Education and training of roller operators contributing to durable and sustainable asphalt pavements

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ABSTRACT

Compaction of the pavement structure and the asphalt mixtures degree of compaction are very important for the durability and the behaviour of asphalt pavements. However in general there is a lack of understanding of the importance of the work of the roller operator. Nowadays many companies rent rollers and some companies have no own rollers anymore. When renting equipment one could ask a truck driver to drive a roller and here the problem will begin.
In an asphalt crew all tasks are important, but the role of the roller operator is often underestimated.
The main problem is that the management often does not see the importance of what roller operators are contributing to the quality of the finished asphalt layer. A good education system for roller operators with a certificate or licence to operate a roller could help to underline the importance of good compaction.
A good education of the roller operator will also improve his/her image and this better image could help to attract more young people to the industry.
Having an operators' licence or certificate for roller operators might be a way to achieve a better education of roller operators. In some countries they already have certificates for roller operators, but that is mainly for safety reasons.
Next to improving the recognition, status and attractively of the job by good education, licencing could also give the roller operators a value on the market, it could give them mobility in the branch and it would also give the contractors an assurance (of knowledge) when hiring them.
Education and training of operators can also lead to significant cost reductions. By adjusting the operators' behaviour and by using the equipment in an optimal way large savings in both fuel consumption and maintenance costs are achievable. So good education is very important and every Euro invested in education will pay itself back.

Keywords: Compaction, Equipment

1. INTRODUCTION

Sustainability and low Carbon footprint are key-words at this moment. Durability is linked to both items. More durable pavements and more durable road surface layers will contribute to a lower Carbon footprint per year and they will be more sustainable too. For pavement structures the proper compaction of the individual layers and for asphalt mixtures the degree of compaction are very important parameters regarding the behaviour of the pavement and its durability. Well compacted mixtures have a better fatigue resistance, a better rutting resistance and have a longer service life than insufficiently compacted ones. The first compaction of the asphalt mixtures (except for mastic asphalt, which is "self-compacting") is achieved by the screed of the asphalt paver. The final compaction is done by rollers.
It is the task of the roller operator to achieve the required degree of compaction. This makes the task of the roller operator important because the quality of the finished product mainly depends on his skills. Despite the important role of the roller operator, his/her status is often very low. Nowadays there are also several tools available that can assist the roller operator in doing his job, like continuous compaction control, but the skills of the operator are still decisive for getting the correct level of compaction for the whole surface. Despite the importance of good compaction the industry does not always see the importance of the roller operator

The goal of this paper is to underline the importance of the job of the roller operator, to improve the image of the roller operator, to generate awareness of his/her role and to find a way to attract young people to the asphalt industry as roller operators. The education and training of the roller operators is playing a very important role here. A skilled roller operator knows what to do and what not to do, to get a perfect compacted asphalt layer.
The way roller operators are educated and trained depends on the local or national situation. In several countries they have education centres and several countries use "best practice guides".
In some countries a roller operator needs a licence to be able to operate a roller, however these licenses are mostly related to safety and operating a roller in a safe way.

In this paper the advantages of having a licence for roller operators to compact asphalt are addressed. Safety aspects are part of this licence. So the license can be seen as a license to operate an asphalt roller.

2. COMPACTION

An asphalt pavement consists of several layers of different materials and it is important that each layer is compacted correctly before the next layer is applied. The subgrade / embankment has to be compacted, as well as the road base layers and the asphalt layers. Compaction increases the resistance against permanent deformation as well as the stiffness of the layers and the fatigue resistance of bound layers. So for the durability of a pavement proper construction of each layer is very important and one of the most important parts of good road construction is compaction.

