DESIGN OF PROPOSED TWO - STOREY RESIDENTIAL BUILDING

BY

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IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF POST GRADUATE DIPLOMA IN CIVIL ENGINEERING.

FEBRUARY, 2011.

DECLERATION

I hereby declare that this project work is a record of a research work that was undertaken and written by me, it has not been presented before for any degree or diploma or certificate at any university or institution.

Information derived from personal communications, published work were referenced in the text

Hassan Monday Usman Date

DEDICATION

I wish to dedicate this project to Almighty God that made everything possible for me through is guidance, protection and to be able to complete the programme and write this report.

Also want to dedicate this project to my beloved wife (Queen) and daughter (Michelle) for their support and kind understanting, my gratitude goes to beloved my parent, bros and sister and in-laws.

CERTIFICA TION

This is to certify that Design of the proposed residential two-Storey building meet the regulation governing the award of the PGD of civil engineering of Federal University of Technology, Minna and it is approved for its contribution to Scientific knowledge literary presentation.

Engr S.F Oritola — Date

Supervisor

Engr.Prof. S. Sadiku — Date

(HO.D)

External Examiner — Date

Dean S.E.E.T — Date

Dean Post Graduate School — Date

ACKNOWLEDGEMENT

I honestly wish to acknowledge the almighty God first and foremost for is present in my life and for the numerous journey mercies and his abundant provision for my needs throughout the duration of'tnis course.

1am particularly indebted to my supervisor in person ofEngr S.F Oritola

For kind support and smoothly success.

My special thanks goes to my friends Attah innocent and Bro Law for their great contribution and helped to see this project to its logical conclusion.

Twill like to express my sincere gratitude to all those who in many way helped me in the course of my academic pursuit. I acknowledge the contribution of my class mate.

TABLE OF CONTENT

CHAPTER FOUR

NOTATIONS

As	Area of Steel
Asp	Area of Steel Provided
b	Breadth (Width of the Section)
b.,	Short Span Coefficient
b.,	Long Span Coefficient
bry	Flange Width
d	Effective Depth
Mr	Modification
Msx	Chart Span Moment
Msy	Long Span Moment
n	Design Load
N	Total Design Load
QR	Allowable Bearing Capacity
Qr	Characteristic Imposed Load
Qu	Ultiamte Bearing Capacity

LIST OF DRAWING

ABSRACT

This project work on the design of proposed residential storey building aims at exposing the undergraduate in to structural design of reinforced concrete structures.

Design in reinforced concrete commenced with the architectural drawing (as contained in the list of drawing and as appended) and this was immediately followed by structural design and detailing drawing.

In the entire design, consideration was given to factors like economy, safety and comfort for the user, the combination of the above drawing (Both architectural and structural design work) gave good start for the structural calculation works with desired output using relevant reference and information in accordance to SS811 0 part 1 and 2(1985) which form the core reference used in this project work.

The introduction and literature review from the chapter one and two of this project work respectively, confidently and in a simplified manner, maintaining the design procedure and principle, the design of independent structural element comprising of stair case, roof and slab as contained in chapter 3,formed the veritable steps.

Similarly chapter 4 contains the dependent element consisting of beam, column and foundation designs.

CHAPTER ONE

INTRODUCTrON

1.1 Background of the study

Structural design the selection of materials and member type, size, and configuration to carry loads in a saf and serviceable fashion. In general, structural design implies the engineering of stationary objects such as buildings and bridges, or objects that may be mobile but have a rigid shape such a ship hulls and aircraft frames. Devices with parts planned *to* move with *relation* to each other (linkages) are generally assigned to the area of mechanical design.

Structural design involves at least five distinct phases of work: project requirements, materials, structural scheme, analysis, and design. For unusual structures or materials a sixth phase, testing, should be included. These phases do not proceed in a rigid progression, since different materials can be most effective in different schemes, testing can result in changes to a design, and a final design is often reached by starting with a rough estimated design, then looping through several cycles of analysis and redesign. Often, several alternative designs will prove quite close in cost strength, and serviceability. The structural engineer, owner, or end user would then make a selection based on other considerations.

Before starting design, the structural engmeer must determine the criteria for acceptable performance. The loads or forces to be resisted must be provided. For specialized structures this may be given directly, as when supporting a known piece of machinery, or a crane of known capacity. For onventional buildings, building codes adopted on a municipal, county, or state level provide minimum design requirements for live loads (occupants and furnishings, snow on roofs, and so on). The engineer will calculate dead loads (structure and known, permanent installations) during the design process. For the structure to be serviceable or useful, deflections must also be"kept within limits, since it is possible for safe structures to be uncomfortably "bouncy." Very tight deflection limits are set on supports for machinery, since beam sag can cause driveshaft's to bend, bearings to burn out, parts to misalign, and overhead cranes to stall. Beam sti ffuess also affects floor "bounciness," which can be annoying if not controlled. Tn addition. lateral deflection. sway, or drift of tall buildings is often held within approximately height/SOO (1/500 of the building height) to minimize the likelihood of motion discomfort in occupants of upper floors on windy days.

