Behavior of Asphalt Pavement Structure Under Influenced Of Alteration Climatic Condition

Huseyin Gökçekuş , Youssef Kassem,Muhammad Kh. Musa

Abstract : The permanence and serviceability of asphalt is defined mainly by its degradation overtime which is influenced by the climatic change that can vary the surrounding ambience, lead to that increase the rate of damaging steps that will act on the durability and safety of pavement in many locations .Alteration of Climate in largely range acts on the environment. Variation in precipitation schema is may lead to drastic water deficiency and/or inundation. Weather conditions have often offered jeopardy to the pavement status, and it is considered as major reasons of of degradation. The amount of vulnerability of asphalt pavement to meteorological status is related to agents like as pavement category and condition, geology, vicinity to water direction and flow of traffic. This instruction recognize how weather condition, degree of temperature and water influence in the various kinds of road pavement such as: rigid, asphalt bituminous and modular pavements. The efficacy of weather alteration on the pavement damage cannot be neglected, and it can be considered during pavement design. Presenting pavement structures, that considered the effect climatic alteration during design has more resistance for disintegrate and damaging than the types not considered.

Keywords: climatic change, flexible pavement, temperature.

I. INTRODUCTION

Climate change is distinguished as a variation in the meteorological condition that continue for a prolonged duration . There is global solicitude that weather condition change is happen today as a result of environmental pollution agents, particularly associated to greenhouse gas transpiration. The evaluation publication by the International Panel on Climate Change in 2007 demonstrate a considerable increment in the condensation of Carbone dioxide in the aerosphere and environment, from 280 parts per million in 1750 to 380 ppm During 255 years, with highrate speed. The significant evaluating of the progressing in the universal heating above pre-industrial levels that occure due to raised condensation of greenhouse gases in theatmosphere is 2.1◦C at 450 ppm CO2-equivalent, and 5.5◦C at 1000 ppm [1].

Revised Manuscript Received on June 05, 2019

Gökçekuş , Professor, Civil Engineering Department/ Near East University/ North Cyprus, Nicosia, Via Mersin 10, Turkey

Youssef Kassem,Assist. Professor, Civil Engineering Department/ Near East University/ North Cyprus, Nicosia, Via Mersin 10, Turkey

Muhammad Kh. Musa,Ph.D. Students**,** Civil Engineering Department/ Near East University/ North Cyprus, Nicosia, Via Mersin 10, Turkey

Weather condition and its effectiveness are now inevitable A according many scientific research supply obvious documents and reasons that " variation in climate condition will extend for many long times, and for many centuries irrespective of the achievement of global improvisation to minimized harmful gas radiation" [1]

The procedure of alteration of atmospheric conditions , such as its vary in degree of heating, status of wind , rainfall schema and the incidence of excessive weather occurrences, have evidence implications for many infrastructure. And the climatic change "accuracy investigation of potential and projected degradation is restricted to some countries (such as USA, Canada. Australia, Canada,), different infrastructure category (such as power lines), and other segment (e.g., transportation, globetrotting)" [2]

Weather variability (for short time) and climate change (long period) has significantly risk on public infrastructure countries economy. Weather changing happening in new years have presented intuition into what successive variation might designate for framework: administration floods influencing and highway pattern, deterioration of permafrost threatening the integrity of building composition, shoreline and disturbing required works and services.[3]

And it has a significantly effecting on manufacturing of pavement and renovation and protection. Presently, bygone weather condition utilized to scheme built and preservation and repair processes. However, changes in atmospheric conditions mean that operation and application presently applied may not be proper and suitable for the futurity atmospheric state and hence for the whole service life load pavement. In recent time highways and road project are mainly planed and built for up to 40 years for nominal service life, with the anticipation that duration renewal and replacing layers of asphalt pavement will happen approximately as average each 13 years. Confirming that road construction and highway and repair perform recently is must be appropriate for the subsequent weather condition is to prohibit precocious deterioration. Besides, that the consequence of climate on the asphalt also related to on more other reasons, like as the properties of the pavement (constituent substance, texture and condition), water seepage, characteristic of layers, profile and contour of the ground and transportation movement. Commonly, the result of these risks are damage of the surface, fundamental substrate and composition of the asphalt and, sometime, in the occurrence of severe climatic, disastrous defeat and collapse. The threats are further interconnect, for instance high traffic movement enhancement rutting at high hot weather. Hot dry summer subsequently with wet cold winter increase the rate of peril and detrimental in many high way project on clay soil by causing shrinkage of clay soil underneath of the

pavement creating the crack in soil [4]
The major concept of variation in atmosphere condition for road repair and conservation can be recognizing as below:

- Destroy of structure because of high wind velocity
- Enhanced hazard of occurrence inundation due o increase of seas level rise, revisers and insufficient drainage;
- Degradation and destruction to capacious road project due to variation in temperatures;
- Decrease safety of road due to degradation of infrastructure damaging driving status; [5].