2.1 Importance of compaction

Some people say that building roads is compaction, compaction and compaction.
Correct compaction of the asphalt layers increases the resistance to permanent deformation and improves the fatigue behaviour. Three percent more compaction of the asphalt mixture can result in 15% less thickness needed due to improved fatigue behaviour (in this case 8% air voids versus 5% air voids) [1.]. Better compaction of the asphalt layer also results in a better stiffness and it will enhance the resistance against moisture-related damage and helps reducing oxidation and hardening of the binder.
So for durability the asphalt pavements compaction and the degree of compaction is very important. To give a clear definition of durability a poorly compacted pavement can have a life that is measured in weeks or months whilst a properly compacted pavement can be measured in years or tens of years.

It is also important to have a good homogeneity within the individual pavement layers in all directions, by using homogeneous materials and equal (homogeneous) levels of compaction. A chain is a strong as the weakest element [2.].

Compaction is increasing the density of the material. The level of compaction is often shown as a percentage of a reference density. This reference density can be defined in different ways and the way it is defined depends on the region. There are three primary methods of specifying density: as a percentage of the density obtained in a control test strip, as percentage of a laboratory density or as percentage of the theoretical maximum density.

For asphalt pavements the initial compaction is achieved by the screed of the asphalt paver. Depending on the screed used this compaction is normally between 75% and 92%. The rest of the compaction is realised through the compaction by rollers. It is the task of the roller operator to achieve the degree of compaction required. In the past each asphalt paving company had its own rollers and roller operators. Nowadays many companies are renting rollers and some companies have no own rollers anymore. In the UK 90% of the rollers are rental.

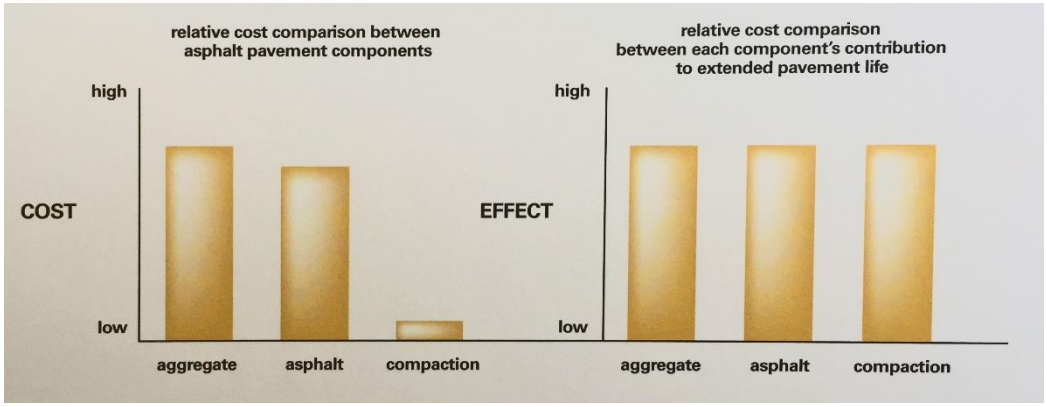

Figure 1: A relative cost comparison between asphalt pavement components and their contribution to extended pavement life [3.].

2.2 Type of rollers

There are different types of rollers that can be used for compacting asphalt mixtures. There are static rollers, vibratory rollers, pneumatic (tyre) rollers, combination rollers, tandem rollers, three wheel rollers, etc. [3., 4. and 5.] The choice of the rollers, the number of rollers used and the weight of the rollers depend on the size of the job, the asphalt mixture used, the paving speed and the prevailing weather. The region, the habits and the experience the contractor has with specific equipment also effects the choice of equipment and methods used. So several types of rollers can be used and in different combinations. What is being used in a region is often based on the local best practice.

2.3 The roller operator

To obtain a good / durable pavement every step in the process chain is important. It starts with a good pavement design and a good mixture design. The right materials (constituent materials) should be mixed in the asphalt plant in the correct way, then it has to be loaded on the truck in the correctly, it has to be transported in appropriate trucks, etc.
In some cases a material transfer vehicle is used (with or without remixing) before the asphalt mixture goes into the hopper of the paver. The asphalt mixture paved by the paver should be homogeneous in grading and temperature in all directions. Then the last step is compaction by rollers.

