

# Sixty Years of Highways Maintenance

Many aspects of highway maintenance have been transformed over the last sixty years. This has been driven by the development of computerised highway asset management systems, the development of analytical methods of assessing road surface condition, the development of new materials, changes in public sector procurement to bring in the private sector and improved integration with other transport policy areas.

Highway maintenance has embraced these changes but the decisions made by the highway engineer are still at its heart and perhaps this has not changed at all. Roads remain one of the most important physical assets for which public authorities are responsible. Effective maintenance and management is crucially important to both users and the community at large and its safe and efficient operation provides vital support to the national and local economies.



## What is Highways Maintenance?

The term highway maintenance covers a wide range of different general activities which can be grouped together as follows:

- **Reactive Maintenance** includes responding to inspections, complaints or emergencies eg filling potholes, clearing and making safe damage resulting from traffic accidents
- **Routine Maintenance** includes surface patching work, cyclic activities such as grass cutting, weed spraying, gully cleaning, road sweeping and maintenance of planted areas and trees within the highway
- **Programmed Maintenance** is normally carried out to a planned schedule and includes surface dressing, resurfacing, strengthening or reconstruction of roads or footways. It also includes kerbing and road drainage improvement
- **Winter Services** which seek to keep the network functioning safely by salting and clearance of ice and snow
- **Emergency Response** to weather and other emergencies affecting the highway network
- **Regulating and Inspecting** the activities of others within the road network

## **What are the Changes?**

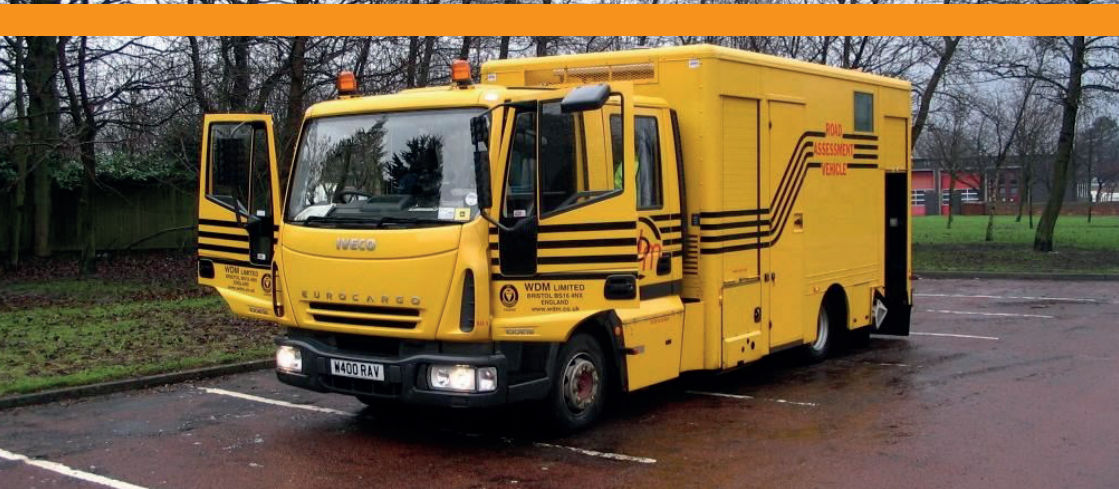
The last twenty five years in particular has seen many changes in how highway maintenance is carried out. They are largely as a result of the development of sophisticated road condition assessment and information management systems, new developments in road surfacing materials, new ways in which highway maintenance is procured, improved integration with other aspects of transportation and improvements in winter maintenance techniques.

## **Road Condition Assessment and Information Management Systems**

An essential part of deciding where and when road maintenance can best be undertaken is a reliable way of assessing the condition and strength of the road surface. Only by doing this can the highway engineer determine road maintenance programmes which make most effective use of the restricted resources available, choose the right maintenance technique and reliably prioritise the different locations requiring treatment.

In 1952 the assessment of road condition, the determination of priorities and maintenance solutions was largely subjective drawing heavily on the individual highway engineer's experience.

However since the late 1970s there has been continuing development of computerised analytical methods of measuring road condition and determining priorities and treatments. One of the aims was to provide improved road surface condition data across the road network on which the highway engineer could base his decisions.