The Roads Board In July 2005, propagate the Final version of the Code Well-maintained Highways, that identify the importance of alteration in weather condition in provide foremost quantity and recommendation in construction and maintenance of the highway service. The Code determines the influence of hot weather on asphalt pavement layers as likely to be the major problem for the road repair and protection service. Circumambient ambience can be impacted on asphalt flexible pavements. The influence of humidity and temperature and combination of both them on pavement composition has been common subject in many pavement investigation for long times. The whole depth and composition of an asphalt pavement influenced by Water and hot weather . The universal heating have an impact on bituminous stratum (involving bound base layer and asphalt layer) since these layers have viscosity and can demonstration plastic and elastic reaction under loadings. Water and humidity can affect the sugared and sub base. In addition, water can do destroy in asphalt layers and lead to damage similar as stripping [6]

II. ASPHALT PAVEMENTS

The asphalt pavements cover a wide spectrum of pavement kinds that involve whole flexible and flexible compound. These pavement categories all have asphalt covering courses. Besides, the preliminary load distribute stratum, or foundation stratum, of a whole flexible pavement is asphalt and for pliable compound pavements it is a hydraulically bound matter. At the middle from these two the main substrate can involve emulsion bitumen stabilized substance. They may also comprise the utilized of primary, secondary aggregates and recycled aggregates, in addition mixture of bitumen and hydraulic binders exerted [7]

III. INFLUENCED OF CLIMATIC ON PAVEMENTS

Atmospheric condition has a wide impact on pavement structure, repair and protection. presently, past weather condition is exert to scheme creation and preservation projects .Besides, variation in climate denote that activities and function that used at present may not be suitable for the later weather condition and hence for the entire service life load of the pavement. Modern roads project are commonly planned and creation for a design life of till to 40 years, with the prediction that each 10 to 15 years the surface asphalt layers will be replacement. The main road designing and conservation perform presently must be appropriate for the future atmosphere condition to avoid untimely degradation over time [8]

Current atmospheric conditions models commonly will extend to variation at an enhancement proportion along the subsequent centenary or more. The human works and operation has large effect on the quanttty and rate of projected future weather condition, [9]

IV. INFLUENCED OF WEATHER CONDITION ON ASPHALT PAVEMENT MATERIAL

There are various kinds of asphalt component utilized for road manufacturing with distinct sorts and aggregates size, various binders and added ingredient such as polymer or fiber. Secondary aggregates and Recycled similar as china clay wastage and grinding tyre are also employed

A. Susceptibility to moisture

Humidity and water deterioration can happen in various shapes such as stripping. The idiom layer from aggregate surfaces adhesion because of the existence humidity and water activity, aggravate by heavy vehicle movement**.** . Generally aggregates having acidic

Properties, such as quartzite and granite, are more vulnerable to stripping since some type of aggregates, similar limestone, are less amenable to stripping. In similar fashion, the binder with high viscosity has less risk to stripped phenomena and additives, like hydrated lime and amines, can minimize the hazard of stripping for an aggregate**.** The magnitude of stripping that happen is mainly depend on to the availability of void and space ,large amont of void lead to the enter high range of water more in to the material [10]

Water influence on asphalt bituminous damaging is a intricate occurrence including, chemical, physical, mechanical and thermodynamic proceedings that assist pavement degradation. It was proved that the experimental temperament of testing procedures and the intrinsic presence of the outcome are the preliminary disputes that prevent the trustworthy delineation and evaluation of moisture acting on pavement decline. Some researchers showed the reality that water influenced on degradation of asphalt is a continually trouble which by extra study and experimental and better comprehension and realization the problem is to be solved. Furthermore, a 6% rising in under groundwater level showed that the spacing betwixt the surface of pavement and groundwater level was diminished by 6%. [10]

Another important thing is that the cancerous matter and poisonous composition in water that are original from asphalt runoff are of large problem. The information and investigation provided points fact that many variation could be made to tactics for purpose to reducing the permeation of these detrimental composition into the environment [11].

