Solid Environmental Solutions

AnyWay

**Rural Transport Infrastructure and**

**AnyWay Natural Soil Stabilizer (ANSS)**

**Ensuring Basic Access for Rural Communities**

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## Summary

A substantial portion of the rural population in developing countries does not have motorized access to transport networks, only unreliable or partial access. It is well documented that ensuring an effective rural transport infrastructure (RTI) system is an essential requirement for rural development. Without reliable access to markets and productive resources, economic development stagnates, and poverty reduction can not be sustained. The provision of all-season basic access is therefore an essential condition not just for rural development, but for development as a whole.

Basic Access is one of the necessary building blocks of poverty reduction. Enormous resources would be traditionally required in order to upgrade rural transport networks to basic access standards, and maintain them at that level. These resources, both economic and material, are for most cases not available in developing countries.

ANSS Natural Soil Stabilizer is a unique and innovative product that was developed for the stabilization of a wide spectrum of soils in an efficient, least-cost manner. ANSS Natural Soil Stabilizer is a proven, environmentally friendly, inorganic, hydration activated powder-based stabilizer that reacts with the soil particles to create layers that are interconnected through a complex inter-particle framework.

The advantages of using ANSS Natural Soil Stabilizer as part of the processes of least-cost, labor-intensive RTI development benefit not only the stakeholders but also and primarily the local population in developing countries. ANSS Natural Soil Stabilizer is **THE** technology for maximizing Rural Transport Infrastructure Development.

AnyWay Solid Environmental Solutions goal in presenting this paper is to show the synergy between the application of ANSS Natural Soil Stabilizer and the desire of International Aid Agencies to support Poverty Alleviation through Basic Access, Rural Transport Infrastructure in developing countries.

## 1. Introduction

According to data published by the World Bank's Rural Transport Thematic Group, rural transport networks in most developing countries are underdeveloped and of poor quality. It is estimated that about 900 million rural dwellers in developing countries do not have reliable all-season access to main road networks, and about 300 million do not have motorized access at all. At the same time, resources are being spent on upgrading roads to higher than economically justified standards for populations that already have a reasonable level of access.

Rural transport interventions must be an integral part of rural development and focus on the ability and access needs of rural communities. Rural transport infrastructure interventions need to be designed in a least-cost, network-based manner focusing on eliminating trouble spots in order to gain basic accessibility for communities in more regions of a country.

AnyWay's corporate vision is to provide a "Whole Concept" solution for the creation of basic access rural roads, in keeping with the guidelines for a holistic approach to the development of rural transport infrastructure.

ANSS Natural Soil Stabilizer, an innovative technology in the field of soil stabilization, is composed of naturally occurring inorganic components that act together to produce an extremely effective, least-cost and environmentally friendly product for social and economic development through infrastructure creation. The contribution of stabilizing roads with ANSS to achieve an improved quality of life can not be underestimated, as in addition to the least-cost advantages, it encourages labor intensive programs and skills development.

## 2. Rural Transport Infrastructure and Poverty Alleviation

Rural Transport Infrastructure has been addressed by numerous International Aid Agencies, whos main goal is to improve transport policies and strengthen transport management in developing countries. RTI is the rural road, track, and path network on which the rural population performs its transport activities.

The RTI network is the lowest level of the physical transport chain that connects the rural population, and therefore the majority of the poor, to their farms, local markets and social services, such as schools and health centers. Any enhancement of RTI can potentially increase real income and improve quality of life for rural areas, which directly transfers to embetterment of local economies.

Ensuring an effective RTI system is an essential requirement for rural development, although by itself it is not sufficient to guarantee success. Without adequate RTI, communities lack the necessary physical access for basic domestic chores, agricultural activities, social and economic services and job opportunities. Without reliable access to markets and productive resources, economic development stagnates, and poverty reduction can not be sustained.

Improvements of the near and intra-village path and track network, and the provision of all-season basic access are therefore essential conditions for rural development. A minimum level of service of the RTI network referred to as basic access, is one of the necessary building blocks of poverty reduction.

### *2.1 Basic Access*

Basic access is defined as the level of service that provides the minimum accessibility required for rural socioeconomic development. In a majority of situations, where traffic is below 50 motorized four-wheeled vehicles per day (VPD), this means single lane gravel or earth roads.
Basic access standards deliver the minimum level of service necessary to promote and sustain the development of rural communities, while providing such access to as many people as possible.

### *2.2 ANSS and Basic Access*

One of the most important aspects of basic access is passability or reliability. In developing countries, resources are usually very limited. Least-cost and economic criteria are required for maximizing the impact of interventions. The concept of 'basic access' fits well into what ANSS has to offer as a product, as it is well adaptive to wearing course layer creation as well as

incorporation into pavement layers. The fact that a single product can be applied for many applications of road creation is positive and well suited to developing regions.

The most important criteria for infrastructure is to be able to withstand the climatic elements and traffic without extensive damage. The removal of water is crucial for the success of basic access RTI, since at traffic levels characteristic of rural regions, water causes more damage than the traffic. ANSS allows for appropriate design to be undertaken that provides for basic access roads that are free from standing water and have adequate camber to quickly remove water from the road surface.

