

[1]Bioengineering
an important tool for sustainable road construction

In 1987 Gro Harlem Brundtland published the report „Our common Future“. It was the first widespread definition of sustainability. It was : development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainability demands three major components
environmental protection
economic growth
social equity

In the follow , I will try to show how bioengineering techniques can promote the idea of sustainability in road construction.

In the context of road construction sustainability always includes mechanical stability. I will thus show, after a short theoretical introduction, some examples of extreme bioengineering work that has by now proved it's stability.

Environmental protection

Bioengineering techniques have proved their mechanical stability. In some pieces the Gotthard road is still running on foundations build at the time of Napoleon, at a time where bioengineering and other labor intensive techniques were still the top of the art techniques in road construction.

Since that time, techniques have developed and research has been added. But today environmental protection is the very center of bioengineering activities, in small local scale as well as in a global view:

The so called „low-tech“ approach of bioengineering results in an almost zero carbon dioxide emission during the construction of the road. Most of the „energy“ used during construction is labor. This is maybe a less productive, slow and backward way of working for some, but it causes almost no irreversible changes in the global biosphere.

Industrial production, transport over long distances and large-scale changes in landscape are avoided or minimized where they are unavoidable.

Let's have a short look on these "irreversible changes" : The most visible ones are the burning of fossile fuels and the movement of soil and rock . The later is already taken into account by the Commission of the European Community through the MIPS-index (**M**aterial-**i**nput-**p**er-**S**ervice unit). The allocation of materials and energie

use in a product cycle are documented in the Ecological Ballancing. This is already subject to international normation (ISO 1440-1443). Bio-engineering always seeks to implement the solution with the lowest use of material and fossil energy possible.

Bio-diversity is one of the important points where bioengineering is concerned. The use of strictly local races is only possible using bio-engineering measures. Modern, industrial techniques can't take into account the use of local seeds and cuttings. Often these seeds have to be produced on the site previous to the actual beginning of the production. In Europe firms have emerged these last years producing and stocking wild flower seeds for various situations. Still the use of these seeds can result in the extinction of local genetic pools if used on a large scale.

Economic growth

Return on investment

Different evaluations from International Monetary Fund and World Bank have shown that rural road construction is the most effective way of creating growth in developing countries. It creates economic growth on a local base in the area where it takes place. It does so due to transport induced production oportunities. It thus participates in avoiding large-scale rural exodus with the known results in the creating mega cities. Research in India showed that road construction has the strongest direct impact on rural poverty . It's impact on productivity is only met by money spent into agricultural research and development.

Adapted design

There has always to be a relation between the use of a road and the design. Woodloggers in dry mountain forests in Madagaskar don't need roads with a speed design of 35 km/h for 40t trucks. At a rhythm like this the forest will be gone in few years. Erosion will destroy not only the road itself but the whole area will be turned in a desert. The same is right for agricultural feeder roads in Nepal and many other cases. Time is not scarce (especially when compared to traditional transport) and the several hundred tons of agricultural production in a single valley doesn't need 40t trucks. Better build ten roads on an adapted scale (and upgrade as soon as productivity needs better transport) than build motorways to remote villages.

Such small roads can entirely be constructed using bio-engineering techniques. But even in the construction of motorways one can use bio-engineering for slope stability, protection against traffic noise and pollution control.

Foreign exchange control

There is also the question of the national budget. Development aid is usually given in foreign currencies. The road construction with „modern“ methods needs a high percentage of its investment for imported goods (and services). Most of the developing countries have no national resources for energy. Thus energy, as well for producing cement as for driving massive building site vehicles, has to be imported and paid for in foreign currency. Machinery and much of the building material have to be imported to. A high percentage of the money attributed by international agencies (most of it as loans) thus returns immediately into the industrial world. Very often without leaving behind enough funds and structural capacities to maintain the new road.

Bioengineering measures try to minimize the use of (mostly imported) industrial products as well as of specialized „imported“ labor. The importance of this will be shown in the next chapter, because it has influence on the question of social equity.

Social equity

poverty alleviation

The approach of social equity means working with and for the poorest. Bioengineering uses a large number of unskilled or lowly qualified labor. Thus a high percentage of the money spent on the construction stays actually in the local economy. This limited employment gives local poor the chance of breaking traditional dependencies (slavery due to endowment still being wide spread in developing countries). The „low-tech“, labor intensive techniques of bioengineering thus allow breaking into rural poverty, opening local markets in addition to the opening of markets for local products due to the better transport facilities.

Building local capacities

In many of our approaches within the third world we actually use local products to replace standard industrial products. Thus even more money can stay in the working area and local economic development is enhanced. We also adopt traditional local working methods (where this is reasonable) which allows the local labor to work efficiently without much adaptation and to be proud of their work. The latter is very important for the acceptance of the created road. Some of the labor, trained during the construction, can in the follow be employed for maintenance work.

Acceptance through the population and regular maintenance are the major components if the actual road should be sustainable; i.e.: should stay functional on the long term.

Labor migration

In third world countries the migration of road construction labor (often living at the

margin of society) can lead to enormous problems. Once the construction is finished the workers are deployed. If they have no new job right away, a part of this labor stays in the area because of a lack of resources to return to their home region. They are thus creating social tensions with the local population.

Let's have a look on Europe:

working with the poor

More and more of the less educated population is pushed to the margin of society. Work is becoming scarce, the political acceptance of public welfare is weakening. There is the emergence of a „second market of labor“ . At the same time there is the demand, that this labor should not be in concurrence with the actual market and that it should contribute to the national well being as it is subsidized by the community. In France there are already multiple organizations working with bio-engineering measures to help "unwanted" labor (long term unemployed persons, former prisoners, persons without professional qualification...) to re-integrate into the first market.

And as environmental awareness grows there is even a demand for these people on the official labor market. Successful examples of bioengineering work make public administrations rethink their strategies and order ecologically sound solutions in the infrastructure sector.

A new perspective for rural areas

It is often said, that bioengineering measures needs excessive maintenance, impossible to be funded. Blocking road shoulders with large boulders or concrete walls is a one-time investment.

With accomplishment of the GATT European agriculture will be on a fragile equilibrium. More and more farmers will have to be paid by the community to maintain landscape. European sheep production has no chance against large scale shepherding in Australia or in third world countries. But without it, Spanish forests will be burning on a much higher rate and the „Alb“ region near Stuttgart in Germany will become densely covered with bushland.

These farmers already employ bioengineering techniques or can easily be trained. Why not combining the positive effect of bioengineering during construction with the long term socio-economic effect of protecting our landscapes, keeping farmers in the fields and rural communities alive.

With global climate changes going on these indices will become more important Bio-engineering always

Followed by pictures from examples of bioengineering work until the time is over.
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