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The Asphalt in The Hot And Cold Areas

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Keywords :

1- Scope

This study discusses the difference between the roads construction in general, and the asphalt pavement in the hot and cold areas.

The common factors such as the traffic loads have been excluded from this study,

This study searching the difference of the factors affecting the sustainability of asphalt pavement, in the hot areas and cold areas.

2- Introduction

The required from the asphalt pavement is to have a good performance to resist the permanent deformations and cracking,

The permanent deformation and cracks, whether in the hot or in the cold areas, depend primarily on the mix design, (selection of the appropriate bitumen, and materials used in asphalt), the environmental factors which have the major effect, intensity and the loads caused by vehicles that run on asphalt,

3- Environmental factors that affect the sustainability of asphalt roads

The environmental factors have the significant impacts on the construction, sustainability and the necessary maintenance of the asphalt roads such that; the temperature, type of the soil, rains, land topography etc.

1-1The climate temperature effect :

3-1-A- In the hot areas

The atmosphere temperature is high and has the big influence on the asphalt mixtures and on the behaviors of asphalt layers, but the most important constituents of asphalt mixtures and sensitive to the atmosphere conditions is the bitumen, the main effect on the bitumen is the aging factor, manifested by loss of elasticity and cohesion by oil evaporation.

1- The asphalt pavement is exposed to the direct sun rays temperature, and ultraviolet rays, in the hot areas the temperature is high, reach 50 C° or more, in this case the bitumen in the asphalt pavement is more susceptible to the loss of volatiles and oxidation, because the oxidation phenomenon depends on the temperature, light, and oxygen concentration.

2- The asphalt becomes harder, and cracking, these due to the bitumen oxidation and oils evaporation, and traffic loads.

3- The bitumen in the asphalt pavement in the hot areas is the most susceptible to such effects, of oxidation and cracking, paradoxically, the hot temperatures soften the bitumen

and allowing heavy tire loads to deform the pavement in to ruts, in case of bitumen excess, or deficient in filler bitumen ratio, or due to not added the required aggregate quantity in the batch as per the mix design.

4- The asphalt mixture workability is appropriate and good during laying in the areas with hot climate, compaction can be done smoothly, and no fear of asphalt coldness, it is more easy to reach the required density than in the areas with cold climate

5- In asphalt mix design, the appropriate bitumen should be chosen, in terms of penetration, and appropriate actions to reduce evaporation and oxidation of the bitumen during bitumen storage and heating. But the better solution in hot areas is to use the modified bitumen by polymer, in order to :

- Increase the pavement resistance against the permanent deformation at high temperatures, and resistance to cracking in the cold temperatures.
- Reduce susceptibility to aging, in both stages, in the preparation of asphalt mixtures, heating, mixing, transporting, and laying, and during its life time of operation.

3-1-B- In the cold areas :

Where the rainfall and low temperatures below 0 degrees, and the factor of freezing and thawing;-

- 1- The seeping of water through the pavement cracks into the sub base and sub grade, which makes the road weak to carry the traffic loads,
- 2- In cold weather the water will enter in voids and under the road and it will freeze, then it will expand, this will cause cracking, and will enlarge the existing cracks,
- 3- The frozen water will thaw during the time, starting from the top, from the asphalt layers then to the sub base and sub grade to the bottom, but as the soils in the cold areas is usually clay or silt, then load will cause potholes during this operation,
- 4- The asphalt mixtures need importance and great care during the paving, for fear that cool, and then it will be difficult to obtain the required density.
- 5- Cold weather can influence the asphalt compaction, causing a high percentage of air voids, these voids obviously will increase the water content, together with moisture by the wet weather will increase the possibility of the road damage.
- 6- The low temperature during winter season produce ther-

mal stresses in asphalt pavement, the bitumen is contracting more than the mix aggregate particles when temperature drops, this causes the asphalt film to get thinner around aggregates, when the temperature drops below the point where bitumen becomes brittle, thermal cracking is initiated in the asphalt pavement.

1-1 Soil

From the important factors for the sustainability and durability of the asphalt pavement, is the solidity and durability of the constituent layers of the road under the asphalt, which depend on the selected materials for these layers, number of these layers, this depend on the topography of the area.

3-2-A- In the hot areas

As known, the soil in the hot areas is semi sandy or sandy, this type of material has a good advantage for roads sustainability, specially the asphalt pavement top surface, that because this material has a good recipes among other materials, such as, water absorption, sand equivalent, and low plastic index, this type of soil is permeable, but if 5 to 10% of dune sand added in order to increase the sand equivalent, lower the PI, and to get more adhesion between the soil particulars to be more workable and more easy for compaction, at the same time good density will be obtained.

3-2-B- In the cold areas

But in the cold areas, most of the soil there, is clay or silty, these type of soil should be improved, to be used as a base for roads construction, the sand equivalent is very low, the PI is very high, and water absorption is very high, So, the moisture content will be high also, moisture content has a big effect on the road and on the asphalt sustainability, specially in winter and spring seasons, and frozen- thaw cycle, as mentioned above.

1-1 Land topography

3-3-A- In the hot areas

In hot areas where few raining, the land there is often desert, and it is almost flat, the natural ground levels there are convergent, maybe a little bit of hills and plateaus, so roads construction in such areas is easy, especially no need to cut or fill in large quantities, and most importantly, rule out the difficulty of choosing materials for filling and its problems, while the other main point, is that the difference between the top surface of the road and the vicinity natural land is very little,

Hence, rule out the necessary precautions and procedures required to be taken to protect the both roadway slopes, and the continuous maintenance necessary to maintain the sustainability of the road,

There is another factor, that in such areas there are no plants and trees that must be removed, and eliminate their danger on the road, either before or after construction.

3-3-B- In the cold areas

But in the cold areas, the situation is different, where there are hills and hills and mountains, so, the roads construction in these areas needs more cuttings and fillings, and in large quantities, leaning up to high levels, in the areas where need more fillings, the difficulties here is in the selection of appropriate materials for the filling, and the process of filling layers, at a cold time and rainy weather, and here lies the danger, that the percentage of moisture will be high, and remain, so the procedure of roads construction there needs too much care and importance, materials selection, type and size, layer thickness, compaction with adequate rollers.

Also for asphalt, the mix design, bitumen type selection, aggregate selection, laying, and compaction procedures, all these need much care and importance, in order to get the best sustainability for the road and the asphalt pavement.

There is another important factor, the cold areas are often have a huge areas with forests and different types of plants, from these trees or plants have a big effect on the roads, causing damage by their strong roots, so, these trees roots should be removed from the roads locations, and the remaining parts of the roots to be treated well to be sure that it will not grow again.

4- Conclusions

There are major differences between the hot areas and the cold areas, in roads construction and asphalt paving,

The factors of environment are the main reasons of these differences, meanwhile these environment factors have a big effects on the roads sustainability, like, the climate temperature, the type of soil, and the land topography,

In both areas, whether hot or cold, have a certain level of precautions and the difficulties of the roads construction, whether road design or execution or the necessary maintenance over time.

But in general, in cold areas the roads construction including the asphalt paving is more costly and difficulty, than the construction in the hot areas,

That based on, the land topography and the type of the soil (the road base), are helping in the hot areas, but need more work and cost in cold areas, and the temperature has a big effect on the asphalt in both areas, but in hot areas they can have a controls easier than in cold areas, especially in hot areas, there is no frozen and thaw, while it is in the cold areas has influent on the durability of the asphalt paving and roads construction.

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