Many rural communities are still without road access. Increasingly there is a deterioration of basic infrastructure, resulting in limited passability in the dry season and not at all in the rainy season. In these situations ANSS can be used for spot improvement, with a significant cost savings when compared with full improvement techniques. In many situations upgrading an existing earth road to basic access standards will only require interventions on 10 percent of the road length, which greatly reduces the costs of providing all-season passability. ANSS is applied to the natural in-situ soil, greatly improving the soils bearing capacity, and reducing the amount of unnecessary excavations of imported materials. This is important due to the fact that good quality aggregate deposits are scarce in or non-suited to extraction in underdeveloped areas.

**3. ANSS Natural Soil Stabilizer**

ANSS Natural Soil Stabilizer is a unique and innovative product that was developed for the stabilization of a wide spectrum of soils in an efficient, least-cost manner. ANSS is an environmentally friendly, inorganic, hydration activated powder-based stabilizer that reacts with soil particles to create layers that are interconnected through a complex inter-particle framework.

ANSS's ability to react with a wide range of soil types and under different soil conditions eliminates the requirement for multiple stabilizers for a given project. Results of many applications both in-situ and in laboratories have consistently proven that the success of the resultant stabilized layer is not jeopardized through changes in the soil type. Clay, silt, sand and gravel based soils can all be stabilized with a single product.

ANSS Natural Soil Stabilizer is well suited to be incorporated into RTI due to the following characteristics:

- Non-toxic and environmentally safe both to the environment to which it is being applied as well as to the individuals applying it. Tested and Certified Environmentally Friendly by the Ministry of the Environment of the State of Israel, and Awarded the Prestigious "Green Label".

- Stabilizing in-situ soils at the site of construction with ANSS eliminates the need to destroy other lands and excavate material in open pits for road construction, which material would have to be transported by polluting heavy machinery to the road site.

- Greatly reduces dust creation on un-surfaced secondary roads.

- Does not deviate from the common principles of application that are currently used for traditional soil stabilizers.

- Effective over a wide range of soil types (broad response spectrum) without jeopardizing the resultant durability.

- Significantly increases the bearing capacity and durability of stabilized soils.

- Limits pore volume so that moisture effects are reduced, which are commonly the most detrimental aspect of rural roads, more so than the traffic weight/volume.

- Packaged in bags small enough to facilitate ease of manual application.

- Hydration activated.

- Applicable to regional design standards and climatic conditions.

- Produces superior results over gravel roads, irrespective of soil type.

When a soil is stabilized with ANSS the following characteristics are achieved:

- Reduction in plasticity index.
- Increase in bearing capacity (CBR).
- Increases compaction ability of clay soils due to the aggregation of clay particles into larger solid particles, thus making the material more friable and workable.
- Makes the stabilized layer less susceptible to moisture ingress, rendering the layer water-resistant.
- Introduces cohesion, thus creates a tensile strength, especially in the early stages of development.
- Reduces swell potential of expanding soils.

## 4. Designing Basic Access Roads with ANSS

### *4.1 Rural Design and Soil Stabilization*

Traditional road design has centered on the use of gravel for construction, which provides a platform with increased load bearing capacity that is superior to the in-situ soil/material. This method of rural road construction has many limitations, especially when considering developing countries and regions. In many cases good quality gravel material for road construction is hard to find, or non-existent within an economically feasible distance to the site of construction, and requires heavy machinery that is not suited to labor-based practices.

It is for this reason that soil stabilization is a fundamental necessity for present day road construction, especially in developing countries. International agencies have recognized the fact

that roads in developing countries should be constructed using soil stabilizers at an increasing rate if they are to improve the state of their rural infrastructure.
Soil stabilization is well suited and adapted to the development of Rural Transport Infrastructures and ANSS Natural Soil Stabilizer was specifically developed to meet these requirements.

### *4.2 RTI Design with ANSS*

Soil Stabilization using ANSS, when combined in a basic access RTI design, produces low-maintenance sustainable rural roads that resist weather and traffic deteriorating impacts. Designs using ANSS are cost-effective, as they take into consideration the low-cost of the planned infrastructure. AnyWay's policy is to stimulate the involvement of the local consulting industry and rural communities in the process of RTI development as part of the alleviation of rural poverty.

The innovation of ANSS is well suited to spot improvement. Spot improvement, by definition, will include the worst sections of a road system, which are most likely to be locations in which poor soil and/or water related problems (flooding, erosion, and drainage) are prevalent. Despite the small size of areas treated by spot improvement when compared to the entire road system, using traditional methods is likely to utilize a disproportionately large amount of resources due to the complex nature of each location. With soil stabilized using ANSS, much of the valuable resources can be saved and applied to other sections of RTI.

ANSS changes the characteristics of in-situ soils that are incapable of bearing traffic loads when soaked. These natural soils are usually characterized as having a high plasticity, which is the result of both the quantity and quality of the fine material (clay/silt) present in the soil. Plastic soils are sensitive to changes or fluctuations in the moisture content of the soil, which is the other factor that is prevalent when considering spot improvement locations.