An early such method was CHART (Computerised Highway Assessment of Ratings and Treatments). This used a visual survey carried out by surveyors walking along the road measuring visual defects and recording them in a standardised way. It became a requirement for the trunk road network and it was adopted by most highway authorities for the A class roads.

The Deflectograph survey was developed for measuring the strength the structure of the road surface and, based on this, a methodology for estimating how many years the road would last until failure occurred. This type of survey was carried out by a large (and expensive) survey vehicle travelling at walking pace along the road. Its use became a requirement on the trunk road network in the early 1980s but due to their high cost, there were only a very small number of vehicles in operation in the country. One however was operated by the Highways Laboratory at Durham County Council.

The above survey techniques provided valuable information on which the highway maintenance engineer could base his judgements. However they were slow to carry out and usually required lane closures or stop/go traffic control to protect survey operatives. As traffic volumes grew, this caused increasing delays to traffic.

Consequently there were pressures to develop automated machine surveys which could assess the road surface condition at normal traffic speeds. After much development work, this type of survey first became available around 2000 and was known as **SCANNER** (Surface Condition Assessment of the **N**ational **N**etwork of **R**oads).

Another vehicle based survey **SCRIM** (Sideway-force Coefficient Investigation Machine) is carried out at near normal traffic speeds and this measures the wet skid resistance of the road surface. This helps to lower accident rates by identifying locations where there is a risk of skidding on wet roads. Ground penetrating radar is also now available to show the thickness of construction layers of road along whole sections, which can supplement the taking of cores samples.

Over the last twenty five years the development of information management systems has transformed the way in which highway maintenance is managed. They have enabled large quantities of data on road condition to be stored, together with data on what is in and on the whole road network (e.g. numbers and location of road signs, number of gullies). The combination of detailed inventory information and pavement condition data has enabled comprehensive asset management systems to be developed. Ready access to and analysis of this data has greatly enhanced the planning of maintenance work and helped in demonstrating the level of funding needed to keep the road network in an acceptable condition.

Utility companies have the statutory right to install and maintain their apparatus in the highway and this needs careful management by every highway authority as it has maintenance implications. Comprehensive management systems have been developed to ensure that these works are undertaken safely and traffic disruption is minimised. Trenching and reinstatement of the highway also results in surface, structural and environmental damage which affects pavement condition by reducing



the life of the carriageways and footways and creating increasingly patchy surfaces.

## Developments in Road Surfacing Materials

The choice of what materials to use in the road surface is largely influenced by the type of road, the volume and speed of traffic and the particular site location. This choice will determine how the road surface stands up to the loading and constant wear and tear imposed on it by the traffic.

Traffic growth over the last sixty years and increases in the size of heavy goods vehicles have placed the road surface and underlying construction layers under increasing stress. To meet this, the road surfacing industry has carried out extensive research and development and now many new proprietary products are available. Generally these newer options have binders which have been modified by the addition of polymers to give enhanced performance properties.



Traditional road surfacing materials (hot rolled asphalt and bitumen macadam) have been supplemented by a whole range of new options. These include stone mastic asphalts / thin surfacings and slurry / micro surfacings, give the highway engineer a wider range of surfacing materials to choose the most cost effective maintenance solution. A Glossary of road surfacing types is given at the end of this article.

Traditional surface dressing techniques, which have been around for over 100 years, have also seen development. Improvements such as polymer modified binders and the introduction of techniques such as “racked in” dressings, using two sizes of stone, have provided more stable surfaces and reduced chipping damage.

Even the basic action of filling in potholes has not been immune from change. Previously potholes were filled manually with bituminous material and usually compacted by hand. Now a mechanised technique (Jetpatcher) is available in which the material is forced into the pothole by compressed air, with consequent better durability and operational time savings.

The recycling of aggregate from existing roads is now becoming a more common occurrence. This not only conserves a valuable raw material but it also can be cost effective. Recycling technologies are advancing rapidly. Increasingly the surfacing industry is developing ways of reducing the carbon footprint of road construction and maintenance both in the production of materials, transport and laying techniques.



