

# **HISTORY OF SUSTAINABLE WINTER ROAD MAINTENANCE SERVICE IN LATVIA 1919 – 2008**

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## **SUMMARY**

As an independent country Latvia exists for 90 years. Regardless of different historical circumstances in its existence and development, the state has maintained and constructed its roads. Together with changes in needs and requirements of the society, road network has expanded and improved in these years. Comparing to the beginning of the 20<sup>th</sup> century its total length has increased almost 30 times.

Methods, currently used in winter maintenance, substantially differ from the ones applied in the beginning of the 20<sup>th</sup> century. If initially passive road protection from windrows of snow was used to ensure horse cart traffic, then today this method is fully replaced by active winter maintenance service with high-power trucks and new technologies since road users drive powerful motor vehicles.

During the last 20 years the development of information system also took a giant leap. It substantially improves the communication between road users and maintenance service, as well as, provides new possibilities for the optimisation of winter road maintenance.

Development and operation of winter road maintenance service in Latvia has been defined by geographical location of the state, climatic and historical conditions. In spite of different obstacles and historical difficulties, today Latvia has winter road maintenance service developed up to the European standards.

## **KEYWORDS**

HISTORY / DEVELOPMENT / PASSIVE SERVICE / ACTIVE SERVICE / INFORMATION

## **1. INTRODUCTION**

Latvia was established on November 18, 1918, as an independent country in the Northeast part of Europe. The new country took over part of the existing road network and a special institution for its management and maintenance was necessary. Therefore on August 1, 1919, the Board of Highways and Unpaved Roads was established. This date is considered as the beginning of united road service of Latvia. At first the state took over 703 km of roads and cobble stone pavements.

Initially, winter road maintenance was performed with passive methods – by planting hedges along the road and placing fences; but later, when motor vehicles took bigger place in traffic, these methods could not ensure the passability of roads in winter. Therefore roads were cleared mechanically with different graders and machines. Development of active winter road maintenance service had started.

20 180 km of roads were subject to state winter road maintenance in 2008. Possibilities and needs of road users have changed. For roads to provide traffic flow also in winter, methods

and equipment for winter maintenance have been completely changed. Passive road service is replaced with active service, low-speed snow clearing devices are replaced with more efficient and high-powered mechanisms. Progress, which took place in Latvian winter road maintenance in 90ties, is evident. It may not be isolated from the changes in living conditions of the society and increased life pace.

## **2. BASIC INFORMATION ABOUT LATVIA AND ITS ROAD MANAGEMENT**

### **2.1. General characteristics of Latvia**

Latvia (officially the Republic of Latvia) is a country in Northern Europe, one of three Baltic States. [Figure 1] Latvia is located on the Eastern coast of the Baltic Sea. The state territory covers 64 589 km<sup>2</sup>. Latvian territory is in temperate zone and its climate is influenced by the proximity of the sea and air masses from the Atlantic Ocean, therefore Latvian climate is mild and humid, succession of the seasons is explicit [16]. Fluctuations of average temperatures are not great. The average temperature of the coldest month – January – is -3°C. Winter usually lasts from the second half of November until the end of March. Steady layer of snow stands from the middle of December until the middle of March. [20] In the west it lasts approximately 80-90 days, in the east – 100-120 days. Due to many thaws snow layer is not thick, usually 30-50 cm and 15 – 20 cm in the seashore. In years with many rainfalls and cold winters its thickness can reach 1 m but in warm winter layer of snow is unsteady [7]. Population according to data of 2008 amounts up to– 2276000 [18].

### **2.2. Characteristics of Latvian road management**

69688.269 km of roads and streets were listed in 2008 in Latvia, 20180 km of which constitute the total length of the state road network. Average road density is 1.08 km per 1 km<sup>2</sup>. Roads in Latvia are divided in 5 maintenance classes. Total number of vehicles in 2008 was 1168756 [20].

Today Latvia has a developed road network and transport but it was not like this 90 years ago when roads in the territory of Latvia were handed over to the state.

## **3. BEGINNING OF WINTER ROAD SERVICE IN LATVIA 1919 – 1940**

### **3.1. Characteristics of road management**

In 1918 independent Latvia was established. In 1919 after the foundation of the Board of Highways and Unpaved Roads 703 km of strengthened roads – highways and cobble stone pavements were handed over to it [2].

