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WORKSHOP ON MAINTENANCE AND MANUFACTURING OF
PERMANENT WAY (RAILWAY) MATERIAL

Innsbruck and Vienna, Austria
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I. BACKGROUND

Industrialization of any country depends to a large extent on a good transportation system. Among the different means of transportation the railways offer high advantages with respect to costs, efficiency and environmental considerations. In fact, present evaluation methods used for justification of investment in public transport take into account the aforementioned factors. The national railway system can play a very important role, provided that its development is integrated in the national development plans.

In many developing countries railway infrastructure has not been renewed and maintained properly. Poor track conditions cause accidents, affect the quality of traffic and produce substantial wear of the rolling stock. Under such circumstances the railways are not competitive and lose traffic to the road. Revenues drop and investment becomes more difficult. Track quality depends on two major criteria: the first refers to material (rails, sleepers, fastenings, ballast, turnouts), the second to geometry. As to the former, techniques are available to refurbish the existing material in order to prolong its life span and to economize in purchases of new material. For this purpose quality criteria must be defined for different types of traffic and detecting and measuring techniques must be available. Maintenance workshops and logistics must be set up for using the material to the maximum extent possible. In many developing countries such programmes are not properly organized or are non-existent. As to track geometry, mechanization of levelling, lining and tamping has been introduced in many developing countries, however management and maintenance of the equipment are often not up to standard. This results in low utilization of existing equipment and unsatisfactory overall results. Co-operation with local engineering and maintenance capacities can often be a solution for improving the performance of the railway system.

Many developing countries have the need and the potential to manufacture permanent way material locally, such as concrete sleepers and some types of fastenings. Existing equipment could be used additionally for refurbishing operations, particularly in the field of turnout maintenance. In this connection, there is a need for developing countries to strengthen their national engineering back-up support services, and improve their overall skills in the field of track maintenance.

UNIDO activities have included the promotion and development of local capabilities in the transport sector. Since its establishment, UNIDO has carried out more than 50 projects related to the transport sector as a whole, including railway transport. For example, UNIDO provided assistance to the Union of African Railways to elaborate a regional development programme as well as the training aspects. A number of recent UNIDO projects were implemented for strengthening national capabilities for maintenance/repair and manufacturing of spare parts/components for railway rolling stock.

Successful workshops and training programmes in these fields have been organized by UNIDO since 1984 in closed co-operation with railway administrations from Western European countries.

The Austrian Federal Railways (ÖBB) has been a successful test ground for the introduction of new techniques in the field of permanent way materials and track maintenance. In co-operation with several well-known industrial enterprises, among them Voest Alpine and Plasser & Theurer, the Austrian railways have developed permanent way technology of very high standards which has been applied worldwide. The Working Committee on Railway Technology (Permanent Way, of ÖVG has used this experience for international training purposes. ÖVG also co-operates with foreign industrial partners, such as the Swiss MATIX group and railway administrations of other countries.

Having organized ten international conventions on subjects related to permanent way and many workshops, ÖVG is highly qualified to conduct such activities and is willing to establish closer contacts with developing countries leading to co-operation arrangements. ÖVG's experience of about 20 years in arranging railway seminars, workshops, training programmes, etc., on an international level, makes it an excellent counterpart agency for UNIDO projects in the railway transport sector. A list of illustrative activities organized by ÖVG during the last ten years, many of which are at the international level, is attached as Annex III.

During a visit to UNIDO of representatives of ÖVG and Plasser & Theurer discussions centered on the urgent need for developing countries to improve their local capacities in the field of railway engineering.

During the visit it was proposed to organize jointly a workshop for participants from developing countries in the fields of manufacture, refurbishing and maintenance of permanent way material and track renewal/maintenance.

The Workshop therefore was organized within the framework of the 11th ÖVG International Permanent Way Convention which took place in Innsbruck, Austria, from 9-12 September 1991. It brought together 18 high-level participants from developing countries, i.e. heads/managers of civil engineering departments responsible for track renewal (see Annex I).

**II. PRESENTATIONS, DISCUSSIONS AND
RECOMMENDATIONS ON THE VARIOUS TOPICS**

**Item 1: Reconditioning of rails, turnouts
and other track materials**

Item 2: Modern turnout design

Item 3: Rail welding

Item 4: Small track machines

Item 5: Concrete sleepers

**Item 6: Maintenance and renewal of the railway track
using modern mechanised systems**

Item 7: International Cooperation and Financing
1) by UNIDO
2) by the Austrian Government

**ITEM 1: RECONDITIONING OF RAILS, TURNOUTS
AND OTHER TRACK MATERIALS**

1.1 Technical Presentation by

Mr. Ulli PETER, MATIX-SAFERAIL, Lausanne

**Rail wear, rail flaws, testing and preventive
measures, Reconditioning of rails**

Track items, i.e rails, sleepers and fastenings have a limited life and need renewal after a certain period of time. During their service life, rails get vertical and lateral wear, head deformation, corrugations and other defects. Rail welds also develop flaws. Sleepers get worn-out or get corroded and lose their rail holding capacity. Similarly rail fastenings get affected with time.

Track materials which have out-lived their service life, are replaced by new or serviceable materials. Materials released from track can be reconditioned to obtain further service life from them. The system adopted for this purpose is usually as follows: Released track materials are sorted out and are placed into following three categories:

- a) which can be used without reconditioning
- b) which can be used with reconditioning
- c) to be scrapped.

Every railway system has developed its own strategy of the use of released materials depending on the techno-economic considerations. Mr. Peter explained at great length the methodology that can be developed in the reconditioning of released rails.

Rail reconditioning plant manufactured by Matix has the following salient features:

- a) a machine for lateral and vertical straightening
- b) a brush cleaning mechanism
- c) an ultrasonic testing equipment
- d) a machine for cutting and drilling of rails
- e) a machine for reprofiling of rail head
- f) equipment for measuring of rail head
- g) rail welding equipment after cleaning of rail web
- h) stripping, final straightening and grinding machines.

Machines for carrying out the above functions have to be suitably installed in the plant, interspersed with adequate rail stocking and transferring facilities to get optimum productivity.

He brought out the fact that even after taking into account the reduced life of the reconditioned rail, such plants can make considerable savings. Mr. Peter also gave a detailed break up of the cost of various machines used in the rail reprofiling plant.

The layout plans and the machinery deployed can vary as per requirement of a particular railway system. The layouts adopted in the plants working in Italy, Germany and Belgium were explained.

Observations and discussions

The participants took active interest in the presentations and took note of the need of utilisation of released rails and other track materials to the extent possible. The need for reuse is all the greater in those developing countries which are dependent upon import of track materials. Any reclamation of track materials will help them to save valuable foreign exchange.

During the discussions it was brought out that almost all the railways have developed some system, where released materials are utilised to the extent possible. The extent of reconditioning work being carried out, varies from railway to railway, depending on the availability of the infrastructural facilities for carrying out the job. Sorting out of the released rails, cutting out the defective portion and their welding into long panels is done by many of the railways.

Almost all the participants felt that it may not be economically justified to install a fully fledged rail reprofiling plant on small railway systems. Mexico Railways, which has a comparatively large rail network and are carrying out an extensive track renewal programme, are however presently making a study for the installation of such a plant.

They however felt that a regional approach on this issue would prove quite advantageous. A rail re-reprofiling plant, which can serve a year may be set up for this purpose.

During the discussions the participants highlighted some of the other track problems having a bearing on LWR/CWR tracks.

These were

- a) problems connected with Thermit welding
- b) ultrasonic testing of rails, including that of welded joints in rail
- c) two block sleepers versus mono block concrete sleepers
- d) suitability of wooden sleeper for modern track
(for c and d see item 5)

Mr. Mundrey, the consultant from India, gave a detailed account of the experience gained by Indian Railways on the items discussed, including their experiences with the reprofiling plants.

Indian Railways have installed two reprofiling plants recently. They are facing a number of teething problems in getting the desired level of productivity from them. It is necessary that a detailed techno-economic study should be carried out before such a plant is purchased.

In ultrasonic testing of rails efficient working of the machine and the competence of operators play important roles. Sufficient attention should therefore be given to these factors to get full benefit out of testing.

