

بسم الله الرحمن الرحيم

قال تعالى:

{ أَفَمَنْ أَشَسَ بُنْيَانَهُ عَلَى تَقْوَىٰ مِنَ اللَّهِ وَرِضْوَانٍ  
خَيْرٌ أَمْ مَنْ أَشَسَ بُنْيَانَهُ عَلَىٰ شَفَا جُرُفٍ هَارٍ فَانْهَارَ  
بِهِ فِي نَارِ جَهَنَّمَ وَاللَّهُ لَا يَهْدِي الْقَوْمَ الظَّالِمِينَ }

سورة التوبة الآية ( 109 )

Dedication

To my parents

My family

My teachers

And others

Who injected genuine improvement spirit?

To all with love

Tirti

## **Acknowledgement**

Deep gratitude, a great means of respect and thank full expresses to my academic supervisor Dr. Sami Abdulla to his model behavior and guidance in this thesis. An indeed appreciation for his encouragement and functional advises.

I would like to thank a few in engineering sectors who are expert and have a position in practice and modification of construction industry.

## **ABSTRACT**

Many Studies on oil storage tank foundation systems have shown that stability and soil movement are the two main factors which may lead to the rupture or even complete failure of oil tanks. Tank foundations are of variable types they are considered as special structures which required special institute (A.P.I.) and British standards (B.S.).

In this study oil tanks foundation problems caused by: soil mechanic and method ology of construction were investigated.

As a case study: oil tank foundations in Khartoum north (KRT.N) area were considered

Available experimental data was collected to identify the mechanical and chemical soil properties the depth of foundation necessary for stability and soil bearing capacity (B.C.)

These are the essential factors for foundation design.

Questionnaire was carried out to indicate the actual implementation practice of oil tank foundations, design and construction. Data drown from the questionnaire was analyzed statistically using (S.P.S.S.)

Based on the two studies conclusion and recommendations are presented, a complete and acceptable identification of the necessary soil properties for adequate oil tank foundation design and construction was achieved.

## التجريد

لقد اثبتت دراسات عديدة عن نظم اساسات خزانات الوقود ان عدم الاستقرار وحركة التربة هما العاملان الاساسيان اللذان قد يؤديان الي تصدع وربما الانهيار الكامل لخزانات الوقود . اساسات الخزانات متعددة الانواع وتعتبر منشآت خاصة حيث تتطلب مراجع ومدونات تصميم خاصة مثل مدونة المعهد الامريكي للبترول (A.P.I) والمواصفات البريطانية (B.S.)

في هذه الدراسة تم تحري مشكلات اساسات خزانات الوقود الناتجة عن ميكانيكا التربة وطريقة التشييد . كدراسة حالة تمت دراسة اساسات خزانات الوقود في منطقة الخرطوم بحري وذلك بتجميع نتائج ا ختبارات متعددة للتربة لتحديد الخواص الميكانيكية والكيميائية للتربة وتحديد العمق المطلوب للأساس لاستيفاء الاستقرار وتحديد قدرة تحميل التربة (B.C.) وهذه هي العوامل الاساسية المؤثرة لتصميم الاساسات.

تم اجراء استبيان لإظهار مدى الممارسة الحقيقية لتطبيق متطلبات تصميم وتشييد اساسات خزانات الوقود . وتم التحليل الاحصائي للبيانات المتحصل عليها من الاستبيان باستخدام برنامج (S.P.S.S.) .

بناء علي الدراستين اعلاه تم الوصول الي الخلاصة وعدد من التوصيات وقد نتج عن الدراسة تحديد مكتمل ومقبول لخواص التربة المطلوبة لتصميم وتشييد اساسات خزانات الوقود .

## Contents

الإهداء	.i
Dedication	.ii
Acknowledgment	.iii
Abstract English	.iv
Abstract Arabic	.v
Content	.vi
List of figures	.vii
List of tables	.viii
List of abbreviation (symbols)	.ix
Chapter 1	001
Chapter 2	010
Chapter 3	034
Chapter 4	048
Chapter 5	124
Chapter 6	141
Chapter 7	144
References	146
Appendix	
A-questionnaire form	
B-geotechnical report sample	

## List of Figures

Fig. No.	Figure Description	Page
Fig 1.1	Oil refineries in the Sudan ( Sudan and south Sudan )	06
Fig 1.2	Thesis structure flow chart	07
Fig3.1	R.C raft foundation section	33
Fig3.2	R.C raft foundation Plan	34
Fig3.3	Typical R.C wall foundation section	35
Fig3.4	Typical R.C wall foundation plan	35
Fig3.5	Typical earth foundation section	36
Fig3.6	PlanTypical earth foundation	37
Fig 3.7	Typical earth foundation with brick work retaining wall section	38
Fig3.8	Typical earth foundation with brick work retaining wallPlan	38
Fig3.9	Typical earth foundation with rc.rw alt.01 section	39
Fig 3.10	Typical earth foundation with rc.rw alt.02 section	39
Fig3.11	Precast concrete retaining wall elevation P.C.R.W	40
Fig 3.12	P.C.R.W precast concrete retaining wall section	40
Fig 3.13	Precast concreteretaining wall typical section	41
Fig3.14	Precast concreteretaining wall plan	41
Fig3.15	Ordinary red brick work retaining wall section	42
Fig3.16	Ordinary red brick work retaining wall plan	43
Fig 3.17	Hollow block retaining section H.B.R.W.	44
Fig3.18	Hollow block retaining section H.B.R.W.	44
Fig3.19	Different typical of stone retaining wall	45
Fig3.20	Normal rectangular stone retaining wall section	45
Fig3.21	Normal rectangular stone retaining wall plan	46
Fig 3.22	Photo of storage tank foundation	47
Fig4.1	Map that indicating location of study area 1	54
Fig4.2	Map that indicating location of study area 2	55
Fig4.3	Map that indicating location of study area 3	56
Fig4.4	Map that indicating location of study area 4	57

## List of tables

Table No	Table Description	Page
Table 1.1	Oil refineries in Sudan and south Sudan	04
Table 2.1	Degree of Damage	27
Table 4-1	Location (EN) of the selected boreholes on study area	49-50
Table 4-2		51-52
Table 4-3		53
Table 4-4		



## **List of abbreviations**

**L.P.G** liquefied pressured gases.  
**G.I.S** geographical international system.  
**G.P.S** geographical positioning system.  
**O.P.E.C** organization of the petroleum exporting  
**U.S.E.I.A** united state energy information administration.  
**KRT.N** Khartoum north  
**A.P.I.R.P 651** American petroleum institute.  
**A.C.I 318** American concrete institutions (code).  
**A.C.I 318 (API 2012)** American codes of concrete of petroleum.  
**R.C.F** reinforced concrete foundation.  
**R.C.R.F** reinforced concrete raft foundation.  
**D.D.T** dry density test.  
**N.G.L** national ground level.  
**R.C.W.F** reinforced concrete wall foundation.  
**P.C** plain concrete.  
**B.K.W** brick work.  
**I.S.G** Iron stone gravel.  
**R.C R.R.W** reinforced concrete rling rating wall.  
**O.R.D R.E.D B.K.W** ordinary red brick work.  
**P.C R.W** precast concrete retaining wall.  
**O.R.D R.E.D B.K.W R.W** ordinary red brick work retaining wall.  
**H.B.R.W** hollow block retaining wall.  
**S.R.W** stoneretaining wall.  
**E.N** easting northing.  
**S.U.S.T** Sudan University for science technology.  
**U.U** unconsolidated untrained.  
**C.U** consolidated untrained.