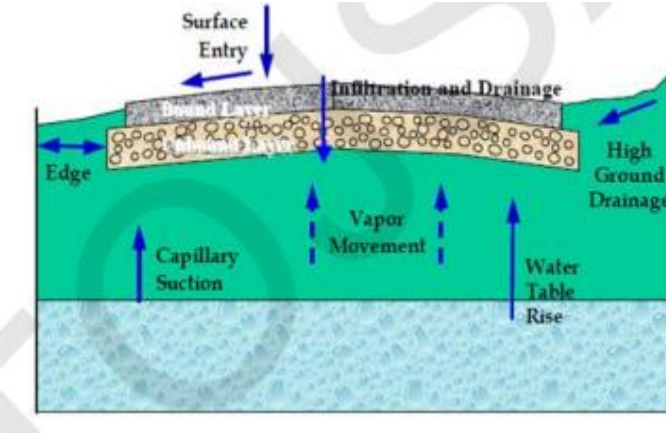

Figure 1. Feasible Water Fountainhead in Pavement [11 andElsayed, 1996)

B. Moisture risk to asphalt pavements

Several moisture hazards and trouble that can happen in asphalt pavement are:

1. Stripping – reducing the bond of aggregate and binder
2. Failures – decrease of sticky between layers and adherence in aggregate and binder
3. Rutting – surface intromission alone wheel path
4. Cracking
5. Bleeding – creation of of asphalt binder layers on pavement [12]

C. Higher excessive Rainfall effect

To reduce the hazard of excessive water and rain fall the following steps should be taken;

- ❖ Improve surface friction by concentrate on surface structures and kipping high persistence.
- ❖ Enhancement rutting resistance
- ❖ Increment required drainage for surface to barricade flooding – improve side trench and culvert ability
- ❖ Increased need for operational subdrainage – good design, installation, and preservation of subdrainage
- ❖ Extra amount of precipitation may menace stability of embankment
- ❖ Decrease in valency of structural of sub grade unrestrained bases and subgrade when pavements are immersed in water − Improve a extra realization and abating better information of how submerging influenced on stratums pavement structural capability and tactics to standing against such condition (Climate change adaptation and pavement design–precipitation items[13]

V. INFLUENCED OF TEMPERATURE

There are many pattern project some increment in average temperature of atmosphere from 2010 to 2050. Amongst the ten special pattern introduced in Meyer et al. (2014), this enhancement is approximately 4 °F (2.2 °C), which is double the amount of the prior 50 years [13]. The main effect of temperature on asphalt pavement can be summarized as follow:

- Pavement softening
- enhancement in the amount of bleeding of older asphalt [14]
- Age hardening of the bitumen speed up with increase temperatures. This will lead to the binder to become fragile and enhanced the occurrence of surface fretting and cracking. It will cause the asphalt becoming more sensitive to cracking as due to stresses induced by thermal.
- Higher temperatures will lead to more surface rutting presenting a danger to the road user when water ponds in the ruts.
- Diminished skid persistence by temperatures increasing as a result of chipping embedment and fatten up.
- The beginning of reflection cracking will be speed up In flexible composite pavements by increased alteration in daily temperatures.
- Asphalt will helped to the increasing ambient temperature of urban environment.
- The Duration that asphalt can be effectively paved will be adversely impressed by high temperature, low temperature and precipitations.[15]
- Alligator and longitudinal cracking may increment or decrement as a consequence of enhanced humidity and temperature[15]
- The rate increment in fatigue cracking (2–9%) is noted to be minor compared to the asphalt rutting (9–40%), as temperature enhanced in the future will have more influenced on in terms of AC rutting at the end of 20 years related on the atmospheric condition region of the pavement sector and prognostication utilize d model[16].
- Increment UV radiation and decrease cloud cover: A little reduction in cloud cover in the South East in summer will cause in more subjected of asphalt pavement to direct sunlight. This increment can be troublesome during sever heat duration, enhancing the quantity of fatting and diminishing persistence for skidding.

A. *Influence of temperature on stiffness*

The basis stratum is the major load distribute layer of a whole asphalt pavement and the modulus of stiffness is a gauged the capacity of the pavement to distributing the load. Asphalt pavements flex similar a bending sheet subjected the influence of a axle load. The underlying foundation resistance and the modulus of stiffness of the bituminous pavement can control the degree of flexing of the asphalt. (Nunn and Smith, 1997) . The result of study showed that the sensibility diminution as the stiffness increment and that the sensitivity is generally in the confined between 0.12 to 0.06 per ºC. The condition and position in the pavement is intricate as age hardening of the major pavement stratum has the action of both becoming the material more fragile and gives the better ability to its load spreading [17] .

B. *Age hardening*

Hardening and solidify of asphalt bitumen can happen in the time of its stockpile and during the production proceeding while it is assorted with aggregate, stocked, hauling and compacted in asphalt pavements. It also carry on during the service life of the pavement. The future achievement of the road is mainly relevance to the hardening of bitumen throughout the in-service life period of the road and the significant traces on the mechanical characteristic of these substances are of preliminary interest for the future proficiency of the road.