Recommendations

a) Developing countries may try to make maximum use of released track materials. Reconditioning depot should be set up whenever not existing and the extent of reconditioning work should be decided based on techno-economic consideration.

b) There may not be sufficient justification for the installation of a fully fledged rail reprofiling plant of the type suggested by Mr. PETER of MATIX in most of the small railways of developing countries.

Mexico with a comparatively large railway system may consider its installation after a detailed techno-economic study. The experience gained by Indian Railways may be of use for carrying out the study.

c) In connection with the experience gained by the African railway system, a regional approach for the development of rail reconditioning facilities may be adopted. A few of the adjoining railways can be combined together to create such a facility where released rails from their railway systems can be reconditioned and taken back home after the work is done for using on their secondary lines.

1.2 Reconditioning of Turnouts and Fastenings

Technical Presentation

Mr. Ratheyser, Head of Department of ÖBB refurbishing plant for permanent way material at Wörth made a presentation of the reconditioning work being done on permanent way materials in their plant. Apart from the rails, the reconditioning work is being done on:

- a) switches and crossings
- b) track fittings such as steel base plate, K-type clips, nuts and bolts, etc.

Switches and crossings are generally reconditioned in the track itself by electric welding process. Techniques used in the reconditioning of crossings in track was demonstrated. However, when complete track renewals are carried out, all the track materials, i.e. rails, fastenings, switches and crossings of turnouts are all brought to the reconditioning depot. In this depot materials are sorted out to identify the pieces which can be reused in the tracks either directly or after reconditioning. The rest of the pieces are sent as scrap. The reconditioning work is then taken up and after the work is completed, these items are distributed to various places in the railway network according to the demands placed on this depot.

Visit to the workshop

Apart from the demonstration of the work of reconditioning of a crossing, a visit to the reconditioning depot was arranged. The participants thus had an opportunity of seeing the work being carried out in the depot.

Observations and discussions

All the participants were quite impressed with the reconditioning work being carried out in the depot at Wörth. The figures of savings of 30 - 40 % as projected by the Austrian Railway was considered quite impressive. All agreed that the developing railways who have to face greater financial problems in buying new materials should take note of the type of work being done and try to set up such depots where they do not exist.

Recommendations

- a) Apart from rails, reconditioning of other materials have great potential for saving money required for the purchase of track materials. All the developing railways may therefore set up such factories to the extent possible.
- b) Reconditioning of switches and crossings is particularly advantageous as in this manner the overall life of the turnouts is considerably increased.
- c) The reconditioning work that can be carried out by railways will depend on the infrastructural facilities that can be created. All reconditioning work may be justified on techno-economic considerations.

ITEM 2: MODERN TURNOUT DESIGN

2.1 Technical presentation by VOEST-ALPINE, turnout plant at Zeltweg

To reduce the cost of maintenance and to improve the level of comforts a number of steps have been taken by the company in the development of modern turnout designs. These steps include

- a) adoption of tangential layout at the switches and the use of thick web asymmetrical section
- b) elimination of gaps by
 - i) adoption of CWR through turnouts
 - ii) use of movable frogs
- c) use of elastic fastenings
- d) use of high strength materials such as
 - i) head hardened rails
 - ii) manganese steel
 - iii) cast manganese steel
 - iv) special alloy steel strip of strength equal to 1800 N/mm^2 , welded to normal structural steel
- e) improved guard rail design and its fastening system.
- f) use of heavy concrete sleepers
- g) evolution of proper geometry at wheel contact area at frog, which meets with the requirement of new as well as old wheel profiles.

Visit to the workshop

Voest-Alpine has a large workshop equipped with some of the most modern types of machines. They include planning, milling, welding, grinding, cutting and drilling machines. All the processes of fabrication of switches and crossings are done under one roof. The turnouts are assembled in the final position in the same area and are thoroughly checked before they are despatched.

The turnouts are fitted with operating and interlocking gears and the inspection include proper setting of the points using these gears.

The workshop has a heavy duty forging equipment in which one end of the thick web asymmetrical tongue rail is forged into standard rail section. The welding of the standard rail end of the tongue rail is done to the standard rail length by the flash butt welding process.

Observations and discussions

Although efforts are going on in many of the developing countries to install modern track structure for plain line tracks the turnouts continue to be based on out-dated technologies. There is an urgent need to adopt modern turnout design to improve their maintainability and achieve higher speeds. The new designs should however be compatible with the earlier designs to avoid mass scale remodelling of yards. The design should be such that adequate facilities for repair and reconditioning of the turnout can be developed within the country.

The participants felt that no specific recommendations for adopting a particular design can be made and their railway departments should exercise their own judgement in making use of the design, most compatible to their systems.

Recommendations

- a) Efforts should be made by the developing railways to adopt modern design of turnouts as they afford better maintainability, can permit higher speeds and extend their life span.
- b) The choice of design should be such that the new design can be adopted without mass scale remodelling of yards. It should be possible to create adequate facilities for the repair and reconditioning of turnouts, manufactured to the new design.

ITEM 3: RAIL WELDING

3.1 Presentation of the papers

Ing. E. Boden of Austrian Federal Railways presented his paper on welding of rails. He discussed at length the advantages that can be gained in having a continuously welded track. On the main lines of the Austrian Federal Railways continuously welded track has been adopted in a big way and even curves down to a radius of 250 m are welded.

The advantages gained from continuously welded track are well known. Such a track leads to considerable economy in track maintenance expenditure, apart from prolonging the life of the track materials and rolling stock. The travelling comfort of the passengers is also improved.

Mr. Boden then discussed the various methods of weldings that can be adopted. They are:

- flash-butt-welding
- thermit welding
- arc welding

Flash-butt welding is considered superior to all other types of welding. In Austria the rails are welded with this process up to 720 m length and thereafter thermit welding is done to convert them into a continuously welded track. Thermit welding was demonstrated in the workshop. Considerable care is needed for ensuring good quality welds with thermit welding process. Both, long preheating as well as "SKV" (short preheating) thermit welding methods are used on the Austrian Railways. Both can produce good quality welds. SKV process is adopted where track possession available for carrying out the work is of a very short duration.

The quality of thermit welding can be considerably improved by adopting in latest SKV technique and by improving the training facilities of welders.

Arc welding is mainly used as repair welding, to repair faults of rails such as wheel burns, scaling, cavities, breakage and notches, etc. This type of welding is extensively used for the reconditioning of switches and crossings.

Mr. Becker of Plasser & Theurer explained the working of the mobile flash butt welding machine K 355 APT. This welding machine can be used both as a stationary plant as well as a mobile welding plant for welding of rails in the track itself. The quality of weld produced by the machine is almost at par with the stationary welding plant.

The infrastructural facilities required for welding with this machine are much less and therefore the cost of welding could be considerably reduced in a situation, where the total quantum of work would not justify the setting up of a fully fledged stationary plant.

Mr. Pitkin, Chief Civil Engineer of the former Rhodesian Railways (Rtd.) gave a presentation of a case-study in which a mobile welding plant of the type discussed above was used in Botswana. With this machine it was possible to develop a flash butt welding facility in a makeshift depot at short notice and the depot was dismantled after the work was completed.

Discussions and observations

All the participants appreciated the advantages that can be gained with the welding of rails. The superiority of the flash butt welding process over thermit welding was also well understood. For flash butt welding of rails it was considered to be definitely advantageous to have a mobile flash butt welding plant on railway systems which do not have sufficient work load for justifying the setting up of a fully fledged stationary flash butt welding plant.

The quality controls that are needed for getting good quality thermit welds was well appreciated. An intensive training programme for the welders, engaged in the thermit welding of rails, would be necessary for ensuring proper quality. The example of the work done in Botswana where mobile flash butt welding machine was used for the installation for long-welded rails was also quite informative and interesting.

Recommendations

a) Welding of rails into long length has many advantages: Apart from reduction of maintenance costs, welded rails prolong the life of the track materials and rolling stock components. Long-welded rails should therefore be adopted to the maximum extent possible, but in doing so, adequacy of the track structure, including the fastening system and ballast should be taken into account. In this connection the work done by Mr. Zoba of ESACC is quite interesting and informative. His case-studies provide a good background in decision making process and it would be well worth the time to study it carefully.

b) Flash butt welding process is decidedly superior to thermit welding. On small railway systems where the traffic is less and axle loads are low, good quality thermit welds may be able to satisfy the requirements.

