difficult. Graphs depicting comparative energy consumption of, for example, extracting raw materials or of processing them do exist. However, these 'facts', important as they are in signalling awareness, represent little in terms of the more complete picture. For example, we do not necessarily have the combined knowledge of the energy source used, their comparative polluting effects, the effect of these processes on health of the workers in these industries and consequent social as well as economic cost, etc. It is a mistake to assume that graphs/tables such as these give a whole picture. The importance and dependence on such abstracted and limited data discredits us. It is in these sorts of areas that information needs careful examination but will ultimately one hopes, through significant development begin to give us clear data on which to make our more holistic judgements on not just materials, but the entire construction and deconstruction process, and the way we access and use our built architecture; in fact a more whole picture of the consequences of our decisions and choices.

Another important view point is the effect (visual, psychological, physiological...) of the architecture on the "user". Healthy built environments for humans is one important aspect of a continuing biosphere.

There can be no revolution in the industrialised regions of the world with regard to the way we extract, process & manufacture, distribute and consume materials - i.e. an energy revolution. Only a long campaign will eventually change our habits, of which this meeting is a small but important part.

**Humanity and intelligence have as much to do with the process of decision-making as with the tangible artefacts which result from our application of science, technology and economics.**

The need to make evident metaphorical intelligence and humanity in what we design should be indisputable.

It is this which drives our design approach.

Real progress for mankind and a real sustainable future for the earth are becoming essentially the same. Architectural and engineering design and construction must deal with its own progress by drawing upon the strong metaphorical stem of the human spirit and earthly values.

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Incorporating extracts from IR writings from 1985-95