الآية

بسم الله الرحمن الرحيم

قال الله تعالى :

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

صدق الله العظيم

سورة التوبة الآية (109)

Dedication

I dedicate this work to my respective parents who have been the constant source of inspiration .Without their love and support this research would not have been made possible .And also to my wife who supported me in each step of the way , and to my wonderful son.

And I dedicate this fruitful work to my honorable teachers and my colleques.

Acknowledgement

Great thanks to Allah the greatest. I would like to express my deepest appreciation to my supervisor, Dr. Nuha Meawia Akasha for her kind patience and invaluable guidance throughout this study, and I would like to extend my thanks for teacher Dr. Fath-Alrahaman Adam for his help and appreciative efforts. Thanks also to the teachers at university of Sudan Faculty of civil Engineering.

Last but not least, my heartfelt gratitude to my family and friends who believed in me and stuck by me from day one.

Abstract

This research concentrate on design a multi storey building consist of twenty storeys building by using manual calculations(BS81101997code) and computer programmes named Etabs and Safe according to different international codes such as: BS8110-1997, ACI-2005, Eurocode 2-1992. The building consist of flat slabs, columns, raft foundation, shear wall and staircases. Moreover, the comparison was made and it was found that: firstly, the area of steel for flat slab by using AC1-2005 is greater than the area of steel for flat slab by using manual calculations(BS81101997code) about 3% ,and greater than the area of steel by using both codes BSI8110-1997 and EC2-1992 codes about 1% . Secondly: the area of steel for columns by using AC1-2005 is greater than the area of steel for columns by using manual calculations(BS81101997code) about 0.2% ,and greater than the area of steel by using both codes BSI8110-1997 and EC2-1992 codes about 2%. Thirdly: the area of steel for raft foundation by using EC2-1992 code is greater than the area of steel in manual calculations(BS81101997code) about 29% ,and greater than the area of steel by using BSI8110-1997 code about 5% and greater than the area of steel by using AC1-2005 code about 3%.

المستخلص

هذا البحث يختص بتصميم مبنى متعدد الطوابق مكون من عشرين طابق يدوياً وباستخدام برنامج الايتابس (Etabs) وبرنامج السيف (Safe) لمدونات مختلفة وهى: المدونة البريطانية BS8110-1997، المدونة الأمريكية ACI-2005،المدونة الأوربية- Eurocode 2 1992. المبنى مكون من بلاطات مسطحة واعمدة واساس حصيرى وحوائط قص وسلالم. قورنت نتائج التصميم اليدوى مع نتائج التصميم بواسطة البرامج المستخدمه . وعليه وجد أن : أولا: حديد التسليح الناتج من المدونة الامريكيه فى البلاطه المسطحه أكبر من حديد التسليح الناتج من التصمميم اليدوى بنسبة 3% وايضا أكبر من حديد التسليح الناتج من المدونتين البريطانيه و الأوربيه بنسبة 1%. ثانيا: حديد التسليح الناتج من المدونة الامريكيه فى الاعمدة أكبر من حديد التسليح الناتج من التصمميم اليدوى بنسبة 2و% وايضا أكبر من حديد التسليح الناتج من المدونتين البريطانيه و الأوربيه بنسبة 2% . ثالثا: حديد التسليح الناتج من المدونة الأوربيه فى اللبشة أكبر من حديد التسليح الناتج من التصمميم اليدوى بنسبة 29% وايضا أكبر من حديد التسليح الناتج من المدونة البريطانيه بنسبة 5% واكبر من المدونة الامريكيه بنسبة 3%.

Contents

List of Figures

List of Tables

List of Abbreviations

ACI 2005 Code:

M_0 = total factored static moment, N/mm^2

q_u = factored load per unit area

l_2 = length of span in direction perpendicular to l_1

l_n = length of clear span measured face-to-face of supports, mm

M_2 = factored moment at section, N/mm^2

d = distance from extreme compression fiber to centroid of longitudinal tension reinforcement

f'_c= specified compressive strength of concrete,MPa

f_y= specified yield strength of reinforcement, MPa

$A_{s,min}$= minimum area of flexural reinforcement, mm^2

b_w = web width, or diameter of circular section

c_c = clear cover of reinforcement, mm

d_b = nominal diameter of bar, wire, or pre-stressing strand, mm

f_s= calculated tensile stress in reinforcement at service loads, MPa

S = snow load, or related internal moments and forces

V_u = factored shear force at section, N

r = radius of gyration of cross section of a compression member, mm,

f_{yt} = specified yield strength f_y of transverse reinforcement, MPa

A_v = area of shear reinforcement spacing s, mm^2

φ = strength reduction factor

β = ratio of long to short dimensions: clear spans for two-way slabs

α_s = constant used to compute V_c in slabs and footings

ψ = is the effective length factor at the restrained end

b_0 = perimeter of critical section for shear in slabs and footings, mm

β_1 = factor relating depth of equivalent rectangular compressive stress block to neutral axis depth

T = cumulative effect of temperature, creep, shrinkage, differential settlement, and shrinkage- compensating concrete

P_u = factored axial force; to be taken as positive for compression and negative for tension, N

ε_t = net tensile strain in extreme layer of longitudinal tension steel at nominal strength, excluding strains due to effective pre stress, creep, shrinkage, and temperature.