The possibility of having a mobile flash butt welding plant may be considered wherever a stationary flash butt welding plant cannot be justified on account of the lesser workload. Bigger railway systems will however be able to obtain considerable economic advantage with the installation of a proper stationary flash butt welding plant.

c) Welding of rails should also be considered for the re-use of released rails. The rails released from the track, after they are sorted out and the defective rail portions removed, can be welded into short rail panels for use on secondary lines.

ITEM 4: SMALL TRACK MACHINES

4.1 Presentation of the papers

Mr. Ströbl of ROBEL, Munich, gave a presentation in which the working of the various small track machines and equipment manufactured by Messrs. ROBEL was explained. Robel manufactures a wide range of machines, including:

- rail cutter
- rail drill
- rail mover
- jaw cramp
- hydraulic rail bender
- rail grinding machine
- gauge and super-elevation measuring equipment
- impact wrench/power wrench
- rail loader.

He also explained the working of the Robel train which can carry long-welded rails from the welding plants to the relaying sites. The standard model can transport 30 rails up to a length of 240 meters each. As the cranes run over the whole length of the train, one pair of rails can be either unloaded or loaded in a period of 5 minutes.

He also explained the capability of a newly developed single sleeper laying unit PK1-20 ES. This unit takes 20 sleepers from the transport waggon, transports them to the site and lays them on the ballast bed continuously in uniform spacing.

The capability of the Robel's ganger's trolleys and the catenary maintenance car was also explained.

The participants also had the opportunity of seeing the sleeper laying unit at Innsbruck where a demonstration of its working capability was arranged.

4.2 Discussions and observations

The participants were generally satisfied with the demonstrations of small track equipment of the type being manufactured by Robel. Such equipment apart from its potential in labour cost savings is also useful in achieving better quality standards for track work.

The productivity of the track maintenance gangs can be considerably increased if they are provided with small track machines. The need for having a train for carrying long-welded rails from the stationary flash butt welding plants to the laying site is inescapable. Some sort of improvised arrangement of carrying such long rails on roller mounted waggons will have to be devised if fully mechanised trains of the Robel type for example, cannot be procured. The working of the sleeper laying unit which combines the function of transporting and laying the sleeper was found quite interesting and advantageous particularly where small scale track renewal work is to be carried out.

4.3 Recommendations

- a) Small track machines which can facilitate the gang work, improve their productivity and achieve better quality standards, may be procured by the railways, taking into account the infrastructural facilities available on their system for their transport, operation and maintenance.
- b) A system for handling and transporting long-welded rails would be necessary for all railway systems which have to move long rails from flash butt welding plants to the track laying sites.
- c) The railways may consider the use of small sleeper laying units for carrying out limited track renewal work.

ITEM 5: CONCRETE SLEEPERS

5.1 Presentation of the papers

Mr. Gruber, Head of the Permanent Way Department ÖBB, explained to the participants the approach adopted by Austrian Railway system in the use of concrete sleepers. Austrian Federal Railway is using concrete sleepers to the maximum extent possible. They do not use concrete sleepers on tracks with poor formations or on sharp curves. Almost all the concrete sleepers are of mono block type. Earlier, Pandrol clips were also used as one of the fastenings systems, but for the last 2 years only Vossloh clips are the standard fastenings, as they have been experiencing some wear problems with the Pandrol clips. Austrian Railways has also started using concrete sleepers for switches and crossings and has found them to be of quite an advantage over wooden sleepers.

Dr. Schilder of ÖBB explained the philosophy adopted by Austrian Federal Railways in deciding the use of concrete sleepers. He also explained the comparative advantages and disadvantages of the two main types of concrete sleepers, that is mono-block and twin-block. While mono block sleepers provide better distribution of vertical loads, the lateral resistance of twin-block sleepers is superior to mono block sleepers. Austrian railway however has decided in favour of mono block sleepers only.

The participants had an opportunity to visit a sleeper manufacturing plant called Maba, which has only been put into production in 1990. This plant uses the latest technology in producing high quality sleepers; it is a sophisticated plant with the technology obtained from Sweden.

Mr. Lackner, production manager of the factory, explained the working of the plant. In this plant long-line method of production of concrete sleepers has been adopted. The pre-stressing wires are pretensioned and about 36 sleepers are cast in one length. Four lines of operations have been installed, out of them one is being used for the manufacturing of turnout sleepers.

A cycle of 24 hours operation has been adopted and the same sleeper mould can be used on the successive day. No curing of concrete is done.

A film of plastic material is showered on the sleepers so that the water used in the preparation of concrete is not allowed to evaporate but used in the curing of concrete. The plant is fully automatic and very few workers were seen around in the plant for the manufacture of sleepers.

5.2 Discussions and observations

The participants were favourably impressed with the advantages of the concrete sleepers over all other types of sleepers, particularly they have a clear advantage over other types of sleepers when modern long-welded rail track is to be constructed. The bulk of the material used in the manufacturing of concrete sleepers is usually locally available and thus it should be possible to manufacture such sleepers at a reasonable cost. The type of manufacturing plants that may be installed will depend on the local conditions prevailing in each country. It may not be necessary to go in for a highly sophisticated labour saving plant of the type seen by the participants. The plants which can be operated by the skilled people available in the country would prove more desirable. Such plants are existing in many developing countries where concrete sleepers of reasonable good quality are manufactured using local pre-stressing technology. The advantages/ disadvantages of mono-block and twin-block sleepers were discussed at length. The role played by the fastening system in deciding the type of concrete sleeper was also discussed. It was left to the individual Railway administration to decide as to which type of concrete sleeper will provide them the best techno-economic solution under their own conditions.

Mono block concrete sleepers have generally been found more advantageous in developing countries, as they need less sophisticated track machinery. When necessary infrastructure for their laying and maintenance has been developed, satisfactory performance has been reported by these railways.

Wooden sleepers can be effectively used for modern track, but based on environmental consideration and on account of better suitability of concrete sleeper for modern LWR track, the use of concrete sleepers should be encouraged.

5.3 Recommendations

a) Concrete sleepers are considered ideal sleepers for the construction of modern tracks; although other types of sleepers continue to be used by various railway systems with reasonable degree of satisfaction.

b) Both mono-block and twin-block sleepers have been used by the various railways and they have found them quite useful under their conditions. The railways systems may therefore choose the sleepers best suited for their conditions taking into account the facilities available with them for their manufacture, transport and laying in tracks. The availability of a suitable fastening system should also be taken into consideration while deciding the type of sleepers. Concrete sleepers for turnouts may also be considered for adoption wherever considered economically justified.

c) A variety of manufacturing systems are now available for the manufacturing of concrete sleepers. They vary from fully automatic plants to semi-automatic and manual intensive units. Each country may adopt the system best suited to its needs, as long as the concrete sleepers can be of good quality and are able to meet their traffic demands.

**ITEM 6: MAINTENANCE AND RENEWAL OF THE RAILWAY TRACK
USING MODERN MECHANISED SYSTEMS**

6.1 Presentation of papers

Mr. R. Wenty, Deputy General Director of Plasser & Theurer gave a presentation on the range of track machinery, being manufactured and marketed by Plasser & Theurer of Austria. The machinery manufactured by this firm is now being used in 85 countries and the company has established its own manufacturing plants in many countries, apart from its main manufacturing unit at Linz. To look after the health of track machines, service centers have been established in almost all the countries where the machines are supplied. Technical guidance in the use of track machines and technical training for their operation and maintenance is also being provided.

Mr. Wenty then spoke of the range of track machinery, starting from the simple tamping machine to the most sophisticated, "unit maintenance systems". The range includes various types of lifting-, levelling-, lining- and tamping machines, ballast regulators, ballast cleaners, welding equipment, track recording cars, dynamic stabilizers, crib- and shoulder consolidators, rail-reprofiling units and sleeper and rail renewal equipment of various types. He brought out the advantages that developed and developing countries have obtained with the use of the track machines. He specially mentioned the savings achieved by Federal German Railways among the developed countries and Thai State Railways among the developing countries. He indicated that Plasser & Theurer is in a position to manufacture the type of machine best suited to a particular railway system; efforts are also made to have tailormade machines for specific purposes.