The methods of ageing are intricate and difficult; Petersen (1984) explained the subsequent preliminary methods and steps included

- Oxidation – Due to contacting of bitumen with oxygen it is gradually oxidized;
- diminution of volatiles and unstable substance – vaporization of volatile ingredients;
- Steric hardening – Rearrangement and change in direction of of bitumen molecules and waxes crystallization;
- Leakage and Permeation – motion of oily portions that extrude from the bitumen into the aggregate;
- Polymerisation persuades due to ultra- violaceous waves from solar irradiance.

Age hardening enhancement the binder viscosity the degree of hardening relies on atmospheric condition, time and the thickness of bitumen layers. The hardening procedure wills development rapidly with superior temperatures pavement and larger porosity of the asphalt mixture. Extra age hardening can influence in fragile binder with mainly reduction flow ability. This hardening has both advantage and disadvantage action. On the disadvantage, the asphalt altered to brittle material with low flexibility. This will increment the hazard erode and cracking of pavement While on the affirmative side it lead to an enhancement in the modulus of stiffness or increment the capability to spreading loads of the bituminous pavement and gives better resistance against deformation In the few thickness of asphalt pavements age hardening is not acceptable. It will reduction flexibility of the pavement under the action of traffic loads and precocious cracking will be occur.[18]

The ageing hardening reduction deviation of the pavement d over time and decrease the hazard of fatigue cracking . In addition, for acceptable and favor surface asphalt proficiency the bitumen layers must be remains have sufficient ductility and flexibility and does not harden considerable. It must be noted that the rate of oxidative age hardening enhancement with increment average temperatures [19].

VI. ASPHALT PAVEMENT PERSISTENCE AGAINST DEFORMATIONS

Due to metamorphose in one or more of the asphalt bituminous film by movement loading rutting is formed in the pavement layers. Ruts are lengthwise concavity along the tracks wheel because of the passage of vehicle wheels forever disfigure pavement layers which loss adequate interior consistency**.** water is stack up in the ruts and increment the dangerous of sliding vehicles in wet surface of the road, insignificant vision as the result of sprinkler and diffuse so it can influenced on the driving. In severe state, and more particularly in in low thickness n pavements, it lead to reduction of structural strength as it decrement the action of pavement depth**.** Commonly, deformation in the toper asphalt layers not influence on the whole structural of the pavement**.** The asphalt pavement persistence for rutting relay on road temperature and traffic load . The deformation increase at high temperatures do rutting is more probable to happen especially on highly traffic volume**.**

Deformation ability is defective severely, making ultraviolet elderly asphalt more fragile than the unaged one under the several status [20].

Some study has shown that the high rate of surface rutting arise during some days of the year, while the the temperature of the pavement surfacing be more than 45°C and it causes asphalt materials be relatively unstable [21] **.**

Rutting does not increase in a linear way and generally the amount of rutting is prone to decrease with the road age, but larger quantity is noted in the time of severely hot summers**.** The sensibility of asphalt's metamorphosis persistence to vary in temperature relay on the kinds of mixture [22] .

VII. THE INFLUENCED OF ATMOSPHERIC CONDITION ON ASPHALT PAVEMENT STRUCTURES

The highway basis comprise of the sub grade, capping layer and sub base. During the road construction, it effect as a manufacture stage on which to rest and compact the road base. In function it supplies the fundamental patronage for the pavement. This support is at hazard if water saturation happen at this surface. It should be well dehydrated and prevent from water entrance.

A. *Surfacing proficiency and durability*

Commonly hot rolled asphalt (HRA) used in high range with surface stratum material of pre-coated chippings bituminous asphalt pavements on the major roads that withstand waxing and polishing .that asphalt pavement structures, which were completely measured or the weather conditions of 1980 to 2009 and commonly had a

service life of 30 years, will exactly have a shorter service life.[23]

The HRA often contain less air voids which reduced binder ageing and hardening. Additionally, for adopt and maintain the pre-coated chippings, the pavement bitumen is composed of of a asphalt mixture in which the bigger size of aggregate fragment are spread rather than being in contiguity with together**.** The main description of a thin layer employed by the British Board of Agrément's Highway Authorities Product Approval Scheme (BBA, 2004) is *a appropriative bituminous yield with proper characteristic to afford a surface layer that is situated at a nominal thickness of fewer than* 50 *mm*[24].