The number of vehicles was quite small – less than 100 motor vehicles in the whole country and mostly they were used for army needs and civil service. Only six vehicles were for private needs. Roads were mainly used by horse carts. Thus in 1919 there were 261000 horses (1 per every 8 inhabitants), they were used both in farmstead, and as means of transport [11]. These numbers describe transport that was using Latvian roads in the beginning of the 20<sup>th</sup> century.

### **3.2. Beginning of passive winter road maintenance service**

In the end of the 19<sup>th</sup> century, at dawn of mechanical vehicles, it would be too early to speak about motor vehicles in Latvia. If there is no motor transport, there is no need for suitable roads, therefore winter road maintenance was not necessary in the meaning as we understand it today.

However, already in this period there was greenery for holding back snow, which was widely used here in the middle of the 20<sup>th</sup> century. Initially, in 1860-ties, shrubs were planted along railways when frequent snowstorms of our climatic zone used to interrupt train schedule. Later these snow barriers – two-line fir hedges – were used for access roads to railroads where the main vehicle was horse cart. Snow barriers were set not only for preventing windrows of snow, but also for formation of thicker layer of snow on road what was necessary for sledge transport [14].

In the beginning of the 20<sup>th</sup> century traffic intensity on roads was insignificant but road maintenance was necessary in winter, too. It was performed by the newly established Board of Highways and Unpaved Roads. Therefore the year 1919 may be considered as the beginning of the winter road maintenance service of the Republic of Latvia [1].

A little later – in 1930-ties – more motor vehicles were added to horse cart transport. In 1930 there were thirty times more cars in the country than in 1919. 90 regular bus lines were developed and they had to ensure that people would reach their destination in winter, too [11]. Therefore in addition to fir hedges, still not common, lath shields – 2x2 m large shields made of wooden laths - were introduced [Figure 5]. Both fir hedges and lath shields were passive winter road maintenance service and they only protected the road from windrows of snow [14].

### **3.3. Beginning of active winter road maintenance service**

In 1930-ties active winter road maintenance service started to emerge in winter road maintenance because roads had to be cleared from windrows of snow and slippery places had to be spread frequently. In this period road workers cleared roads with horse driven triangular wooden plough drags. The Board received first tractors with snow ploughs only in 1938 but highly snowbound sections still had to be cleared manually. Regular spreading with anti-skid materials was not yet applied. In cases of vehicle skidding chains were put on tires, but drivers often used ashes or sand from bags taken along with them or sand that was provided in stacks on road shoulders in steep slopes [14].

In 1938 Board of Highways and Unpaved Roads had 130 finishers and graders, as well as, 34 snow ploughs per 10041 vehicles in the country [11].

Information exchange was limited in the first half of the 20<sup>th</sup> century. Weather forecast was broadcasted through radio. Information exchange between road organisations consisted only through telephone calls. Better communication was mostly between telephone exchanges of state administrative centres, in road units it was very poor [6].

## **4. WINTER ROAD MAINTENANCE IN LATVIA 1945 – 1990**

### **4.1. Political and economical situation in Latvia**

In August 23, 1939, Germany and the Soviet Union signed non-aggression pact, called the [Molotov-Ribbentrop pact](#). It contained a secret protocol according to which Latvia was occupied by the Soviet Union. It happened on June 17, 1940, when the Latvian government lost its legal capacity but the country was controlled by the embassy, army and special troops of the Soviet Union in Riga. Latvia ended its existence as an independent country. A little later, on June 22, 1941, World War II started in the territory of Latvia, which caused heavy losses to inhabitants and destruction to state economy, including roads [8].

#### **4.2. Road maintenance conditions in the Soviet Union period**

After surrender of Germany on May 9, 1945, the territory of Latvia was controlled by the USSR. In all aspects of life the Communist Party of Latvia played the main role but even its self-dependence was limited since all actions and decisions had to be coordinated with functionaries of the Central Committee of the Communist Party of the USSR [8].