Mr. Alois RASTL discussed the role played by his company in developing users technology in the deployment of track machines.

The company is well aware of the different traffic situations and infrastructure facilities available in the different railway systems. It is keen on directing its efforts and strategies in developing the most friendly users technology for the respective track maintenance requirement.

Mr. Mundrey explained the experience gained in India in the use of track machines. Starting from a humble beginning when a 05-machine, manufactured by Plasser & Theurer was procured by IR in 1965, a fully fledged factory, owned by Plasser India situated near Delhi, is now producing a wide range of track machines for use by the Indian Railways. The Plasser machines used on IR include various types of lifting-, levelling-, lining- and tamping machines including the latest machines of 09-series, shoulder and compacting machines, ballast cleaning machines, points- and crossings tampers and track relaying equipment.

6.2 Visit of manufacturing plant of track machinery and of a site for track maintenance

The participants visited the main manufacturing plant of PLASSER & THEURER in Linz, where they were introduced into the history of track work mechanisation and the various fields of application. They were shown a number of machines in different phases of assembly, some of the machines were identified for working in the environment of the railways represented. They were also provided an opportunity to visit a mechanised maintenance site near Retz-Drosendorf. At this site a group of equipment consisting of a ballast cleaning machine working in conjunction with container wagons, a tamping- levelling- and lining machine, a ballast regulator and a dynamic stabilizer were in operation.

6.3 Observations and discussions

The participants fully appreciated the need for the deployment of on-track tamping machines for the maintenance of modern heavy long-welded rail tracks laid on concrete sleepers. Both for the track laying and maintenance of concrete sleepers, proper deployment of track machinery is necessary to obtain the desired quality standards. On long-welded rail track, on-track tamping machines provide a high degree of safety during tamping operations, when compared to other methods of track maintenance.

The changing socio-economic conditions, even in developing countries have created a situation where sufficient labour is not easily available for carrying out strenuous track maintenance operations.

The extent of mechanisation that railway systems would adopt will depend upon many local conditions which vary from country to country.

The railways therefore may choose the type of machines best suited for their railway systems among the wide range of track machines that are now available. It was appreciated that mere acquisition of track machines and track monitoring systems may not be able to give the necessary results, unless a proper track management system is involved. It is therefore desirable that some type of track management system which will integrate the working of the track recording cars, track maintenance units and track renewal operations need to be instituted.

6.3 Recommendations

a) For modern track, consisting of concrete sleepers, elastic fastening systems and long-welded rail track, mechanisation of track maintenance and renewal operations is a technical necessity.

b) The extent of mechanisation would vary upon the infrastructural facilities and the socio-economic conditions prevailing in the individual railway systems. Intermediate technology may provide an optimal solution in many of the developing railway systems.

c) Proper machine maintenance facilities which should include the availability of spare parts, and a good training programme for operations and maintenance are important for the efficient track mechanisation programme.

d) Possibility of utilizing the services of private or public companies in track operations may be considered as in some countries they may be able to obtain better productivity from track machines, in view of their having greater autonomy of operation.

The development of an integrated track management system will surely help in maximising the advantages that can be gained from the mechanised track monitoring, maintenance and renewal equipment.

Item 7: International cooperation and Financing

7.1 UNIDO

Mr. Rojas from Unido offered the following comments:

Regarding financing possibilities and international co-operation, UNIDO, within the framework of its programmes and available resources, can facilitate the implementation of projects to be realized by the individual developing countries. Such possibilities include UNIDO's enterprise-to-enterprise co-operation (ETE) and its Special Trust Fund (STF) Programmes. These two programmes, which are designed to assist public and private enterprises and organizations, complement each other. Under the former, UNIDO acts as an intermediary in arranging international co-operation between two enterprises/organizations; this includes searching for appropriate partners for several forms of co-operation, including possible identification of financial sources. Resulting projects are normally executed under the Special Trust Fund programme, a mechanism which enables UNIDO to provide direct support to industry (public or private) in their efforts to overcome problems such as improvement of plant performance, project expansion and rehabilitation, industrial maintenance programmes, and preparation of feasibility studies. Under this scheme, UNIDO is able to provide, among other services, teams of consultants or individual experts, as well as procurement of goods and services. The funds required for each project, as a general rule, come from the beneficiary of the UNIDO assistance (self-financed trust fund), or in some cases from a third-party donor which may be a development finance institution, a governmental or non-governmental donor agency, an individual or group of companies, or industrial associations.

Based on UNIDO's experience under this Programme, the beneficiary industrial enterprises/organizations from the developing countries have appreciated the UNIDO services, since UNIDO's supervision of each project is a guarantee to them, and very often the beneficiary enterprises have realized significant monetary savings.

Another possibility and in fact the most common form of UNIDO assistance is through its traditional technical co-operation programme. Through this programme, most technical assistance projects are financed via resources from the United Nations Development Programme (UNDP) which are allocated for UNIDO implementation.

As railway administrations in developing countries are public and government owned, the UNIDO assistance must be requested through the UNDP Offices based in the respective countries.

UNIDO would be pleased to receive project requests from the developing countries, particularly for projects arising from this Workshop; UNIDO will review such projects and will provide advice to the sponsors regarding the applicability of the projects in any of the UNIDO schemes mentioned above.

7.2 Austrian Government

At the request of the participants Mr. Rastl explained the different procedures existing in Austria for soft loans and funds to be granted to developing countries.

a) Export credit facilities:

This most traditional instrument of financing is based on the existence of a payment guarantee given by an insurance company, which in most cases in Austria is the Österreichische Kontrollbank (ÖKB), a 100% government-owned agency. Sometimes third country guarantees or other forms of guarantees can be obtained. ÖKB gives this guarantee on the credibility of the country of the borrower. For each country ÖKB determines limits for such guarantees, for many third world countries this guarantee cannot be obtained.

The terms of the credit are negotiated, a government to government loan usually benefits from better terms. According to the drawing procedure there are buyer's credits and suppliers credits. In both cases the supplier gets paid by his banks, the time-schedule of maturities being close to his effective achievements. ÖKB refinances the payments made by the banks.

b) Co-Financing with the World Bank

A co-financing agreement has been made between the World Bank and the Austrian Federal Ministry of Finance, under which African infrastructure projects with a total amount of about US\$ 100 million have been financed since 1989. It is significant for this facility that the country limits for the guarantees are less restrictive and that IDA-terms are granted. The approach of the Austrian Government is a sectoral one: as soon as the sector (e.g. railways) is identified, a package is determined out of several project components coming from different suppliers.

It is highly recommended that governments interested in an Austrian co-operation within World Bank financed railway activities contact the Austrian Federal Chancellery, Section VI.

c) The Austrian Bilateral Co-operation for Development

This programme is managed by the Austrian Federal Chancellery and consists of soft loans and grants. It is concentrating on the SADCC group of countries in Southern Africa, where substantial amounts have been invested in railway activities during these last years. Project appraisal is following the principles of the Development Assistance Committee of the OECD. Total bilateral, official development assistance (ODA) from Austria amounted US-\$ 280 million in 1990, more than 50% being grants.

d) The Austrian Multilateral Co-operation for Development

This programme is managed by the Austrian Federal Ministry of Foreign Affairs. Most of the financial means for the UNIDO-ÖVG Workshop were made available by this programme.

The total amount of the Austrian multilateral ODA in 1990 was US\$ 90 million, 70% of which is channeled via international financing institutions.

e) Consultancy Services to be supplied by Development Banks

The World Bank and the African Development Bank have made technical assistance agreements with the Austrian Federal Ministry of Finance. Within this co-operation the Banks pay services of Austrian consultants out of a fund made available by Austria as a grant. The services should concern preinvestment investigations. It is highly recommended to submit applications to the two banks.

f) Industrial Co-operation

Exporting companies can obtain support from the Austrian Federal Chamber of Commerce for feasibility studies, training and other activities related to exported capital goods. The application is made by the supplier.