In general there is a lack of understanding what the roller operator is doing. He is just moving his roller forward and backwards, but the roller operators needs to know when to start and when to stop. Next to that every square meter of the pavement should be equally compacted to the right level.
In [7.] the results are shown of a compaction process where the number of roller passes was recorded for each part (m^2) of the pavement. It showed that it is not so easy to apply the right amount of roller passes for each part of the pavement. Nowadays there are supporting systems available like Continuous Compaction Control, but they are not generally used yet and it means that the quality of the finalised pavement largely depend on the skills of the roller operator. Practice has shown that a very experienced roller operator with a poor equipment is able to do a better job than an unexperienced roller operator with up to date equipment. The roller operator has to be educated and trained to obtain the skills required.

2.4 Education and training of roller operators

Education and training facilities for roller operators are offered in different ways. It could be "Training on the job" (working + 1 or 2 days/week going to school), training schools (full time), short courses of several evening plus some days for practical training, trainings at a training centre of an equipment manufacturer or supplier, etc.
As an example in Germany they have training schools that are focussed on health & safety aspects and are driven by the insurance companies; this is a voluntary system. In Germany there is a system where they have a two-week course for paver operators.
At this moment there is no guidance in education and training activities of roller operators and it could be useful if there would be some (European) streamlining regarding these trainings in order to bring the education and training to a certain level.

2.5 The image of roller operators

In many countries (like in Japan [6.]) the paving industry is seen as an unattractive employer for younger people. The asphalt workers usually work often in the weekend and during the night. So one of the biggest problems of asphalt / paving industry is attracting and securing human resources such as engineers, operators and workers (see Figure 2).

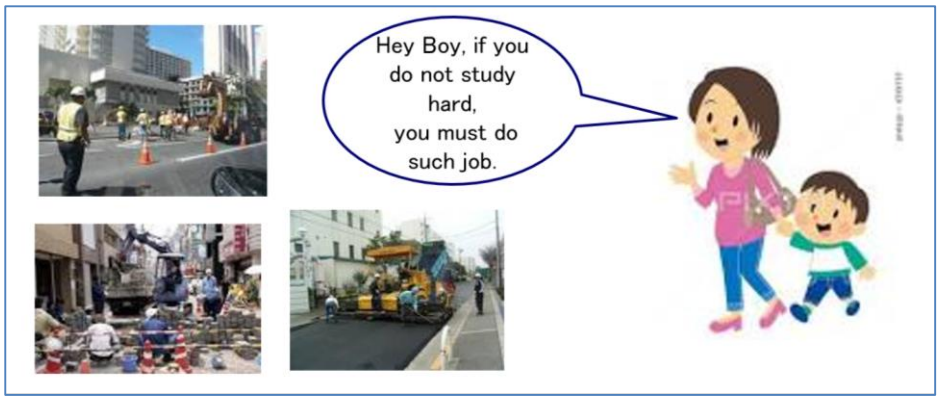

Figure 2: The perception of the status of road workers in Japan [6.].

To attract younger people to the paving industry in Japan they promote the understanding of the social, economic and environmental benefits which are derived from developing roads and road networks and they also appeal to the individuals' sense of self-worth (see Figure 3).

Figure 3: "I want to tell my sweetheart that my job will remain on the map". [6.]

3. ROLLER OPERATORS' CERTIFICATE

In the asphalt industry the role of a roller operator is often underestimated and it does not score high in the hierarchy. For that reason it is important to generate awareness of the importance his job and having a roller operators' certificate can contribute to this.

Some countries already d have a national certification system. As an example the system used in Australia will be described here shortly.

In Australia they have two types of certificates, depending on the level of experience:

- NOHSC 7019 Certificate of Competence
- RIIMPO317D Conduct roller operations [8.]

Certificate NOHSC7019 (NOHSC = National Occupational Health and Safety Commission) demonstrates competence to the minimum national certification standards. It demonstrates the foundation skills of new operators so that they can, in a safe manner, continue to improve their skills and proficiency whilst operating the machine.