The function of the surfacing is to supply a safe and convenient traveling floor for vehicles or foot traffic. Additionally, it prove safe surface the pavement layer of the roads, make the surface waterproof and prevent entering water into the foundations. So permanence and persistence to water are also essential [24] .

The types of surface deterioration that can happen on asphalt roads involves cracking rutting, cavity and erode. There are different agents that can taking part to surface detriment such as the age of the road, traffic movement and atmospheric condition similar to high temperatures road surface and availability of extra water. The damaging of asphalt Surface cause deficient ride quality and produce noise pollution by extra noise form tyre

B. Resistance for Skidding

Frozen water and ice are damaging the surface of pavement for both carriageways and footways. The pavement surface resistance for skidding is depending on the texture surface thickness. Persistence for Skidding reduced with surface wearing and length of life. Since the temperature of surface is commonly much larger than the air temperature its consider the best measure to use for assessing temperature effects on the skid resistance.

the clef road surface criteria skid persistence, strengthen against rolling and noise transpiration of surface pavement road in the background of the European system for road transportation involving their association and the interplay with the climate [25].

Climate criterion like as temperature and amount of precipitation. By depending the results of some research nearly 8% of the whole number of coincidence in hot arid weather status included skidding, for dewy condition it is 27%. Wet friction gives by aggregates surface due to having a harsh and coarse surface which interpenetrate thin layers of water. The surface texture is burnished owing to the traffic in dry hot weather conditions and restitutes throughout the severe cold winter atmosphere condition. The amount of polishing relay on the flow traffic and the aggregate category utilized in the highway surface pavement . Prolonged arid duration and temperate winters may also influence on skidding resistance.

Besides to the action of average temperatures, higher temperatures influenced on persistence of skidding. Uttermost temperatures and a protracted period of the maximum temperatures lead to blubber and bleeding on bituminous surfacing. High temperatures also decrease the resistance against deformation of the asphalt pavement and surface aggregates can be easy depressed and penetrate into the surface of the pavement , causing damaging in of texture. The ruts and grooves of the pavement surface are faster increasing with increment temperatures and water can stack up in these ruts and grooves and cause the hazard of sliding of the vehicle uncontrollably on the wet surface of a road.Bleedin couse a slippage hazard on footpath. Sliding resistance on walkway is influenced by by growing plants and greenery [26].

C. Effects of freeze-thaw on the asphalt pavement

When Water penetrated the pavement is exposed to the action of ice and melting throughout the winter. The water volume increase when frosty and reduce when thawing producing tensile stress in the pavement. This causes to cracks which diffusion into the structure during any freeze-thaw repetition. The repetition of freeze-thaw revolution can be increment by de-icers. Freezing pull up moisture from the subbase, enhancement the quantity of water in the pavement . Icy of a pavement be accomplished from the floor to facedown, pull up water from underneath layer. Stratums of ice lead to expand the road upwards. Freeze-thaw is an unimportant problem in the winter status when the ground stays frozen or does not freeze anywise. [10].

The interior degradation within the asphalt mixture increases, by increasing number of freeze-thaw cycles; the interior detriment of asphalt mortar also enhanced and it lead to the proficiency to slowly degenerate. After 25 freeze-thaw repetition, the creep curves have a tendency toward creep failure [27]

During maintain very low temperature throughout winter months, the ground will freezing until specified thickness under pavement and expand in volume. Thus asphalt layers will subject to the swelling pressures.

Under the Fluctuating Thermal Regime some month, the temperatures are tending to alters daily – with small difference temperatures in day and night subsequently. Thus temperature reflux, frequent diurnal along a some month, be able create pavement depression, especially in its upper films, by the action of 'Thermal Fatigue'.(]28] .

D. Stripping

Some bituminous pavement more amenable to this event than others, relay on the kinds of aggregate and binder viciousness . Design of asphalt mixture and building may also effected on sensitivity to stripping .Water can penetrate to the asphalt composition and become confine between two bituminous films of asphalt. And due to a result of successive hydraulic pressures created by vehicle movement physically washing the asphalt from the other component wich cause to failure under these conditions [29]

While water go into the asphalt pavement it can in all direction for significant

distances inside the material that is usually insufficient compacted at the horizontal asphalt stratum junction.additionally it feasible for moisture to movement up direction from the subgrade as the result of daily temperature changing In this proceeding, recognized as hydrogenesis, water traveled upgrade if the temperature enhancement with with depth. The idiom is particularly used to foundation and soil layer beneath road pavements where a thermic pumping action lead to the aspiration of air humidity, which then constrict, creating an ever augment quantity of moisture in the pavement and occasionally stripping and inconsistency [8].