As a result of military operations Latvian road infrastructure was completely destroyed, in many places only sites of roads remained, therefore more than five years passed until Latvian roads regained their pre-war level. All instructions and decisions related to road construction and maintenance in the territory of Latvia were adopted centrally in the USSR State Planning Committee in Moscow. Every year special norms were set for road works, transport and equipment for road units, as well as, other materials necessary for the industry. However, with these norms it was impossible to meet the requirements of winter road maintenance service. It is characteristic of this time period that information about roads and bridges in the state territory was confidential. Specific facts illustrated with numbers are hard to find in public literature [1].

In 1960-ties total length of roads, subject to winter road maintenance service, was approximately 13500 km. It was maintained by 26 road units under centralised management. Economy and subsequently motor transport developed rapidly. Still both passive and active winter road maintenance service was used [14].

#### **4.3. Passive winter road maintenance service**

Planting of fir hedges continued in increasing amounts but, since they grew slowly, other plants were used for this purpose – willows and different shrubs. However, these hedges were not sufficient to prevent windrows of snow therefore snow fences were installed frequently. Passive service required a lot of manual labour, it was not mechanized enough. Hedges had to be trimmed regularly, snow fences made, installed in the beginning of winter and removed in the end. They served not more than five years when they had to be made anew [5]. Figure 3 shows the number of protective hedges and snow fences, as well as the total length of protected roads. As it may be seen, in the middle of 1970ties there were approximately 1500 km of hedges on Latvian roads. Together with snow fences, snow barriers shielded almost 3000 km of roads from windrows of snow.

Hedges along the road played a big role in environmental protection. Big amount of emissions were typical for soviet machinery but fuel contained lead which harmed the environment. Studies performed in 1970ties proved that fir hedges held up almost 60 % of lead and other hazardous substances that were spread with exhaust gases in 60 m wide zone by the road [13].

The importance of passive winter road maintenance service started to decrease in the beginning of 1980-ties. In 1986 there were 939 km of hedges and 235000 snow fences for

the protection of roads from windrows of snow [2] that in total protected approximately 1000 km of roads. Evidently in 10 years total length of roads, maintained with passive winter road maintenance service, had decreased by 2/3. Liquidation of hedges along the roads started. Part of the greenery had to be dug out by road workers themselves when doing road reconstruction but the greatest part was removed by soviet collective farms which wanted to expand their farmland [15].

#### **4.4. Active winter road maintenance service**

With the decrease of passive winter road maintenance service, active service developed increasingly. Right after the war all kinds of snow clearing devices, available in the country that was destroyed by war, were used – horse driven drags, hooked and automatic graders and different tractor ploughs. Deep snowdrifts still had to be removed with hand shovels. It was also mandatory to spread the black spots with anti-skid materials – sand or mix of gravel and sand. At first spreading was performed with shovels from horse cart or truck but in the sixties road workers invented and implemented disc spreaders and hooked spreaders. In steep slopes piles of sand were placed and covered with conifer branches for road workers and road users to use [1].

Already in the middle of 1960-ties new method was implemented for maintenance of bituminous pavement – to clear away snow up to the surface and not allow the formation of ice. It gave a possibility to increase road capacity and improve traffic safety. To achieve this, salt was used in spreading – NaCl was mixed in the sand (up to 10 %) – and therefore snow melted. There were still not enough loaders and the necessity to load spreaders urgently usually arose at nights therefore shelters for spreading material were constructed near roads, in steep slopes and entrenchments and they were filled during the day [Figure 4]. From the shelters the driver loaded ready material in the truck. When the amount of spreading increased, there were not enough shelters, therefore spreading material was kept in open stacks and salt and gravel was mixed in advance with bulldozers. Work was more mechanized, too, since excavators and other loading machinery loaded the spreading material in spreaders [3].