## Changes in Procurement

In the first half of the last sixty years, carrying out highway maintenance was the preserve of the local highway authority's own Direct Labour Organisation (DLO), with input from specialist contractors (e.g. surfacing and surface dressing contractors) as required from time to time for specific schemes or programmes of work. However some local authorities with extensive road networks to look after such as County Councils did find it cost effective to operate their own surfacing and surface dressing gangs as well.

The introduction of Compulsory Competitive Tendering (CCT) for local authority "blue collar" services in the late 1980s radically changed the way in which highway maintenance was delivered. As a result of CCT, for the first time, private contractors were brought into the delivery of the highway maintenance service as a whole, rather than just for specialist services. However in some local authorities the DLO was successful in retaining the highway maintenance work in-house.

The requirement for CCT was removed by central government in the late 1990s. However it has left a legacy of a more commercial approach applied to service delivery and the involvement of the private sector in



local authority highway maintenance work through partnership arrangements with the local authority or through out-sourcing.

The maintenance of Trunk Roads, such as the A1 and A19 is the responsibility of central government and until the early 1990s they carried this out through agency agreements with the County Councils. In a move parallel to CCT on local roads, central government changed to a regime of competitive tendering involving private sector consultants for management services and contractors for works services. Initially these two aspects were separate contracts, but in later rounds of tendering they were combined.

In 1992 central government introduced the concept of Public Private Partnerships (PPP) as a means of attracting private capital and expertise into the delivery of public services. As part of this, central government introduced Design Build Finance Operate (DBFO) arrangements on the A69 and A19 (south of the River Tyne) Trunk Roads. Both included aspects of new build – for the A69 the Haltwhistle Bypass, and the A19, improvements between Norton and Parkway. The arrangements also included maintaining the routes, together with long lengths of adjoining road network, for a thirty year period up to 2027.

Private Finance Initiative (PFI) is another variant of PPP, where a whole service is managed by a private company at an agreed cost over a specified number of years. A handful of local authorities in some parts of the country have introduced a PFI for the whole of their highway maintenance service, but, in this region, the approach has only been taken up for street lighting as a joint venture in North Tyneside / Newcastle and in Sunderland.

## **Integration with Transport & Strategic Policies**

Over much of the last sixty years the planning and delivery of highway maintenance has often tended to have been poorly integrated with other highway works and wider policy areas. At best, this did not provide opportunities for adding value between services and, at worst, led to unresolved conflicts between policies, programmes and priorities of different services.

However the Comprehensive Performance Assessment regime introduced after 2000 for local authorities has created a stimulus for policy integration between services. This is now apparent with local authorities' capital funding for highway maintenance provided through the Local Transport Plan (LTP). This encourages the promotion of highway maintenance in the wider context of all public spending on the road network and other transport facilities.

It is now recognised through the LTP that the development of a comprehensive Highway Asset Management Plan (HAMP) is fundamental to demonstrating the value of adequately funded and well planned highway maintenance in delivering the wider objectives of corporate strategy, transport policy and value for money.

## **Winter Maintenance**

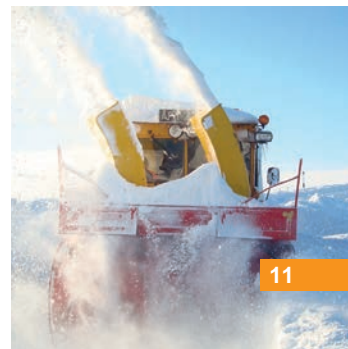
Winter maintenance plant has evolved over the last sixty years with the continued development of powerful dedicated specialist vehicles for gritting and snow clearing, together with improved systems for converting general highway maintenance vehicles for use as gritters and snow ploughs.

However, perhaps the biggest change in recent times has been the introduction by most highway authorities of ice prediction systems. These include roadside sensors at key locations and coupled with thermal mapping of the road network give the winter services manager instant access to actual conditions across the road network. This information is also accessed by the Weather Forecasting organisation and helps them refine and improve their predictions.

The de-icing agent, rock salt, is an expensive material and there is now increasing guidance on ensuring, for different conditions, that optimum rates of spread on the road surface are used. Stock management and control has improved and the benefits of storage in purpose built salt barns, rather than open stockpiles, to prevent leaching out is recognised.