Not only will ANSS decrease the natural in-situ soils plasticity index, it will reduce the porosity of the soil, increase the density and substantially increase the load bearing capacity. ANSS reacts with the soil particles to form an inter-particle crystal matrix, which binds the soil into a solid layer. Due to the inter-particle medium that is formed between the soil particles, and the

increase in density of the layer (particles are thus closer together), the capillary and pore spaces within the layer are greatly reduced. This reduction in porosity is extremely important in reducing the layers sensitivity to fluctuations in moisture content.

Stabilization of in-situ soils with ANSS allows low strength materials to be incorporated into location specific designs. Spot improvement will require designs that are suited to specific locations and soil types, therefore the fact that ANSS reacts well with a wide range of soil types (broad response spectrum) is an asset to the designer. A flexible approach to designing can be achieved due to the high degree of efficacy with which ANSS can be applied to the RTI network.

## 5. Implementation

### *5.1 Least-Cost Structures*

The developing world is having to do a lot with very little, and establishing infrastructure, which at very best is basic access, is no exception. The resources available for RTI are limited and consequently these networks (roads, paths, and trials) need to be designed with a least-cost mentality. This least-cost mentality is directly related to appropriate design. In fact, the correct structure for the developing world at present is that of least-cost structures. The design of least-cost structures is basically different then the conventional pavement structure design. This is not only due to different load analysis but also due to the use of different structural materials.

The need for innovations to be incorporated into the design of developing countries is fundamental, as gravel is seldom an option (both by cost and availability). This innovation must come from better quality soil stabilizers that are suited to a design regime that is flexible to challenging circumstances. ANSS suits this challenging environment. The ability to dramatically change the characteristics of in-situ soils that are incapable of bearing traffic loads when soaked is a key element in rural road design, and producing least-cost durable and reliable structures.
Soils stabilized with ANSS have the durability to be used as a wearing course layer due to the considerable increase in the CBR value and tensile strength of the treated in-situ material.

Depths of stabilization and the percentage of the stabilizer to be added vary depending on soil type, traffic considerations and climatic conditions. Typical rural road designs will utilize a 100-

150 mm stabilized in-situ layer over a compacted sub-grade. Alternatively, for projects in which drainage and moisture fluctuations are a factor two stabilized layers over the compacted sub-grade can provide a sufficient structure.

ANSS provides the flexibility in design to create low-cost, region specific, appropriately designed roads.

Soil stabilization is a technique that will be an integral part of any RTI. Despite the fact that the majority of networks carry less than 50 VPD, many of these vehicles will be overloaded. This coupled with the fact that there are commonly large variations in climatic conditions (rarely temperature, but mostly moisture), requires a well-designed and constructed road.

It is AnyWay's policy to provide "Whole Concept" solutions for design, construction, and quality control of Rural Transport Infrastructures. This approach is supported by a team of professionals who are skilled in the relevant knowledge to manage the design and supervision of the application.

### *5.2 Labor-Based Technology*

The application of labor-based approaches to basic access RTI interventions contributes to their poverty-alleviating impact. RTI construction with ANSS with the use of local labor allows the community to earn wages and develop skills. The term labor-based is used to describe projects where labor is substituted for equipment when it is cost effective. This covers most road-related activities apart from compaction and heavy earthworks. The term also includes the use of appropriate light equipment (tractor-trailer) which supports the utilization of labor.

### *5.3 Labor-Based Approaches*

Labor-based approaches are important to RTI as they help in alleviating the poverty level in the region of construction. Furthermore, incorporation of local labor into the road building project imparts a sense of ownership to the road, which is a valuable aspect for developing a reliable maintenance regime.The importance of labour-based projects is further realized when taking

into account the World Banks findings that labor-based construction was about 10 to 30 percent less costly than more equipment intensive works, and it reduced foreign exchange requirements by 50 to 60 percent and created for the same amount of investment two to five times more employment.

ANSS was developed and is applied in many countries as part of the need to provide labor-based application methods. ANSS is a powder-based stabilizer and as such is preferable due to ease of application. ANSS is an inorganic powder-based product that has undergone substantial environmental and toxicity testing. It has been certified by the Ministry of the Environment of the State of Israel, as being an environmentally friendly product, for which it was awarded the "Green Label".

**6. Maintenance**

Many of the issues surrounding rural road infrastructure and basic access involve the ownership of roads. This aspect is particularly important when considering the future maintenance of the road. In fact, road maintenance is an aspect of road design and cost analysis that is rarely given enough consideration. Much of the experiences of past rural road projects has pointed to the deterioration of roads resulting in a lack of resources, which stems directly from the lack of appropriate consideration of required maintenance costs. However, in many parts of developing countries where resources are stretched beyond their capacity, maintenance is usually an aspect of road building that is neglected.

ANSS contributes to the quality and longevity of the constructed pavement layers, which significantly reduces the required maintenance. In many developing countries, reserves of naturally occurring gravel used for periodic renewal of gravel layers are simply not available. With ANSS, the costs of developing and maintaining all-season passable rural infrastructure are now much more economical due to the elimination of gravel applications and grading.

ANSS provides the least-cost solution for road development with the existing natural in-situ soil.