In 1970-ties road units abandoned the method, widely practised before, when graders had to start road clearing only after snow had stopped falling and snowstorm had ended. When practising the old method, roads were often snowbound, thick layer of snow had formed on road surface, which was compacted by traffic, turned into ice and was not possible to be cleared away. Apart from widely used tractors K-700 and T-150, manufactured in the Soviet Union, road workers started to use combined road work vehicles (KDM-130) equipped with snow plough, container for spreading material and spreading device [Figure 7]. These machines started their work as soon as snow began to fall and cleared it with specially designed brooms. If snowfall was too heavy and layer of snow was too thick, road was cleared with graders first and then with the machines mentioned above. People often worked for 15 – 20 hours without any break. If snow fell for a long time, drivers necessarily got tired. In spite of persistent work cleared sections were quite short. One machine could clear only 8 – 12 km of road. Every day specialized brooms had to be changed but there was a lack of material necessary for manufacturing. After clearing the road had to be spread, but frequently after half an hour spreading material was covered with snow. Work had to be done all over again. These conditions forced to think of new technologies [10].

Therefore in the beginning of 1970-ties, when snow began to fall, road workers started preventive spreading on bituminous roads. It was performed in any time of the day to prevent compacting of snow by traffic and icing. Fine gravel and sand mixture with salt was used for

spreading. 0.5 – 0.7 m<sup>3</sup> of this spreading material was used per 1 km. Because of the salt slush developed on road and it did not freeze to the surface. Usually spreading material was made in summer [9].

Regardless of the fact that work was more mechanized [Figure 6], the efficiency of labour was quite small but fuel consumption was considerable. There was also a lack of machinery for winter maintenance, therefore, when concluding contracts, the machinery of construction, land amelioration and agricultural organizations was used. It was very useful when roads were snowbound. Proportion of this machinery was 30 % of all equipment used for road clearing and spreading in the season. Road workers themselves contributed a lot in road spreading since based on their ideas and suggestions more than hundred hooked spreaders suitable for different trucks were made thereby improving work quality and speed of performance [3].

#### **4.5. Information broadcasting**

To organize winter maintenance works better, it was important to receive complete and reliable information on road conditions, therefore in 1972 regular information broadcasting was launched on radio about weather conditions on main roads of the republic. It improved the functioning of winter road maintenance service, as well as, traffic of buses and road transport. Special patrol service was established and with its help persons on duty gathered information on machines and work in road units. Their work continued for 24 hours. Persons on duty received information on conditions of particular road section from responsible road masters. Radiophones were used for broadcasting [10].

Even though from 1945 to 1990 the number of vehicles in the republic increased many times and new work methods were implemented, this time period in general may be described as very labour-consuming and hardly effective. Although new methods for work improvement were searched, their implementation was difficult because the centralized supply of road units with necessary machinery and transport could not satisfy constantly growing needs of the society.

### **5. WINTER ROAD MAINTENANCE SERVICE IN LATVIA 1991 – 2008**

#### **5.1. Changes in organization of winter road maintenance service**

In 1990 Latvia regained its independence and big changes started to happen in the state economy, as well as, in road management. In this time 20180 km of roads went under the state management. Latvian communication with other European countries started to develop, what was not possible in the USSR, therefore effective foreign technologies were quickly adopted in our country [1].

After regaining the independence, the number of vehicles in Latvia has rapidly increased every year. The biggest growth of number of vehicles has been registered in the last three years when it was 10 % higher comparing with the previous year [17]. It requires other – more efficient – approach to road management. Qualitative break in winter road maintenance was the introduction of fast trucks with large lifting capacity, equipped with snow ploughs and spreading roads with wet salt.

Winter road maintenance levels were defined for organizing winter road maintenance service. Based on traffic intensity and importance, as well as, economical and social significance of

every road, roads were divided into five classes (A; A1; B; C; D). For every class it is defined when and in what level road has to be spread and cleared. [Figure 2] Local roads with no regular bus lines are not marked in the map. They belong to maintenance class D [20].

Today to eliminate ice on state roads the following technologies are applied:

- Spreading of wet salt (temp. above  $-10^{\circ}\text{C}$ ; black ice, white frost, freezing rain, light snowfall);
- Spreading of sand – salt mix, 120 kg of salt per  $1\text{m}^3$  (temp.  $-6^{\circ}\text{C}$  to  $-10^{\circ}\text{C}$ ; heavy snowfall, compacted snow by traffic, expected drop of temperature);
- Spreading of sand (in rapidly changing weather conditions, temp. below  $-10^{\circ}\text{C}$ ). Used mainly for gravel roads;
- Clearing with high-speed trucks equipped with front, side and middle plough, as well as clearing with high-power graders;
- Creasing used for roads of classes C and D [20].

