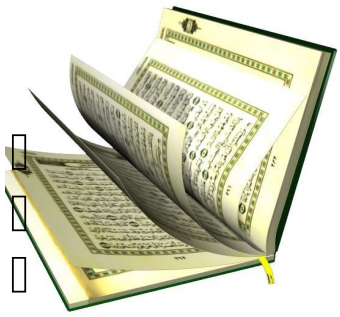

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{وَقُلِ

وَالْمُؤْمِنُونَ }

صدق الله العظيم
التوبة – الأية 105

DEDICATION

To my Mother

To my Father's Soul

To my Prather's and Sister's

To my Friends

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my advisor, professor: ***Galal Abd Alla Ali*** who has provided me with numerous opportunities to perform research in the area of flexible pavement design I am greatly indebted to him for the challenges he has placed upon me as well as his invaluable guidance throughout this research

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I finally would like to thank my friends in Sudan University of Science and Technology, College of Graduate Studies.

ABSTRACT

AASHTO design procedures for pavements design (flexible, rigid and overlay) are reviewed, summarized and presented. Where necessary, tabulated data, charts and nomographs involved in the design are reproduced in equation form to suit Excel, the programming language employed in this study.

Spread sheets are developed for the above categories of AASHTO pavement design. Results from the research approach adopted obtained by manual solutions deemed to be the same, except…….

The developed spread sheets could not only be used in pavement design, but also can be used as a teaching tool for its simplicity, ease of use, and straightforwardness. These will avoid the use of tedious use of nomographs and trial and error techniques involved in the design procedures.

These spread sheets can be developed further to include reminder types of pavements applying the AASHTO such as Low – volume gravel roads and other design methods e.g. Asphalt Institute.

التجـريد

تمت مراجعة و تلخيص و رصد طرق تصميم أرصفة **الطرق** المرنة, الجامدة و طبقة إضافية أسفلتية على **الرصف المرن** وفقا لطريقة **الآشتو**. كما تم تحويل بعض الجداول و المخططات المتطلبة في عملية التصميم أينما تطلب الأمر إلى معادلات لتناسب برنامج اكسل المستخدم كلغة برمجة في هذه الدراسة.

تم اعداد أوراق **إكسل** من أجل تصميم أنواع طبقات الرصف المذكورة أعلاه. نتائج أوراق اكسل عند مقارنتها مع نتائج الحلول اليدوية لبعض الأمثلة بدت متطابقة تماما عدا حالة واحدة و كانت نسبة الإختلاف لا تتعدى .7%

تم إعادة صياغة المخطط المستخدم في إيجاد الرقم الإنشائي للطرق المرنة ليصبح أكثر سهولة و سرعة.

بالإضافة إلى استخدام أوراق إكسل في تصميم طبقات الرصف فإنه يمكن استخدامها **أيضا في** تدريس طرق التصميم لأنها بسيطة و سهلة و مباشرة. هذه الميزات تجنب تعقيدات استخدام المخططات و مبدأ التجربة و الخطأ المتضمن في طرق التصميم المعدة لهذا الغرض.

يمكن تطوير الأوراق المعدة هنا لتستوعب بقية طرق التصميم وفقا لآشتو مثل الطرق الحصوية قليلة التكلفة و كذلك طرق **التصميم** المنسوبة لمعاهد **أخرى** كطريقة معهد الأسفلت.

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SYMBOLS AND ABBREVIATIONS

A: Average number of axle per truck.

ADT: *A*verage daily traffic.

AASHTO: American Association of Highways and Transportation Official

ARMI: asphalt rubber membrane interlayer

a_1, a_2, a_3: layers coefficients

a_1: *Dist*ance from center of slab

BRRP: Batinah Road Rehabilitation Project

CBR: California Bearing Ratio

CF: Condition factor

C_d: Drainage coefficient

Cv: Coefficient f variance

C_R: Cost ratio

D,D_f: *Directional distribution* factor for traffic

*D: T*otal thickness of pavement layers above the subgrade

D: Slab thickness

D_i: Damage ratio for load i

D, S: Center to center distance between two wheels

d_o: Deflection measured at the center of the load plate

d_r: Surface deflection at a distance r from the load

E: Modulus of elasticity of concrete

ESAL: Equivalent Single Axle Load

EALF, f_i: Equivalent axle–load factor.

ESWL: Equivalent single wheel load

E_p: effective modulus of all pavement layers above the subgrade

f_L, *L*: lane distribution factor

FHWA: Federal Highway Administration

G: Growth factor

G_t: Logarithm of the ratio of loss in serviceability at time t

HMAC: Hot Mix Asphalt Concrete

J: Load transfer coefficient

k: Modulus of subgrade reaction

L: Lane distribution factor

L: Radius of relative stiffness

M_R: Resilient Modulus

MS: Medium-setting

m_2, m_3: Layers drainage coefficient

NDT: Non Destructive Test

N_i: Allowable repetition

$(N_i)_T$: Total design application number of load i for n years

$(N_i)_1$: Initial year design application load

N_p: Total traffic to date in 18-*kip* (80 *KN*) ESAL

$N_{1.5}$: Total traffic to pavement failure (PSI = 1.5) in 18-*kip* ESAL

N_{eff}: Remaining design traffic to pavement failure (*PSI =1.5*) in *18-kip* ESAL

n_o: Initial number of repetition per day for i^{th} load group

n_i: Load repetition of load type i

P: Wheel load

PCC: Portland Cement Concrete

P_i: Percentage of total repetitions for the i^{th} load group

P_t: Serviceability at the end of time t

R: Resistance value

R: Reliability

RL: Remaining life

RS: Rapid-setting

r: Annual growth rate

r: Distance from the load

SC: Structure capacity

SN: Structure number

SN_{eff}: Effective structure number

SS: Slow-setting

S_0: Standard deviation

S_c: Concrete modulus of rupture

T: Percentage of trucks in the ADT

T_f: Number of 18 *Kip* (80 *KN*) single – axle load per truck

VSTM: Visual Survey and Material Test

W_t: Axle load at time t

$W_{t18:}$ Number of 18 *kip* (80 *KN*) single – axle load application to time t.

$W_{tx:}$ Number of x – axle load application at the end of time t.

Y: Design period in years

z: Desired depth.

ε_x: Tensile strain at the bottom of asphalt layer due to an x – axle load

ε_{18}: Tensile strain at the bottom of asphalt layer due to an 18 *kip* (80 *KN*) – axle load.

σ: Maximum tensile stress in concrete

σ_d: Deviator stress⁻

υ: Poisson's ratio

Δpsi: Present Serviceability Index