In a recent development, the Highways Agency has moved to treating the trunk road network with pre-wetted salt. In this technique the gritter carries brine as well as salt and the two are mixed just prior to spreading. The advantages of this are better retention of the salt on the road surface and a quicker de-frosting action. However this does reduce the salt carrying capacity of the gritter.

The trend over the last fifteen years has been for milder winters with reduced snowfall, but the relatively harsher winters and higher snowfall in 2009 and 2010 have been a reminder of conditions more common forty or fifty years ago.





*Thanks to Malcolm Smith, of CIHT North Eastern Branch, for preparing this article.*

**If you enjoyed this article, try also:**

*The A69 Carlisle to Newcastle DBFO*

*Highway Authorities in the North East*

*Memories – surface dressing*

*Memories – winter services*

*Memories – the ‘Yellow Circus’*

## Glossary of Road Surfacing Terms

**Bitumen Macadam** – a well proportioned mixture of aggregate particle sizes to give a dense matrix on compaction which is held together by a low bitumen content binder. Its strength largely is derived from the interlocking of the aggregate particles. It is laid by a paving machine and is generally used on roads with lower traffic volumes.

**Hot Rolled Asphalt** – a traditional material used to surface roads with higher traffic flow and it consists of two components, the surface course mixture and high skid resistance stone chippings pre-coated with bitumen. The surface course mixture is made up of a bitumen binder mixed with intermediate quality small sized aggregate. Its strength is derived from the cementing together of the binder/aggregate mix. It is laid to the required thickness (usually 40mm) using a paving machine. The pre-coated chippings are now spread on to the laid surface to give the final compacted surface a texture and a skid resistance.

**Recycling** – the technology for recycling road aggregates is advancing rapidly and additional developments include the use of glass and other recycled waste products in the surfacing course.

Typical methods of recycling road aggregates include:

- Repave which involves the heating the existing road surface to 150 degrees C and scarifying it up to a depth of 30 mm. Re-profiling is carried out straight away using an oscillating floating screed. The process is completed by the immediate application of new surfacing material and compaction. The heat retained by the scarified material from the existing surface welds it together with the new surfacing material.



- **Remix** is similar to repave but the broken up existing road surface is removed, crushed, graded, reheated and mixed with some new material and binder before being re-laid and compacted at the original site.
- **Hot recycling** is similar to the remix process, except that the existing road surface material is removed by planing. It is then removed off-site, crushed, graded and heated, the material is mixed with binder and re-laid and compacted. This process can also be done on a smaller scale on-site by using portable machinery.

**Slurry / Micro Surfacing** – cold laid, very thin proprietary surfaces incorporating a bituminous emulsion binder with fine graded aggregate and filler. The application is either by machine or hand and typical the laid thickness is less than 15mm. A single application giving a thickness of about 6mm is usually referred as a slurry. Micro surfacing incorporates a polymer modified binder and is often a two coat application up to a thickness of 15mm. They have similar properties to surface dressing in sealing the road surface and restoring skid resistance, but additionally, particularly the thicker applications can reshape and re-profile the existing road surface.

**Stone Mastic Asphalt** – a proprietary surfacing used for the running surface of the road. It is made up of a high content of coarse aggregate particles which interlock to form a stone skeleton. This is filled by a high bitumen content binder and a filler. It has been developed to give improved resistance to deformation which stems from more aggregate to aggregate contact than other types of surfacing.

**Surface Dressing** – is a long established cost effective method prolonging the life of the road surface by sealing it to prevent water penetration and arresting disintegration of the existing surface, as well as restoring skid resistance. The process is relatively fast and consists of spraying a bituminous adhesive coat on the existing road surface, followed by spreading a layer of high quality aggregate chippings. The bituminous adhesive coat can be modified by the addition of polymers to enhance performance. At higher stress sites the technique of ‘Racking in’ is used. This is the successive laying of one layer of binder followed by two layers of chippings, the second layer being of a smaller size.

**Thin Surfacing** – are a grouping of modern proprietary surfacings which have been developed to give safer, durable and quieter road surfaces. They include stone mastic asphalt. Depending on circumstances and the particular proprietary surfacing they can be laid at thicknesses down to 18mm.