VIII. Cracking in asphalt pavements

A. Reflection cracking

Reflexion cracking is a main consideration for engineers surfacing the trouble of road repairing and modernization [30] .

The problem becomes visible by the existence of cracks in the preceding pavement stratum that increases into the asphalt top layer when vehicles and movement load transmission on the cracks and by temperature changing. That reflection cracks generally begin at the top layer of the road and diffuse facedown to reach a presence crack or joint in the fundamental concrete layer (Nunn, 1989). Moreover according some research that environmental action also lead to reflection cracks in the pavements (Nesnas and Nunn, 2006) .

Existence any types of crack will permit water to penetrate the asphalt and a pumping action will cause an imbibe in the moisture-vulnerable to subgrade and produce subsidiary cracking.

Subgrade heave and contraction largely influenced building rural roads in large plasticity index (PI) clay zones. Their age have an impact by the contraction and high traffic in subgrade soils. Troubles may be yield at the large PI soil desiccate throughout periods of dryness and afterwards soaking up all the while extended dump durations. The presence of trees near to the pavement pattern which traction large moisture from underplaying of the asphalt pavements. Absence of sufficient highway side trench for drain purpose and weak drainage more dangerous for asphalt pavement [30] .

B. Surface cracking

Cracking of asphalt pavement is a complicated occurrence that can happen by different reasons. It is related with pressure produced in the bituminous pavement films by loads of the wheel, variation in temperature or syntax of the two loads and thermic created stresses can cause of crack beginning and diffusion. Warmer climate will accelerate the oxidation steps and cause the material more susceptible to cracking and colder daily temperatures will produce tensile stresses due to thermal that lead to crack formation and dispersion since extra soil contraction can produce reflectance cracking in the pavement flooring stratum. All types of cracks in these pavement will permit water to penetrate the asphalt and a pumping action will lead to an subversion in the moisture- sensitive subgrade and produce minor cracking [31] .

At supreme temperatures the sticky composition overcomes and fully stress relaxation may take at very short time, and at high cold weather relaxation require some hours or even days. At high temperatures stress relaxation will avoided these stresses attain a level that can create cracking. Since at cold weather, the tensile state will insist and, thus pavement cracking will be more probabilistic. These surfaces beginning to cracks are commonly due to of recurrent variation of temperature. In thick asphalt pavements, these cyclic, daily and yearly alters are mainly in charge of for crack dissemination [8] .

IX. CONCLUSION

According man new researches in United kingdom that summer will be wormer drier and winter will be wetter hotter. There will also be extra severe precipitation and the sea surface will enhanced. Civil engineers have also challenge several of the repair and protection produced by the changes in the atmospheric condition . The significant weather condition risks for pavement of road will be enhanced average and sever temperatures and increase water level.

In general the the climatic change has the following affects on the asphalt pavement:

- Stripping: Due to reduce the stickiness between asphalt binder and aggregates and asphalt binder that commonly start at the lower part of the Hot Mixture Asphalt layer and increase upward.
- Flooding caused landslides or erosion
- Variation in temperatures causes pavement softening, bleeding ,rutting ,age hardening, many types of crack , reduce skid resistance, decrease modals of stiffness
- Reduce the strength and structural of pavement by throwing and freezing, reduce durability and proficiency of pavement surface, stripping and cracks

The Following function and and activity can benefit to lessen potential hazard of pavement damage:

- Prolonged arid duration causing hurt of persistence for skidding
- placing asphalt mixes that have enough resistance to metamorphosis in low thick stratum in warm weather
- preserving the floor of pavements when subjected to very wet weather
- Vary and modify standers for asphalt
- Supply and provide better drainage system for roads
- Planning and Design attempt which depend on long-range prognostication system must modify such models to combine with presence climate anticipation models instead than depend only on old data records
- Check survey the use of high strong materials for asphalt pavement and designs that carry out superior in very sever temperature, rainfall and inundation master plan.
- Establish sufficient and well maintained

drainage system to response with the enhance repetitiveness of severe rainfall incidents

- The pavement should be in good situations, to prevent penetration water in to the structural substrates.
- It necessary to use the "climate proof" asphalt pavements.
- The utilization of WMA is evaluated to supply a diminution of 26% on the universal temperature and 29% on the acidification[32].
- To minimize rutting the suitable Asphalt-Grade should be Selection