In 1990-ties our country gradually started to replace the equipment, manufactured in the Soviet Union, with more powerful and better equipped machines. Cooperation with Finland, Sweden, the Netherlands and other countries began. Road units purchased Volvo, Sisu and Scania trucks which could clear snow with side ploughs.

Creasing of road ice is practised with high-power trucks and graders and it reduces the sideslip of vehicles on roads with less traffic intensity. Speed and carrying capacity of these trucks have improved works of road spreading and clearing many times [Figure 9]. This way one winter road maintenance truck may ensure satisfactory conditions for driving approximately on 70 km of road [19].

In 1993 spreading of wet salt began in Latvia [20]. This method was adopted from foreign countries, too. Wet salt technology is much more effective than the use of dry salt. In the same time use of sodium chloride requires high work culture because salt may cause a lot of damage to the environment – influence flora near the road, pollute surface and groundwater, activate metal corrosion etc. [12]. In environmental protection Latvian road administration works in compliance with the European standards on nature protection [22]. For various roads environmental impact assessment is performed including measurements of air pollution and noise distribution in zones by the roads [20].

In the last decade the number of snowstorms has noticeably decreased in the territory of Latvia. Worn-out Soviet equipment has been slowly replaced by new, much more powerful machinery. It is also important that winter tires today are mandatory for every vehicle. Due to these factors passive winter road maintenance service has increasingly lost its importance. In 2008 there are still approximately 600 km of snow barriers in our country but they all have remained as a living evidence of earlier methods of winter road maintenance and are not maintained anymore [Figure 8] [20].

With the financing from the European funds, our state roads are being reconstructed and improved, therefore places, where the road and hedges along it have kept their initial appearance, are very rare.

## **5.2. Information system development**

During these years our country has adopted foreign experience not only in road management and construction, but also in developing information system.

In 1996 Latvia started to implement Road Weather Information System. In the first year 6 weather stations, procured in Finland, were installed [2]. In 1998 there were 30 of them, all connected in one system. In 2005 Traffic Information Centre was established and today it provides continuous and reliable information on weather and driving conditions in the state road network to road users and maintenance divisions. In the end of 2008 there are 48 weather stations in our country. Since 2006 Traffic Information Centre has developed into twenty-four hours informative service for road users ensuring uninterrupted surveillance of traffic conditions, attendance of informative telephone line and publicity of traffic information [20].

In winter road maintenance service contractor has to ensure automatic work tracking system, as well as, possibility to follow up the movement of winter road maintenance vehicles online with the help of GPS satellite signal. Trucks and spreaders are equipped accordingly to ensure complete registration, archiving and storage of data, therefore enabling control and integrated analysis of performed works on roads of maintenance classes A and A1 [19].

During the last 18 years significant changes have happened in both development of our country in general, and in methods and technologies of winter road maintenance. Soviet time machinery has been completely replaced by more efficient and powerful equipment. International cooperation and possibility to adopt and adjust methods and processes necessary for winter road maintenance in our country played an important role in this matter. Development of joint information system allows both road administrators and road users to ensure favourable driving conditions in winter more easily.

## **6. Conclusion**

Since 1919, when Latvian roads went under the state management, road sector has become an industry without which the economic existence may not be imagined. Horse carts are replaced by motor vehicles, snow clearing with hand shovels is replaced by high-powered machinery with much more higher efficiency. Simple telecommunication devices, problematic in use, are replaced by global information system available to everyone.

Development of winter road maintenance in Latvia is directed to stimulate the efficiency of winter road maintenance, save available resources, make this sector more environment friendly, as well as, to meet the society needs for travelling and freight transport in winter months. Winter road maintenance service continues to develop and improve its work methods to meet the requirements of road users better and provide their security on roads.





