

Contents

Item	Page
الآية	I
Dedication	II
Acknowledgement	III
Contents	IV
List of figures	VII
List of tables	IX
List of charts	X
Notations	VIII
Abstract	XVI
المستخلص	XVII

Chapter One

Introduction

1-1	Introduction	1
1-2	Types of slabs	2
1-3	Objectives	5
1-4	Overview	5

Chapter Two

Edge supported slabs structural behavior, and design

2-1	Introduction	6
2-2	One-way slabs	6
2-2-1	Structural behavior	6

2-2-2	Analysis and design	7
2-2-2-1	Analysis and design for flat one way slab	7
2-2-2-2	Analysis and design for one way ribbed slab	10
2-3	Two-way edge supported slabs	10
2-3-1	structural behaviour	10
2-3-2	analysis and design	14
2-3-2 -1	method of coefficient	14

Chapter Three

column supported slabs structural behavior, and design

3-1	Introduction	20
3-2	Structural behaviour	20
3-3	Analysis and design	26
3-3-1	Analysis and design of coffered floor	35
3-3-1-1	Approximate Method	36

Chapter Four

Analysis and Design Applications

4-1	Introduction	39
4.2	Analysis and design calculations	39
4.2.1	Design assumptions	39
4.2.2	Design calculations for (6×8)m edge-supported slab	40
4.2.3	Design calculations for (7×7)m flat slab	47
4.2.4	Design calculations for (6×8)m one-way ribbed slab	51

4.3	Comparison between slabs	55
4.3.1	Materials (Concrete + reinforcement)	55
4.3.2	Form works	57
4.3.3	Cost	59
4.4	Conclusion	59
4.4.1	Flat Slab	59
4.4.2	Slab with beam	60
4.4.3	Ribbed slab	60

Chapter Five

Conclusion and recommendation

5-1	Conclusion	62
5-2	Recommendations	63
	References	64
	Appendix	65

List of figures

FigTitlePage

- 1.1** Types of structure slabs **4**
- 2.1** Deflection shape of uniformly loaded one-way slab **7**
- 2.2** Unit strip for flexural design **8**
- 2.3** Two-way slab on simple edge support: (a) bending of center strips of slab; (b) grid model of slab. **11**
- 2.4** Moment and moment variations in a uniformly loaded slab with simple supports on four sides. **14**
- 2.5** Variation of moments across the width of critical sections assumed for design. **16**
- 2.6** Plane of typical two-way slab floor with beams in column lines. **16**
- 2.7** special reinforcement at exterior corner of a beam supported two-way slab. **18**
- 3.1(a)** Column supported two-way slabs: (a) with beams. **21**
- 3.1(b)** Column supported two-way slabs: (b) without beams. **22**
- 3.2** Moment variation in column-supported two-way slabs without beam : (a) critical moment sections. (b) moment variation along a span. (c) moment variation across the width of critical sections. **24**
- 3.3** Moment variation in column-supported two-way slabs with beam: (a) critical moment sections. (b) Moment variation along a span. (c) Moment variation across the width of critical sections. **25**

3.4 Portion of slab to be included with beam 27

3.5 Distribution of total static moment M_o to critical sections for positive and negative bending. 28

3.6 Conditions of edge restraint considered in distributing total static moment M_o to critical sections in an end span: (a) exterior edge unrestrained, e.g. supported by a masonry wall. (b) slab with beams between all supports. (c) slab without beams. (d) slab without beams between interior supports but with edge beam. (e) exterior edge fully restrained, e.g. by monolithic concrete wall. 29

3.7 Tributary areas for shear calculation. 33

3.8 Types of grid-floors. 36

3.19 Deflection of ribbed slabs. 38

4.1 Section and plan for two way edge supported slab 41

(a) Partial floor plan

(b) Typical cross section (x---x)

4.2 Section and plan for two way slab floor without beam on column lines 47

(a) Partial floor plan

(b) Typical cross section (x---x)

4.3 Section and plan for ribbed slab. 51

List of Tables

Table Title Page

2.1	Minimum thickness of non pre-stressed one-way slabs	9
2.2	Minimum ratios of temperature and shrinkage reinforcement in Slabs based on gross concrete area.	19
3.1	Distribution factors applied to static moment for positive and negative moments in end span.	29
4.1	Show panel dimension and live load.	40
4.2	Coefficients for negative and positive moments.	42
4.3	Analysis and design results for edge supported rectangular slabs.	47
4.4	analysis and design results for edge supported square slabs	47
4.5	Distribution of moment into column strips and middle strip	49
4.6	Analysis and design results for square panel of flat slabs	50
4.7	Analysis and design results for square panel of flat slabs	50
4.8	Analysis and design results for one-way ribbed slabs	54
4.9	Show the amount (mm^2) and percentage of steel required	55
4.10	Show the amount (m^3) and percentage of concrete require	56
4.11	Show the amount (m^2) and percentage of formwork required	58
	(a) cross section (x---x)	

List of charts

ChartTitlePage

4.1Show the percentage of steel in the (flat slab and ribbed slab) **56**

to percentage of steel in (slab with beam

4.2Show the percentage of concrete in the (flat slab and ribbed slab) **57**

to percentage of concrete in (slab with beam)

4.3Show the percentage of formwork in the (flat slab and **58**

ribbed slab) to percentage of formwork in (slab with beam)