The nationally recognized certificate "RIIMPO317D Conduct roller operations" [8.] includes planning and preparation for work, the conduct of operational checks, the safe and effective operation of the machine for a range of mandatory tasks, the fitting, use and removal of attachments and operator maintenance activities. This program is addressing the following skills:

- Planning and preparing for operations
- Pre- and post-operational checks
- Start up and shut down procedures
- Vibrating rollers
- Static and multi-tyre rollers

- Compaction practices for road construction
- Roller patterns
- Density
- Operator maintenance

The above mentioned skills for the "RIIMPO317D Conduct roller operations" certificate can be seen as the basic skills required for an effective operation of the machine. For a well-trained roller operator more knowledge is needed than the basics. A longer overview of items that are relevant for roller operators is listed in chapter 4.

4. SKILLS RELEVANT FOR ROLLER OPERATORS

The following list gives an overview of items that are relevant for roller operators:

- Basic Asphalt Mixture knowledge
  - Mixture types
  - What is density
- Basic principles of asphalt and asphalt compaction
  - Dense mixes
  - Open mixtures
  - WMA
  - Cold Mixtures
  - HMA
  - Materials
- Basic rules for compaction work on asphalt mixes
- Compaction methods
- Compaction equipment
  - Vibrating rollers
  - Static and multi-tyre rollers
  - Pneumatic Tire rollers
- Equipment characteristics of rollers; basics
- Technical data of asphalt rollers: oscillation
- Compaction performance
- Planning and preparing for operations
- Preparing the compaction equipment
  - Pre- and post-operational checks / Start up and shut down procedures
- Safe handling of the equipment
- Rolling patterns
- Compacting joints
- Compaction and paving faults (learning from mistakes)
- Compaction measurement and documentation systems. Monitoring documentation; Different systems available. / Compaction Control Systems / Intelligent Compaction
- Operator maintenance
- Fuel efficiency / minimising fuel usage.

5. ADVANTAGES

The advantages of having an operators' licence or certificate for roller operators are:

- It will improve quality of the work
- It will reduce costs for the contractor as less poor quality work will need removing
- It will reduce penalties due to insufficient compaction
- It will reduce the cost for future maintenance of poor quality pavements
- It will reduce machine operating costs and the machine will produce less CO_2. Practice has shown that training of operators can lead to significant fuel reductions. By adjusting the operators' behaviour and by using the equipment in an optimal way 20% fuel savings are achievable.
- It will improve the recognition, status and attractively of the job. It will lift up the importance of the roller operator because the roller job is often given to the least experienced one at this moment.
- It also would give the roller operators a value on the market, it gives them mobility in the branch
- It will give contractors an assurance of knowledge and skills when hiring a licenced roller operator.

In short: Good education and training is very important and every Euro invested in education and training will pay itself back, so it is crucial for the bottom-line of the contractor.

6. HOW TO ORGANISE THIS

A certification system can be implemented in existing structures of the professional education systems of a country. For getting an operators' licence / certificate an advanced study with training is required and it should take place after a basic (safety) education. It could also be part of an advanced continuous education programme.

7. CONCLUSIONS

The durability of pavement layers is very important for creating sustainable asphalt pavements. The compaction and the degree of compaction and the homogeneity of the compaction are parameters with a big influence on the durability of asphalt layers. The final compaction of asphalt layers is achieved by rollers and the roller operators are in fact the persons that have a direct influence on the durability of the asphalt layers.
Despite the important role of the roller operators, the image of the roller operator is quite low and the management often does not realise the importance of his job.

Education and training for roller operators is important for various reasons. It improves the quality of the pavement, it will save money and last but not least it will improve the status of the roller operator and can help to attract the young generation.
A system with a certificate for roller operators, a kind of roller operators' licence, can show that the certificate holder has got the essential education and training to do a good job.
Such a system can be implemented in existing structures of the professional education systems of a country. It could even be part of an advanced continuously education programme.

Education and training of roller operators is also important to be able to implement (future) new developments like the continuous compaction controls systems that are available nowadays.

8. LITERATURE

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