Success in all above mentioned procedures depend on good projects, correct application of procedures, close co-operation of all partners and endurance. The railway sector, benefitting from very large investment in Europe, is considered having a direct impact on the social situation of the population in developing countries. Therefore it is worthwhile to apply for official development assistance in this sector, having a fair chance of being allocated among other infrastructure investment projects.

**III. SUMMARY OF DEVELOPING COUNTRY
SPECIFIC VIEWS AND NEEDS**

- Item 1: Reconditioning of rails, turnouts and other track materials
- Item 2: Modern turnout design
- Item 3: Rail Welding
- Item 4: Concrete sleepers
- Item 5: Maintenance and renewal of track using modern mechanised systems

The workshop was attended by 18 high-ranking railway officers of the civil engineering sector, coming from 10 African, 3 Asian and 3 Latin American railway administrations, from the African Union of Railways and the regional training centre for railway managers ESACC in Brazzaville.

All along the workshop a great effort was made to apply the items of the reports and discussions to the specific situation of the railways represented. Each participant had sent country papers in advance and presented his report during the workshop. Some of the positions expressed by the participants on the subjects of the workshop are listed below. The comments prove the relevance of the programme for the present situation of the respective railways.

The managers of the workshop asked the participants to draw up terms of reference, specifications, cost comparisons, feasibility studies and the like on the themes of the workshop, thus suggesting priorities of investment to their respective management. Three of the participants submitted detailed texts, some commented in written form, some abstained, indicating that no financing was available and that many projects have been submitted by them to their management without any response.

Item 1: Reconditioning of rails, turnouts and other track materials

ESACC, Mr. ZOBA, pointed out that a viable project depends on the available quantity of rails suitable for reconditioning and the demand for reconditioned rails. Cooperation among regional railways may face the problem that no guarantees are given for the lifetime of reconditioned rails.

TRC, Tanzania, has just commissioned a steel sleeper reconditioning plant (supplied by Henry Berry & Co., UK). TRC is seeking financial support to establish a permanent way depot.

RNCFM, Madagascar is reconditioning steel sleepers by warm pressing.

NRC, Nigeria, is operating a reconditioning plant for turnouts.

GRC, Ghana: 3 rail flaw detectors are needed.

SRT, Thailand is inviting technical assistance to work on a study on the determination of standard and optimum usage of permanent way material. The terms of reference are listed in the country paper.

FNdeM, Mexico, hires the services of the SPERRY rail flaw detector car (USA) to check the soundness of rail.

Item 2: Modern turnout design

SNCS, Senegal: V_{max} for passing on turnouts is presently limited to 30 km/h. Purchasing new turnouts has to take into account modern design to allow higher speed.

REGIFERCAM, Kameroun, limits V_{max} on turnouts to 40 km/h. The same necessity is felt for new generations of turnouts.

SRT, Thailand: most turnouts are manufactured at SRT Switches and Crossing Workshop

FNdeM, Mexico: due to difficult layouts and heavy axle loads ($\Rightarrow 30t$) the life span of turnouts is less than 5 years on average. FNdeM have established a programme to improve the turnout maintenance and to make some regeneration works. The new turnouts installed since 1990 have been hardened by means of explosives.

Item 3: Rail Welding

CFCO, Rep. du Congo: rail breakages are very frequent in the system. They cause accidents and increase the costs of track maintenance. To reduce this loss a flash-butt welding plant is being installed at present. Ultrasonic rail flaw detection is another measure which has to be taken. For this purpose a suitable small scale self propelled vehicle should be studied recording at a speed of 15-20 km/h.

It should also be studied if the ultrasonic detection set could be installed on an existing trolley. A programme of recording trips is to be laid down.

SNCS, Senegal: rails are flash-butt welded in a stationary plant and brought to site on special wagons, where they are welded with the thermit process. Testing equipment for rail flaw detection does not exist, neither in the plant nor on site.

GRC, Ghana: recently, it became necessary to start thermit welding of rails on an experimental basis due to problems encountered with the joints management. Due to very sharp curves the current experiment is restricted to a rail length of 120'. Data is being collected to work out the economic justification for the exercise.

REGIFERCAM, Cameroon: more than 300 rail breakages are reported every year on joints welded with the thermit process. This causes a total of 450 hours of traffic interruption per year. Mr. MOUSSA, a participant in the workshop has worked on a cost comparison of welding. With 7.800 welds per year one joint welded by the mobile flash-butt welding machine costs ff 232,- while the railways have figured out that a thermit weld is costing ff 380,-.

SNCZ, Zaire, is using the mobile flash-butt welding machine operated by a contractor

UR, Uganda: a CWR section of 60 km has been thermit welded, welding material is left for another 170 km. Welding is considered expensive because of high cost of petrol used for preheating.

TRC, Tanzania: a stationary flash-butt welding machine was purchased in 1960. The machine was used for welding the Mwanza line: the rails were shop welded to 74 m and thereafter thermit welded to 1 km on a distance of 197 km. It is planned to continue the in situ welding up to Mwanza (380 km) with the thermit process. The World Bank supported restructuring programme of TRC has provided US-\$ 500.000,- for welding.

KTM, Malaysia: a flash-butt welding machine is welding 40' rails to 480' in a stationary plant. The plant is able to produce 77 joints per day at a rate of 11 joints per hour. At site the rails are thermit welded. KTM is also contracting out welding of rails to an enterprise using its own mobile flash-butt welding machine.

SRT, Malaysia: a rail welding workshop was set up as early as 1958. Rails are flash-butt welded to a maximum length of 144 m, transported to site and thermit welded to the longest possible length (until $R_{min}=400m$). Turnouts are still jointed.

FNdeM, Mexico: 3 stationary flash-butt welding plants and 5 mobile flash-butt welders meet the present need of rail welding. The thermit welding process is only used to close stretches of long welded rail.

ENR, Egypt: flash-butt welding has replaced the thermit process, welding is done in Tanta and Minya workshops since 1986. A training programme was arranged with foreign assistance for the technicians and workers for welding and distressing.

Item 4: Concrete sleepers

SNCS, Senegal, is studying a new mould for its bi-block concrete sleepers in order to use a Pandrol type of fastening.

GRC, Ghana, installed 400 concrete sleepers on the Prestea branch on experimental basis only. Timber sleepers are cheaper in Ghana and therefore the use of concrete sleepers has not yet been followed up.

KTM, Malaysia, awarded a contract to a local manufacturer in 1982 to produce 100.000 prestressed mono-block concrete sleepers per year. Swedish technology is being used.

SRT, Thailand: a pilot plant for twin-block concrete sleepers was established in 1962 and this type of sleeper became the standard. Between 1977-81 mono-block sleepers were purchased for replacement of wooden sleepers. After studying the difference of track quality fitted with the two types of sleepers, the production of the twin-block sleeper has been abandoned and a mono-block sleeper plant has been set up.

FNdeM, Mexico: since 1967 mono-block post-tensioned concrete sleepers (system DYWIDAG) have been adopted.

Item 5: Maintenance and renewal of track using modern mechanised systems

UAR, Union of African Railways is planning a study on the aspects of contracting out track work to public or private enterprises.

SNCS, Senegal, started contracting out mechanised track work in 1988. A track recording car would be required to improve work programming.

REGIFERCAM: main efforts are made to improve work programming and increase the cost-benefit ratio for mechanised track work by better site management and supervision.

TRC, Tanzania, introduced mechanised track maintenance in 1984 with most of the machines grounded for lack of spare parts. TRC is seeking financial assistance to revive these machines.

PJKA, Indonesia: for speeds beyond 80 km/h fully mechanised track maintenance is considered compulsory.

KTM, Malaysia: mechanised track maintenance started in 1978 and includes ballast cleaning, ultrasonic rail flaw detection and track recording by vehicles and turnout tamping. A shortage of track maintenance engineers is felt. Input is needed to integrate the mechanised maintenance programme with the manual track maintenance to achieve maximum efficiency and productivity.