Notations

Notation for chapter two and three

w_a	Share of load w carried in the short direction
w_b	Share of load w carried in the long direction
M_o	Total static moment
M_u	Factored moment
M_{ab}, M_{cd}, M_{ef}	The moment across AB, CD, EF
M_{ac}, M_{bd}, M_{gh}	The moment across AC, BD, GH
E	Young modulus
I	second moment of inertia
α_f	Parameter of the relative stiffness of beam and slab
E_{cb}, E_{cs}	Modules of elasticity of the beam and slab
I_b, I_s	Moment of inertia of the effective beam and the slab
β_t	Parameter of relative restraint
C	Pertains to the torsional rigidity of effective transverse beam
l_1	The span in the direction of the moment analysis
l_2	The span in the lateral direction measured center to center of the support
w_{Du}	Uniform distributed dead load in short direction
w_{lu}	Uniform distributed live load in short direction
w'_{Du}	Uniform distributed dead load in long direction
q_1, q_2	The load share in the x and y directions
a	Short dimension of grid

a_1, b_1 The spacing of the rib *in* the x and y directions

q *Total load per unit area*

δ *Deflection of the rib*

Notation for chapter four

f'_c compressive strength of concrete

f_y yield strength of reinforcement

$d.l$ dead load

$l.l$ live load

W_u design load

h thickness

L span

L_a span of short direction

L_b span of long direction

m' ratio of panel ($L_a \backslash L_b$)

M_{aneg} negative moment at short direction

M_{bneg} negative moment at long direction

$M_{a\ posdl}$ dead load positive moment at short direction

$M_{b\ posdl}$ dead load positive moment at long direction

$M_{a\ posll}$ live load positive moment at short direction

$M_{b\ posll}$ live load positive moment at long direction

M_u factored moment

M_n nominal flexural strength

b width

d depth

R_n design strength

ρ reinforcement ratio

ρ_{max} max reinforcement ratio

ρ_{min} min reinforcement ratio

A_s area of reinforcement

A_{smin} min area of reinforcement

ϕV_c shear strength for concrete

ϕV_s shear strength for steel

E_c modulus of elasticity

I moment of inertia

Δ_d deflection due to dead load

Δ_L deflection due to live load

L_n clear span

M_o total factored static moment

β_t Parameter of relative restraint

α ratio between relative stiffness of beam to relative stiffness of slab

V_u factored shear force

b^o parameter of critical section for shear

A_c area of concrete section

V_c nominal shear strength

ϕ strength reduction factor

a lever arm

b_E effective width

C	compression force
T	tension force
b_w	width of web
S	spacing
A_v	area of shear reinforcement

Abstract

Slabs are surface structures which can derive their spatial configuration through continuous three dimensional surfaces, and the loads are resisted by the surfaces themselves. These structures carry tension, compression and in-plane shear within the surface as membrane forces. Bending and transverse shear are carried either normal to or within the surface, depending on the loading and the surface orientation

Reinforced concrete slabs are used in floors, roofs in building, deck of bridges...ect. The floor system of a structure can take many forms such as in situ solid slabs, ribbed slabs or precast units. Slab may span in one direction or in two directions and they may be supported on monolithic concrete beams, steel beams, walls or directly by the structure's columns. Normally they carry uniformly distributed loads. Slabs also tend to work as a diaphragm for lateral loads, it provides the overall structure stability by bracing columns.

Slabs are much more difficult to analyze because the surface geometry and the three dimensional material properties must be taken into account. Slabs which are rectangular can be analyzed using the elastic analysis by idealization into strips or beams spanning one way or a grid with the strips spanning two ways, method of coefficients which is used for the two-way systems that are supported on non-yielding beams and the direct design method which can be used for column supported slabs.

Slabs provide some of the most efficient structural systems in terms of material usage, cost, time, formwork and this leads to inherent economies.

المستخلص

تعتبر البلاطات من المنشآت السطحية وهي عبارة عن منشآت لها أسطح مستمرة ثلاثية الأبعاد ومقاومة الأحمال تكون عن طريق الأسطح نفسها. هذه المنشآت تتحمل الشد، الضغط و القص في مستوى السطح في شكل قوى سطحية. العزوم والقص العرضي تتحملهما البلاطة في إتجاه السطح او عمودياً عليه حسب إتجاه السطح والتحميل.

تستخدم البلاطات الخرسانية في عمل الأسقف, أرضيات المباني,الجسور...ألخ. البلاطات يمكن أن تأخذ عدة أشكال وأنواع مثل البلاطات المسطحة و البلاطات المعصبة، كما أنها يمكن أن تكون مصبوبة في الموقع أو مسبقة الصب. يمكن تصنيف البلاطات إلى البلاطات ذات الإتجاه الواحد و ذات الإتجاهين، على حسب توزيع الأحمال كما يمكن أن تستند على أقيام خرسانية أو فولاذية، حوائط أو مباشرة على الأعمدة. تعمل البلاطات على تحمل الأحمال و توزيعها و تعمل على نقل الأحمال الجانبية و تثبيت الأعمدة.

توجد صعوبه في تحليل البلاطات، وذلك لأنه يجب الأخذ في الإعتبار شكل السطح و خصائص المادة ثلاثية الأبعاد.البلاطات مستطيلة الشكل يمكن تحليلها بإستخدام طرق التحليل المرن عن طريق تقسيمها الي شرائح او عارضات في إتجاه واحد أو إتجاهين، تستخدم طريقة المعاملات لأنظمة البلاطات ذات الإتجاهين التي تستند على عارضات ذات جساءة عالية كما تستخدم الطريقة المباشرة للبلاطات المسندة على أعمدة.

تعتبر البلاطة أحد أكثر الأنظمة الإنشائية كفاءةً ممن ناحية إستخدام المواد, تكلفه ,زمن و فرم مما يوفر ويؤدي الى الإقتصادية.