

DEDICATION

To my Mother

To my Father's Soul

To my Prather's and Sister's

To my Friends



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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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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.

التجريد

تمت مراجعة و تلخيص و رصد طرق تصميم أرصفة الطرق المرنة، الجا مدة و طبقة إضافية أسفلتية على الرصف المرن وفقا لطريقة الآشتو. كما تم تحويل بعض الجداول و المخططات المتطلبة في عملية التصميم أيذما 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 الاختلاف 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 بـ قية طرق التصميم وفقا لآ شتو مثل الطرق الحصوية قليلة التكلفة و كذلك طرق التصميم المنسوبة لمعا هد أخرى كطريقة معهد الأسفلت.

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SYMBOLS AND ABBREVIATIONS

A: Average number of axle per truck.

ADT: Average daily traffic.

AASHTO: American Association of Highways and Transportation Official

ARMI: asphalt rubber membrane interlayer

a₁, a₂, a₃: layers coefficients

a₁: Distance from center of slab

BRRP: Batinah Road Rehabilitation Project

CBR: California Bearing Ratio

CF: Condition factor

C_d: Drainage coefficient

C_v: Coefficient of variance

C_R: Cost ratio

D, D_f: Directional distribution factor for traffic

D: Total 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

ν : Poisson's ratio

Δpsi : Present Serviceability Index