SRT, Thailand: Mechanisation of track work with heavy duty equipment became essential in 1984. Average performances and costs of machine use 1984-91 are given in the country paper. SRT intends to have a study made for the establishment of standards and manuals for track work in order to increase the working efficiency of the staff.

FNdeM, Mexico, is intending to extend the use of heavy track work machinery to dynamic track stabilisation and rail grinding.

ENR, Egypt: mechanised track maintenance and renewal is contracted out to two joint venture enterprises and other foreign contractors.

IV. FUTURE PROGRAMME FOR CO-OPERATION BETWEEN UNIDO AND ÖVG

Many railways in developing countries are operating small networks and relatively low traffic. However, staff qualification is required all the same: the more efficient the railway should be run, the higher are the requirements. High standard training programmes need technical assistance from advanced railway systems, which is expensive. Therefore regional co-operation for training is the only way of making available suitable programmes, trainers of international reputation and practical training facilities using modern training methods. Regional co-operation is a traditional field of activity of the international organisations, in particular of the UN-family.

UNIDO will certainly continue to take a keen interest in transportation projects in the developing world.

ÖVG has proven to be the competent Austrian platform in order to arrange training projects for international railwaymen in the field of permanent way technology. A continuation of this co-operation is most desirable for a similar workshop on the occasion of the 12th Permanent Way Convention, which will take place in Austria in September 1994. Before programming the workshop a questionnaire should be circulated in order to determine the themes, the duration and the programme.

Other training activities could be planned, like specific training courses for operating and maintenance staff of track maintenance machinery. Co-operation could be sought with the World Bank, the Sub-Saharan Africa Transport Programme and other regional railway training activities, such as those of SATCC (Maputo/Mozambique) or of ESACC (Brazzaville).

In Asia co-operation could be sought with the Asian-Pacific Railway Co-operation Group of ESCAP (Bangkok) and the Asian Development Bank (ADB), thus taking up a link which was established in 1985, when AUSTRIA RAIL ENGINEERING arranged a railway seminar in Vienna under a technical assistance obtained from ADB.

In Latin America co-operation could be sought with the Inter-american Development Bank.

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II. ORGANISATIONAL MATTERS

All participants had their travel expenses and local costs covered by UNIDO, while Mr. ZOBA of ESACC benefitted from a scholarship of the company PLASSER & THEURER.

The workshop was managed by:

Mr. Luis E. ROJAS, Industrial Development Officer, Industrial Co-operation and Funds Mobilization Division of UNIDO also made a statement during the opening ceremony of the ÖVG Convention in Innsbruck.

Mr. Alois RASTL, engineer with PLASSER & THEURER, specializing in applied technology of mechanised track maintenance and renewal. Before joining PLASSER in 1989 he was with the consulting firm AUSTRIA RAIL ENGINEERING (in co-operation with the Austrian Federal Railways), and

Mr. J.S. MUNDREY, Adviser Civil Engineering of the Railway Board of the Indian Railways. He has retired recently but continues to work for IR as a consultant. His experience was highly appreciated by the participants and helped very much to lead discussions to final conclusions and recommendations. Mr. MUNDREY was at the entire disposal of the participants as a technical adviser.

On behalf of the Managing Board of ÖVG Mr. Roman JAWORSKI took a keen interest in the activities of the workshop. He was General Manager of ÖBB and is now the president of the Permanent Way Committee of ÖVG.

11th ÖVG International Permanent Way Convention

The 11th International Permanent Way Convention of ÖVG, Innsbruck, 9-12 September 1991, was part of the workshop. 560 participants of 55 different countries attended the congress - a rich opportunity for the participants of the workshop to meet people of the field and to exchange experience.

Although some of the subjects presented and discussed on the Convention were European high-speed matters, the participants of the workshop benefitted from particular papers, like those of the small European railways, the presentations on the "cost side" of permanent way (Mr. VEIT and Mr. WOTRUBA) and that of the representative of Thailand.

The programme of the Convention (see annex II) included a visit to the construction site of the railway "bypass Innsbruck", where the Northern portal of the Inn valley tunnel (the longest railway tunnel in Austria) and the Inn valley bridge could be seen under construction. Of course, the tunnel is driven according to the method called "NÖT", which is the New Austrian Tunnel Building Method. The participants were impressed about the size of the investment.

Part of the excursion was also an exposition of track work machinery used by the Austrian Federal Railways. Some of the machines were demonstrated in operation, such as small track machines of ROBEL and a gantry crane for handling and laying sleepers one by one (manufactured by PLASSER & THEURER).

The workshop programme in Innsbruck

The Austrian Federal Railways (ÖBB) had offered their assistance by making available training rooms in Innsbruck's main station. The first lecturer was Mr. Ulli PETER, General Manager of MATIX-SAFERAIL, Lausanne and former head of MATISA's after sales services. Mr. PETER passed years of his railway career in Southern Africa.

In Innsbruck the participants started presenting their country papers. They attached great importance to this opportunity, since exchanging experience among themselves has been as instructive as receiving information from lecturers.

They repeatedly confirmed that it was an extraordinary opportunity to meet so many high-ranking railwaymen of the track branch, coming from railways facing similar problems.

On the way to Vienna the participants travelled on the corridor train of the "Westbahn" through Germany. Most of them took the opportunity for a ride on the loco.

**The workshop programme at
VOEST-ALPINE turnout factory of Zeltweg**

From the Vienna Southern Railway Station, the group was accompanied by Mr. Reimar HOLZINGER, engineer of the track department of the General Directorate of ÖBB, consultant of VOEST ALPINE for turnouts since his retirement in 1985, and Mrs. Sigrid LEITNER of the Sales Department of VOEST ALPINE, who also acted as Spanish interpreter. The group was booked on a coach at the tail of the train in order to have a look on the track installation in the interesting section of the Semmering pass (first European mountain railway, constructed 150 years ago).

At Zeltweg the group was welcomed by the Sales Director, Mr. Reinhard BRANDL, the head of the design department Mr. Helmut ADELSBERGER, Mr. Johannes OSWALD, design department and Mr. Wolfgang SCHRIEFL, production manager. This team accompanied the participants during their visit of the factory, while the main paper on turnout design was presented in the afternoon by Mr. ADELSBERGER. A summary of his subjects is attached to this report as Annex V.

The Workshop Programme at Werke Wörth of ÖBB

The workshops of Wörth depend on the Central Workshops for Rolling Stock at St.Pölten, although they are suppliers of the civil engineering sector. For this reason the participants were welcomed at Werke Wörth by Mr. Heinz GERL, head of the Central Workshops of St.Pölten. He presented some main statistical figures of ÖBB and of the flow of permanent way materials through Werke Wörth. Werke Wörth is also hosting the Central Training School of ÖBB.

The papers presented at Wörth dealt with the two themes of rail welding and reconditioning of permanent way material, the authors were specialists of ÖBB (Mr. Erich BODEN of the Regional Direction Vienna and Mr. Johann RATHEYSER, head of the reconditioning workshop), of companies (Mr. Rudolf BECKER of PLASSER & THEURER, Mr. Bruno STRÖBL of ROBEL, Munich) and the British consultant Mr. Ken PITKIN, former chief civil engineer of the Rhodesian Railways.

The programme of Wörth also included the visit of a track maintenance site North of St.Pölten. The work consisted of ballast cleaning, adding new ballast and final surfacing of a single track line.

The work shift started at 8 p.m., track had to be handed over to traffic at 5 a.m. The waste materials had to be transported to the next station in order to be loaded on wagons. The participants were shown the functioning of the single track spoil handling system MFS 40, composed by a shuttle part (2 container wagons) and a storage part (one container wagon). They also watched the ballast cleaning system and the work of the following mechanised maintenance train ("MDZ"), composed of a lining-levelling-tamping machine, a ballast regulator and a dynamic stabiliser. The machines were operated by two contractors: the contracting branch of PLASSER & THEURER and the SWIETELSKY.

The Workshop Programme in Vienna

ÖBB had offered to ÖVG a conference room in the General Directorate. The participants were welcomed by Mr. Gerhard GRUBER, head of the permanent way department of the General Directorate. Mr. Rudolf SCHILDER, engineer in charge of track technology within this department, presented the theme on concrete sleepers. He contributed all necessary data for the investment project of the new sleeper manufacturing programme in Austria.