X. RECOMMENDATIONS

- Take into consideration underneath roadway layers to restriction wave function and flow detriment for littoral pavements. This may due to repeated deluge.
- Consider stabilized soil by vegetated or compacted soil embankments to withstand weir-flow detriment for coastal pavements.
- Utilization of water insusceptible substance (steady against loose materials) overall the pavement composition to reduce the lose in structural resistance that happen when asphalt pavements are immerse in water
- Revision the pavement planning, characteristics and execution work utilized in those countries which have atmospheric condition similar to be be knowledgeable in the United Kingdom.
- expand instruction for local government on distinguish the dangerous to their walkway and vehicle way local networks posed by climate change
- Backing essential investigation into the impact of high temperatures combined with high raining on evolved pavements involving foundations
- Cheering the asphalt industy to progress repairs and resolution of the difficult situation and question produced by weather condition change.
- Preserve to conservation and repairing scheme and therefore keep away from small imperfection changing main maintenance. Well protection roads are reduce susceptible to weather change actions. This involves certain sufficient drain system preparation and maintenance of drained a culverts.
- Flood wave water stream along a roadway causes detriment to embankments and pavement structures There is several certification to propose stabilized by planting shoulders and embankments of compacted soils can further defends against flow damage [33].
- As an indirect influenced of variation in weather condition on pavements, the the topography and location of road needs to be deliberate to ameliorate the frame and structure composition. For example, the degradation of a concrete asphalt close to the sea may be faster by variation in atmospheric condition if the traffic volumes are remained constant.

REFRENCES

1. Solomon, S,Climate changes the physical science basis. In AGU Fall Meeting Abstracts. Natural Resources Canada. (2007). from impacts to adaptation: Canada in a changing climate. Ottawa: Government of Canada ,IPCC (2007
2. Boyle, Jessica, Maxine Cunningham, and Julie Dekens. "Climate Change Adaptation and Canadian Infrastructure." International Institute for Sustainable Development (IISD): Winnipeg, MB, USA (2013).
3. Thornton, Philip K., Polly J. Ericksen, Mario Herrero, and Andrew J. Challinor. "Climate variability and vulnerability to climate change: a review." Global change biology 20, no. 11 (2014): 3313-3328.
4. Rababaah, Haroun. "Asphalt pavement crack classification: A comparative study of three AI approaches: Multilayer perceptron, genetic algorithms and self-organizing maps." PhD diss., Indiana University South Bend, 2005.
5. Howey, David, Robin North, and Ricardo Martinez-Botas. "Road transport technology and climate change mitigation." Grantham Institute for Climate Change, Imperial College London 10 (2010).
6. Airey, Gordon D., and Young-Kyu Choi. "State of the art report on moisture sensitivity test methods for bituminous pavement materials." Road Materials and Pavement Design 3, no. 4 (2002): 355-372.
7. Chaddock B and Roberts C (2006). Road foundations for major UK highways. PPR1(2006).
8. Willway, T., L. Baldachin, S. Reeves, M. Harding, M. McHale, and M. Nunn. "The effects of climate change on highway pavements and how to minimise them: Technical report." The Effects of Climate Change on Highway Pavements and how to Minimise them: Technical Report 1, no. 1 (2008): 1-111.
9. Pachauri, Rajendra K., Myles R. Allen, Vicente R. Barros, John Broome, Wolfgang Cramer, Renate Christ, John A. Church et al. Climate change 2014: synthesis report. Contribution of Working Groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change. Ipcc, 2014.
10. Yilmaz, Altan, and Şebnem SARGIN. "Water effect on deteriorations of asphalt pavements." TOJSAT 2, no. 1 (2012): 1-6.
11. Nemeth, Andrew Francis, Devon Allen Ward, and Walter Gordon Woodington. "The effect of asphalt pavement on stormwater contamination." (2010).
12. Kodippily, Sachi, John Yeaman, Theunis Henning, and Susan Tighe. "Effects of extreme climatic conditions on pavement response." Road Materials and Pavement Design (2018): 1-13.
13. Emery, J. "Climate change impacts on asphalt pavements: Global perspective, adaptation and opportunities." In Canadian User Producer Group of Asphalt, Canadian Technical Asphalt Association, Edmonton meeting. 2010.
14. Boyle, Jessica, Maxine Cunningham, and Julie Dekens. "Climate Change Adaptation and Canadian Infrastructure." International Institute for Sustainable Development (IISD): Winnipeg, MB, USA (2013).
15. Qiao, Yaning. "Flexible pavements and climate change: impact of climate change on the performance, maintenance, and life-cycle costs of flexible pavements." PhD diss., University of Nottingham, 2015.
16. Gudipudi, Padmini P., B. Shane Underwood, and Ali Zalghout. "Impact of climate change on pavement structural performance in the United States." Transportation Research Part D: Transport and Environment 57 (2017): 172-184.
17. Nunn, M. E., and T. M. Smith. "Improvements to the indirect tensile stiffness modulus test." In PERFORMANCE AND DURABILITY OF BITUMINOUS MATERIALS. PROCEEDINGS OF THE SECOND EUROPEAN SYMPOSIUM ON PERFORMANCE AND DURABILITY OF BITUMINOUS MATERIALS, LEEDS, APRIL 1997. 1997.
18. Read, John, David Whiteoak, and Robert N. Hunter. The shell bitumen handbook. Thomas Telford, 2003.
19. Leech, D., and M. E. Nunn. "Deterioration mechanisms in flexible roads." In PERFORMANCE AND DURABILITY OF BITUMINOUS MATERIALS. PROCEEDINGS OF THE SECOND EUROPEAN SYMPOSIUM ON PERFORMANCE AND DURABILITY OF BITUMINOUS MATERIALS, LEEDS, APRIL 1997. 1997.
20. Jiani, Wang, Xue Zhongjun, Tan Yiqiu, and Zhang Lei. "Effect of Ultraviolet Aging