Figure 1 – Map of Latvia

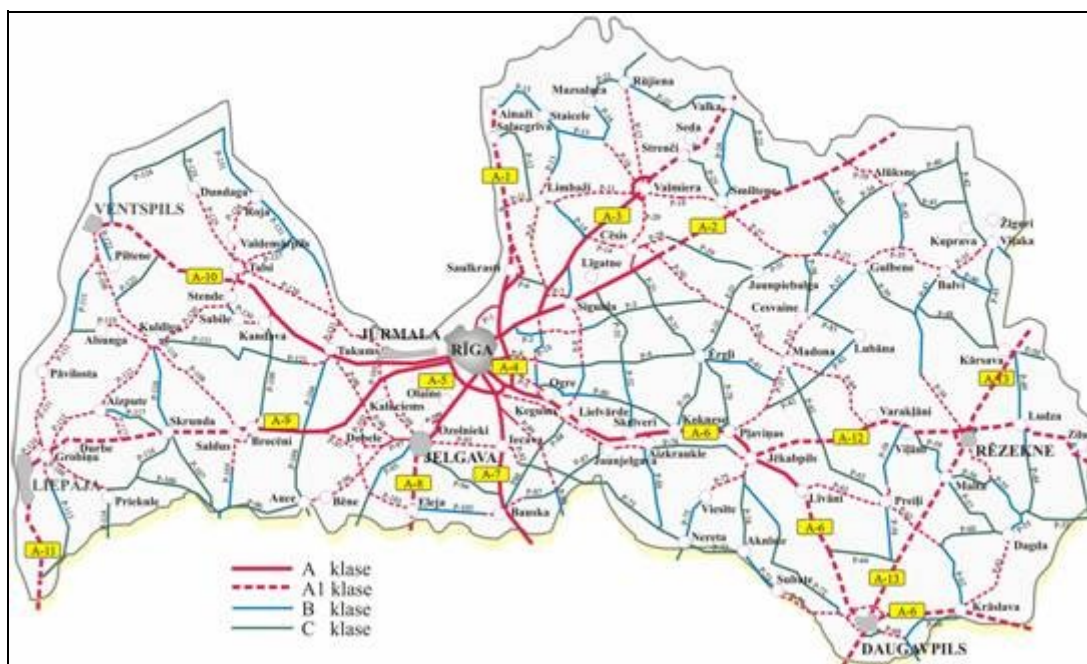


Figure 2 - Winter road maintenance classes in the Latvian road network

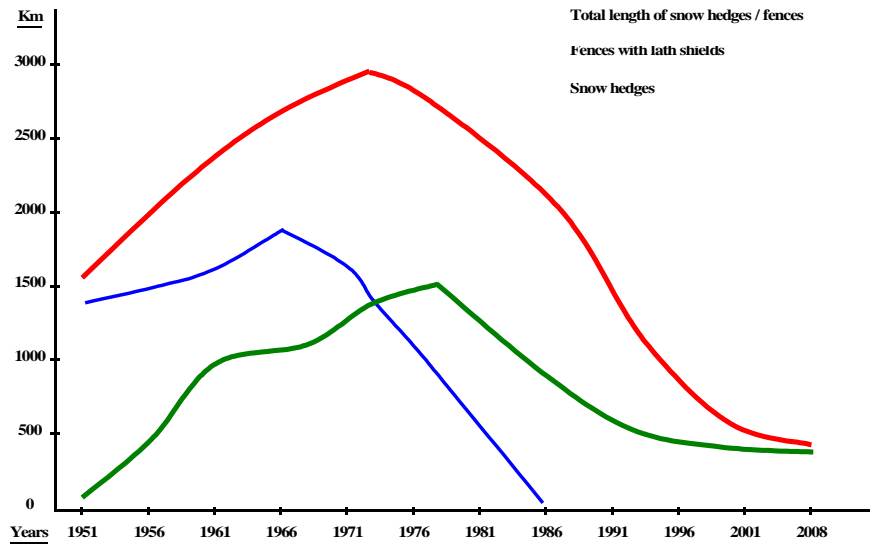


Figure 3 - Passive winter road maintenance service in Latvia



Figure 4 - Shelter for spreading material, 1960ties



Figure 5 - Renovation of snow fences along the road



Figure 6 - Soviet machinery at work



Figure 8 - Fir hedges in 2008



Figure 7 - Truck KDM-130



Figure 9 - Snow clearing machinery nowadays

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