The sleeper manufacturing plant at Wöllersdorf is owned by a private civil contracting group HOFMAN & MACULAN, whose director for railway activities, Mr. Franz SCHEIBENECKER, welcomed the participants in the factory. He and the production manager, Mr. Heinz LACKNER and his assistant, Mr. Christian HILD, showed the group through the factory. The factory is producing pre-stressed concrete sleepers for standard gauge and turn-outs.

The theme of mechanised track maintenance and renewal was then presented by Mr. Rainer WENTY, Deputy General Manager of the sales branch of PLASSER & THEURER in Vienna. He also hosted the reception given at the PULLMAN BELVEDERE Hotel in honour of the participants, which was attended also by representatives of the Austrian Federal Chancellery, the Austrian Federal Ministry of Foreign Affairs and the Austrian Federal Chamber of Commerce.

UNIDO-ÖVG Workshop, Austria, September 9th-21th, 1991

Programme of the Workshop

September 9th: arrival of participants in Innsbruck, registration

P r o g r a m m e

September 10th-12th: participation on the International ÖVG Permanent Way Convention:
"Optimizing the Railway Track - Systems, Strategies and Costs" in Innsbruck, Austria, see enclosed programme

September 13th: a day to be spent on the theme: "how to prolong the life of rail and fastenings", with Mr. Ulli PETER of MATIX-SAFERAIL, Geneva
training class II of the Austrian Federal Railways (ÖBB) in the main railway station of Innsbruck

1. material and machines

08.30 causes and definitions of wear and tear of rail material
rail profile deformations, rail flaws, small P.W. material wear

09.00 material inspection in track
rail wear measures, flaw detection (ultra-sonic), visual inspections

09.30 preventive actions in track
burr removal, fastening adjustment or exchanges

09.45 coffee break

10.15 stationary corrective action
classification of incoming material, rail regeneration operations, small P.W. material recycling

2. Economics

11.45 plant requirements
to be quantified depending on networks (questionnaire/
group work)

12.30 Lunch

13.30 Presentation and discussion of group work

14.15 proposals of machines with cost. Establishment of sample plant (group work)

14.45 Installation and running costs of sample plant

Coffee break

16.00 Comparison of costs of regenerated material
calculation of profitability ("return on investment")
discussion

September 14th: presentation and discussion of the individual country papers

09.00 presentation of the country papers by the participants of the workshop

11.00 discussion of the objectives of the workshop

12.00 Lunch

afternoon: transfer to Vienna by train

September 15th: free Sunday, sightseeing in the city of Vienna and the surroundings

September 16th: day with VOEST ALPINE Eisenbahntechnik, dedicated to the turnout technique, under the guidance of Mr. Reimar HOLZINGER, railway engineer ÖBB ret.

07.28 departure by train from the South Railway Station
paper presented by Mr. HOLZINGER in the train on some specific aspects of turnout manufacturing and maintenance

10.06 arrival at Zeltweg, transfer to the plant

10.30 welcome at the plant, presentation of the company, visit of the workshops of turnout manufacturing

12.00 Lunch in the factory

13.30 papers and discussions on the subjects:
design and technique of modern turnout manufacturing, with the aim of prolonging the life and reducing maintenance costs of turnouts
types of turnouts for high performances in speed and axle loads

16.00 departure from the plant by car, transfer to St.Pölten passing by the touristic region of Mariazell, Dinner on the way to St.Pölten

22.30 visit of a mechanised track maintenance site: ballast cleaning, ballasting and final surfacing using a mechanised maintenance train between Eggenburg and Sigmundsherberg

September 17th: "Rail welding day" with ÖBB, the company PLASSER & THEURER and ROBEL

08.00 departure from St.Pölten to Wörth

08.30 welcome at the track construction unit of ÖBB "Werke Wörth"

08.45 Mr. Erich BODEN, welding engineer of ÖBB:
The track and the joints: short and long rails, continuous welded rails - track stability taking into account narrow gauge
types of rails and categories of track, joint treatment, fastenings, tightening

09.45 Coffee break

10.00 Mr. BODEN: rail welding techniques -
evaluation of methods taking into account quality and economic criteria, welding of rail ends and building up by welding

11.00 Mr. Rudolf BECKER, PLASSER & THEURER: the mobile flash butt welding machine K 355 APT, treatment of joints with the system "STRAIT", the half-mobile welding depot in Botswana (a project case-study)

12.15 Lunch in the canteen of ÖBB Central Training School

13.45 visit of the stationary flash butt welding machine in the plant, demonstration of the various welding processes by Mr. BODEN

16.00 Coffee break

16.30 transportation of long rails on rail: problems and their solution, paper and video presented by the company ROBEL, Munich

17.30 Dinner in the Central School

19.00 return to St.Pölten

September 18th: morning: "Refurbishing permanent way material the practice of ÖBB"

08.00 departure from St.Pölten to Wörth

08.30 M. Johann RATHEISER, Head of Dept. of the ÖBB refurbishing plant for permanent way material at Wörth: refurbishing of rails, fastenings and turnouts, processes in operation within ÖBB

10.00 Coffee break

10.30 visit of the workshops of the Wörth plant, guided by Mr. RATHEISER

12.15 Lunch in the Central School

noon: visit of the manufacturing plant of PLASSER & THEURER in Linz

12.45 departure from Wörth to St.Pölten railway station, departure 13.21, arrival Linz 14.32

15.00 welcome at the manufacturing plant of PLASSER & THEURER, presentation of the company and visit of the workshops

17.30 buffet at Restaurant Landhof

20 h return to Vienna by train

September 19th: morning: manufacturing and maintenance of concrete sleepers

08.15 welcome at the General Direction of ÖBB, meeting room,

08.30 Mr. Rudolf SCHILDER, engineer ÖBB: new types of monobloc concrete sleepers, the experience of ÖBB

09.30 departure by car to Wöllersdorf, South of Vienna

10.00 visit of the manufacturing plant MABA, a line which was put into service in 1990, guided by production manager Mr. LACKNER

11.30 departure to the refurbishing plant for timber sleepers at Steinabrückl of the company G.RÜTGERS

13.00 return to Vienna, Lunch on the way

noon: "Maintenance and renewal of the railway track using modern mechanised systems"

15.00 - 17.00 meeting room ÖBB, M.Rainer WENTY, Deputy General Director of PLASSER & THEURER: mechanised systems used for track work, presentation, evaluation and discussion

19.30 Official cocktail offered by ÖVG for the participants of the workshop, UNIDO, the Austrian Federal Ministries,

the Federal Chancellery, the Federal Chamber of Commerce,
ÖBB and the firms

September 20th, morning: continuation on specific fields of
mechanised track work

08.30 ÖBB meeting room, Mr. Alois RASTL, PLASSER & THEURER:
conditions for mechanizing track work, the fields
concerned by the user technology, e.g. maintenance of
machines

10.00 Coffee break

10.15 reports given on experience gained in mechanising track
in the developing world

12.00 Lunch in the General Direction

14.00 minutes of the results achieved in the workshop,
reports, propositions et recommendations

16.30 closing session with ÖVG, Mr. Roman JAWORSKI, former
Director General of ÖBB

September 21st: departures

Monday, 9th September 1991

Congress House Innsbruck, Convention Office

4 00 - 6.00 p.m.

Registration and distribution of participants' tickets and documentation

Tuesday, 10th September 1991

Congress House Innsbruck, Hall "Tirof"

8 00 a.m. Registration and Distribution of Participants' Tickets and Documentation in the Convention Office

9 00 a.m. Opening of the Convention and Welcoming Speech by the Chairman Hon. Prof. Hofrat Dipl.-Ing. Dr.-techn. Roman Jaworski Director General of the Austrian Federal Railways (ret.), Vienna University of Technology

Welcoming speeches

9 30 a.m. TGV - Ten Years in Service Mr. Michel Walrave Secretary General of U.I.C., Paris

10 00 a.m. Fast Rail Traffic in Spain:
- The Connection Barcelona - France Prof. Dr.-Ing. A. Lopez Pita Polytechnical University of Catalunya, Barcelona
- The High Speed Line Madrid-Sevilla Manuel Pérez-Beato de Coe Director de Construcción de Alta Velocidad Española RENFE, Madrid

Coffee break 10.45 - 11.15 a.m.