on Asphalt Rheological Properties." China Petroleum Processing & Petrochemical Technology 15, no. 4 (2013): 26-32.
21. Nicholls, J. Clifford, and I. G. Carswell. The behaviour of asphalt in adverse hot weather conditions. Transport Research Laboratory, 2001.
22. McHale M & Hargreaves A (1997). The Development of Rutting on Scottish Roads: Interim Report, PR/SC/3/97. TRL Limited, Crowthorne,(1997)
23. (Kayser, S.(2009) Climate Change–Ramifications for Structural Road Design. .(2009)
24. British Board of Agrément's Highway Authorities Product Approval Scheme (BBA, 2004)
25. Vos, Erik, Jacob Groenendijk, and Minh-Tan Do. "Tyre and Road Surface Optimisation for Skid Resistance and Further Effects: D05 Report on Analysis and Findings of Previous Skid Resistance Harmonisation Research Projects." (2009).
26. Wilson, M. I., M. H. Burtwell, and A. Zohrabi. Assessment of Safecote de-icer product: Phase 2. PR/IS/13/02. 77 p. KELIŲ PRIEŽIŪROS MEDŽIAGŲ ĮTAKA METALŲ PAVIRŠIAUS KOROZIJAI, 2002.
27. Cui, Yanan, Dongsheng Chen, Lei Feng, and Le Wang. "EFFECTS OF SALT FREEZE DAMAGE ON THE VISCOELASTIC PERFORMANCE OF ASPHALT MORTAR." Ceramics–Silikáty 61, no. 3 (2017): 257-266.
28. Kachroo, P. N., and N. G. K. Raju. "Freeze-thaw effect on roadways-approach to pavement design with special reference to roads in Mongolia." In International Seminar on the appropriate use of Natural Materials in Roads, Ulaanbaatar, Mongolia. 2002.
29. Kandhal, P., and I. Rickards. "Premature failure of asphalt overlays from stripping: Case histories." Asphalt Paving Technology 70 (2001): 301-351.
30. Pais, Jorge. "The reflective cracking in flexible pavements." Romanian Journal of Transport Infrastructure 2, no. 1 (2013): 63-87.
31. Nesnas, K., and M. E. Nunn. "A thermal pavement response model for top-down reflection cracking in composite pavements." In 85th Annual Meeting of the Transportation Research Board, paper, no. 06-0127. 2006.
32. Mazumder, Mithil, Vedaraman Sriraman, Hyun Hwan Kim, and Soon-Jae Lee. "Quantifying the environmental burdens of the hot mix asphalt (HMA) pavements and the production of warm mix asphalt (WMA)." International Journal of Pavement Research and Technology 9, no. 3 (2016): 190-201.
33. Douglass, Scott L., Bret M. Webb, and Roger Kilgore. Highways in the Coastal Environment: Assessing Extreme Events. No. FHWA-NHI-14-006. 2014.

.

AUTHORS PROFILE

First Author: Huseyin Gökçekuş **,** Professor, Civil Engineering Department/ Near East University/ North Cyprus, Nicosia, Via Mersin 10, Turkey , huseyin.gokcekus@neu.edu.tr

Second Author : Youssef Kassem**,**Assist. Professor, Civil Engineering Department/ Near East University/ North Cyprus, Nicosia, Via Mersin 10, Turkey, yousseuf.kassem@neu.edu.tr

Third Author : Muhammad Kh. Musa**,,**Ph.D. Students**,** Civil Engineering Department/ Near East University/ North Cyprus, Nicosia, Via Mersin 10, Turkey , mmkidre @gmail.com

.