P_n = nominal axial strength of cross section, N

l_u = unsupported length of compression member, mm

k = effective length factor for compression members

K = wobble friction coefficient per meter of tendon

M_2 = larger factored end moment on compression member, always positive, N.mm.

M_1 = smaller factored end moment on a compression member, to be taken as positive if member is bent in single curvature, and negative if bent in double curvature, N.mm.

A_g = gross area of concrete section, mm^2 For a hollow section, A_g is the area of the concrete only and does not include the area of the void(s)

M_n = nominal flexural strength at section, N.mm

h = overall thickness or height of member, mm

E = load effects of earthquake, or related internal moments and forces

M = maximum unfactored moment due to service loads, including P effects, N.mm

E_s = modulus of elasticity of reinforcement and structural steel, MPa.

A_{st} = total area of nonprestressed longitudinal reinforcement, (bars or steel shapes), mm^2

$P_{n,max}$=maximum allowable value of P_n, N,

V_n = nominal shear strength, N,

ρ = reinforcement ratio Eurocode 2

Euro codes 2-1992:

M = moment or bending moment breadth or width b

f_{ck}= characteristic cylinder strength of concrete

b_w= minimum width of section

h = overall depth of section in plane of bending

t= thickness

i= radius of gyration

A_s = cross-sectional area of tension reinforcement

f_{ctm}= mean tensile strength of concrete

x = neutral axis depth

$A_{\acute{s}}$ = cross-sectional area of compression reinforcement

$\acute{d}$ = depth to compression reinforcement

f_{yk} = characteristic yield strength of reinforcement

$A_{s,prov}$ = cross-sectional area of tension reinforcement provided at the ultimate limit state

$A_{s,req}$= cross-sectional area of tension reinforcement required at the ultimate limit state

δ = moment redistribution factor

L_0 = effective height of column or wall

L_a = lever–arm factor = z/d

s = spacing of shear reinforcement or depth of stress block

A_{sw} = cross-sectional area of shear reinforcement in the form of links or bent –up bars

$\propto$ = coefficient of thermal expansion

I = second moment of area

k_I = average compressive stress in the concrete for a rectangular parabolic stress

k_2 = a factor that relates the depth to the centroid of the rectangular parabolic stress

L = Length or span

E = modulus of elasticity

n = ultimate load per unit area

A_c = concrete cross-sectional area

N_{Ed}= design value of axial force

M_{Ed} = design value of moment

s_r= is the radial spacing of perimeters of shear reinforcement

$f_{ywd,es}$= is the effective design strength of shear reinforcement

V = shear force

N= axial load

$V_{Rd,es}$ = is the punching shear resistance of the reinforced slab

s_t = is the spacing of links around the perimeter and.

$A_{sw,min}$ = is the area of an individual link leg

$V_{Ed,max}$ = maximum design shear force

$V_{Rd,max}$= crushing strength of the concrete diagonal strut at the section of maximum shear

$\emptyset_{ef}$ = effective cr].]

British code B8110-1997:

d= Effective depth of tension reinforcement

g_k = characteristic dead load

q_k= characteristic live load

L_x = the length of the shorter side

z= lever arm

l_e is the effective span in the shorter direction

M = moment after redistribution

M' = moment before redistribution

β_{sy} = moment coefficient

L_x = the length of the longer side

f_y= Characteristic strength of reinforcement

f_{yv} = Characteristic strength of link reinforcement

f_{cu}= Characteristic concrete cube strength

N = Ultimate load per unit area

P = Final prestress force

ρ = percentage of total reinforcement in acolumn=100A_s/bd

ρ = percentage of tensile reinforcement in abeam=100A_s/bd

h = Overall depth of section In plane of bending

N=Axial load

B=Width of section

M = design ultimate moment.

V = design ultimate shear force

V_c=Ultimate shear stress in concrete

C_x =horizontal dimension of a column, parallel to l_x

x = Neutral axis depth

C_y = horizontal dimension of a column, parallel to l_y

s_v = Spacing of links along the member

l_0 = Effective height of a column or wall

e_x = is the resultant eccentricity of load at right angles to the plane of the wall (with minimum value h/20)

A_{sc} = Area of steel in column

A_{sv} = Cross-sectional area of shear reinforcement in the form of links

$A_{\acute{s}}$ = Cross-sectional area of compression reinforcement

A_{sreqd} = area of steel required from calculations

A_{sprov} = area of steel actually provided.

A_C = net area of concrete

f_s = Service stress or steel stress.

Z = Seismic zone factor

I = Importance factor

W =Total seismic dead load

C =Numerical coefficient

Rw = Numarical seismic coefficient

S = Site coefficient for soil charactristic

T= Fundamental period of vibration of structure

hn = Hight in meter above the base to level N