11 15 a.m. The Future of Passenger Traffic in the USA Mr. Dennis F. Sullivan Executive Vice President, AMTRAK, Washington DC

11.45 a.m. High Capacity Turnouts - geometrical design, construction, laying methods, maintenance Hofrat Dipl.-Ing. Erwin Klotzinger BB-Direktionsrat (ret.), ÖVG, Vienna

12 15 p.m. Discussion

12 45 p.m. Lunch break

2 30 p.m. Computer-assisted Planning of Civil Engineering Work and Train Operation Prof. Dr.-Ing. Rolf Kracke, Hanover University of Technology, Institute for Railway Engineering Dipl.-Ing. Dragomir Jovanović ŽG - Prometni Institute, Ljubljana

3.15 p.m. The Permanent Way in the Cost Calculation Mag. Rudolf Wotruba Austrian Federal Railways Section for Applied Economics, Vienna Dipl.-Ing. Peter Velt Graz University of Technology Institute for Railway Engineering, Graz

3 45 p.m. Discussion Discussion chaired by:
o Univ.-Prof. Dr.-Ing. Ench Kopp Head of the Institute for Railway Engineering Innsbruck University

Wednesday, 11th September 1991

Congress House Innsbruck, Hall "Tirof"

9 00 a.m. Interactive Parameters of Permanent Way Maintenance - Approach to New Strategies on DB Prof. Dr.-Ing. Lothar Fendrich German Federal Railway Central Office - Headquarters, Frankfurt/Main

9 30 a.m. Rail 21 in the Netherlands Ir. N. A. Koom Directeur Groep Bedrijven Infra N.V. Nederlandse Spoorwegen, Utrecht

Coffee break 10.00 - 10.30 a.m.

10.30 a.m. Integration of Maintenance Requirements into Civil Engineering and Operational Planning Dipl.-Ing. Heinz Pfarrer Section Head Permanent Way Maintenance Dept., SBB, Bern

11 00 a.m. Discussion Discussion chaired by:
o Univ.-Prof. Dipl.-Ing. Dr.-techn. Klaus Rieseberger Head of the Institute for Railway Engineering Graz University of Technology

11 30 a.m. Introductory Talk to the Technical Excursion

12 noon Lunch break

2 00 p.m. Technical Excursion to visit the Innsbruck loop line and to see track maintenance machines that are used on Austrian Federal Railways

Thursday, 12th September 1991

Congress House Innsbruck, Hall "Tirof"

9.30 a.m. Objectives and Methods of a State Administration of the Railway Infrastructure Managing Director Jan Brandborn BANVERKET, Borlänge

10.00 a.m. Strategies to Improve the Track Structure of a High Density Railway Y. P. Anand Member Engineering, Ministry of Railways Railway Board, New Delhi

Coffee break 10.30 - 11.00 a.m.

11.00 a.m. Problems of Track Maintenance with Heavy Freight Movement and High Tonnage Lines Earl J. Currie Vice President Engineering CSX Transportation Inc., Jacksonville, FL C. Lynn Jensen Chief Engineer Union Pacific Railroad, Omaha, NE

11.45 a.m. Costs and Successes of Permanent Way Mechanisation in Thailand Prachoom Annavadhana Former Member of Railway Board SRT Project Consultant ESCAP since 1968, Bangkok

12.15 p.m. Discussion Discussion chaired by:
o Univ.-Prof. Dipl.-Ing. Dr.-techn. Edwin Engel Head of the Institute for Railway Engineering Vienna University of Technology

1.00 p.m. Closing words and End of Convention

Convention languages: German, English, French Summaries of the talks will be available to participants before the talks are held

Participant's Fee: A.Sh. 2,100.— to be paid in the Convention Office when the participant's ticket is issued. The participant's fee is free of V.A.T.

The Convention Badge (name card) will be handed out together with the participant's ticket; please wear this badge visibly, it entitles you to take part in all the events

We reserve the right to make programme alterations Closing date for registration 09.08 1991

INTERNATIONAL CONVENTIONS, SEMINARS ON RAILWAY TRANSPORTATION
REFERENCES

Date	Place	Subject	Participants
October 1991	Vienna, A	Railway Round Table with the World Bank 1) Role of railways in the future 2) Role of the governments and the regulatory framework 3) Financing of requirements for growth and modernization 4) Requirement for staff	South/Southeast Asia
September 1991	Innsbruck, A	"Optimising the railway track: systems, strategies, costs"	international
September 1991	Innsbruck } Vienna } A St. Pölten }	Workshop with UNIDO "Maintenance and manufacture of permanent way materials"	11 African, 3 Asian 3 Latin American countries
February 1991	Czechoslovakia	"Modern track management"	CS
May 1990	Vienna, A	Railway Round Table with the World Bank 1) The shape and role of railways in the future 2) Role of the governments and the regulatory framework 3) Government subsidies 4) Man power planning and management	Near East, North Africa
March 1990	Oslo, N	"Efficient maintenance of track and catenary with special emphasis on the problems of single track lines with heavy traffic"	NSB, N
November 1989	Schladming, A	"Track maintenance on high speed lines"	PKP, PL
September 1989	near Vienna, A	"Construction of overhead contact system"	BDZ, Bulgaria OSE, Greece
June 1989	Bad Ischl, A	"Management of track work"	DR, GDR
April 1989	Borlänge, S	"Track maintenance on high speed lines"	Bankverket, S
April 1989	Vienna, A	Railway Round Table with the World Bank same subjects as above (May 90)	H, PL, P, TR, Yu
March 1989	Madrid, E	"Track maintenance on high speed lines"	RENFE, E
September 1988	Villach, A	"Traffic loads and track quality of modern RWs"	international

March 1988	Frankfurt/M, D	"Permanent way, the base of the new railway"	DB, D
June 1987	Vienna, A	"The modern railway of high performance and its railtrack"	ÖBB, A
June 1987	Rust, A	"Modern management of track work"	CSD, CS; DR, GDR
December 1986	Gloggnitz, A	"Mechnized track maintenance in urban rail transport	DSB, DK and SJ, S
Oktober 1986	Baden, A	"Latest systems of track maintenance"	MAV, H
September 1986	Feldkirch, A	"The roadway of high performance trains"	international
March 1986	Budapest, H	"Economic track maintenance in small urban railway systems"	urban transport
December 1985	Lackenhof, A	"Modern management of track maintenance"	FS, I
November 1985	Beijing, PRCh	"Track design and maintenance in the future"	PRCh
September 1985	Lackenhof, A	"Modern management of track maintenance"	PKP, PL
September 1984	Baden, A	"Economic aspects of permanent way"	international
September 1982	Badgastein, A	"Renewal techniques of the railways"	international
September 1980	Badgastein, A	"Progress in Railway Track"	international

Advanced Concepts and Technologies for Turnouts to Increase Life Time and Reduce Maintenance

(Summary of Presentation by Dr. Adelsberger in Zeltweg, Sept. 16, 1991)

Criteria: Wear

Loss of stability of geometrical position

Causes: FORCES (Dynamic Forces, Impacts, Jerks)
Properties and Behaviour of Superstructure Materials

Measures: 1) Reducing dynamic forces
2) Increasing wear resistance
3) Increasing stability of geometrical position

- 1 a) Avoiding discontinuities of alignment by tangential transition into branch line
- 1 b) Reducing discontinuities of curvature by application of transition curves (clothoids etc.)
- 1 c) Eliminating gaps by continuous welded track incl. tongues
- 1 d) Optimising transition geometry at frog gap or eliminating it by application of frogs with movable parts
- 1 e) Uniforming elasticity of rail fastenings
(Inner Stock Rail Fastening IBAV)

- 2 a) Using materials with corresponding wear resistance
(S 900 A, HSH, Mn 13 without/with prehardening, VARIO)
- 2 b) Improved guard rail and guard rail fastening design.

- 3) Using heavy concrete sleepers