Technological advances have created many novel materials such as carbon fiber- and boron fiber-reinforced composites. which have excellent strength, stiffness, and strenth-to-weight properties H wever, because of the high cost and difficult or unusual fabrication techniques required, glass-reinforced composites such as fiberglass are more common, but are limited to lightly loaded applications. The main materials used in structural design are more prosaic and include steel, aluminum, reinforced concrete, wood, and masonry.

In an actual structure, various forces are experienced by structural members, including tension, compression, flexure (bending). shear, and torsion (twist) However, the structural scheme selected will influence which of these forces occurs most frequently, and this will influence the process of materi al selection.

Analysis of structures is required to ensure stability (static equilibrium), find the member forces to be resisted, and determine deflections. It requires that member configuration, approximate member sizes. and material properties be known or assumed. Aspects of analysis include: equilibrium; stress, strain, and elastic modulus; linearity; plasticity; and curvature and plane sections. Various methods are used to complete the analysis.

Once a structure has been analyzed (by using geometry alone if the analysis is determinate, or geometry plus assumed member sizes and materials if indeterminate), final design can proceed Deflections and allowable stresses or ultimate strength must be checked against criteria provided either by the owner or by the governing building codes. Safety at working loads must be calculated. Several methods are available, and the choice depends on the types of materials that wiH be used. Once a satisfactory scheme has been analyzed and designed to be within project criteria. the information must be presented for fabrication and construction. This is commonly clone through drawings, which indicate all basic dimensions, materials, member sizes, the anticipated loads used in design. and anticipated forces to be carried through connections.

f. f.O Structural Elements

However, this particular project is carried out in accordance to BS811 0 part 1 and 2, which is capable of resisting applied load without appreciable deformation, cracking and shear of one part relative to other.

Structural elements can be group into two such as stair, slab, beam, roof and column as independent and dependent elements.

1.1.0 Dependent elements

1. Fiool' Beam

A beam is a structural member that supports the floor slab, block wan and itself weight and transmit these loads to the column, for further transmission to the foundation.

It is designed per it whole width which make it different from slab, which is design per meter run. The beam in this project is to be cast monolithically with the column and for this reason they are considered to be fixed

A beam can be monolithic and *still* be design as simply supported reinforced concrete designed consists mainly of providing member details, which will adequately resist ultimate mornet, s rear force and support moment.

At the same, serviceability requirement must be considered to ensure that the member will behave sansfactory under the working load.

1.1.2. Column

A column is structural element that carries the load from the beams and slab down to the foundation and therefore, 1hey are primary compression members.

In the analysis, it is necessary to classify the column in to one of the following types.

A. Braced column, where the lateral loads are resisted by the wall or ant form of bracing

B. Unbraced column. where lateral loads are resisted only by the bending action of the column.

C. Short and slender column, a column is said to be short ifboth the Ie x/b and Ie *y/b* are

(a) Lex< 15 for a braced column

(b) Ley<15 for an unbraced column

1.1.3. Foundation

;\ building is generally composed of supper structure above the ground level and sub-structure which form the foundation below the ground; however foundation of structure can be defined as that part of the structure which is in direct contact with the ground. Tt is there function to released load from the superstructure through the column and spread it in to firm soil strata.

II is expected that those load to be transmitted by the foundation does not exceed the bearing capacity of the supporting soil. Otherwise settlement may occur resulting in damage to the structure and its service facilities.

Some of the factors consider in foundation designed are

A. Designed load

B. Bearing capacity

C. Erosion

D. Depth of foundation

E. Subsidence

F. Soil type

G. Water table and fluctuation

H. The e isting structure

I. Environmental impact

1.2.0 Indepenendent structural element

1.2.1 Stair Case

A stair case is an incline slab connecting two or more floor together within a building; this may include one or more landing

1.2.1.1 Component of the stair

A. Landing: is a level plate like constructed between the floor either where the flight or step change direction or to make break in what would otherwise be over along flight of steps.

B. Flight: this is the continuous horizontal treat or steps.

C. Riser: is the vertical steps

D. Coin",: this is the horizontal distance measured from one face of one riser to the face of another.

1.2.2. Floor Slab

The reinforced concrete slab is another important structural member that are used in floor, roofs and wall in building and decking of bridges etc.

The floor system of a structure can be constructed as insitu solid slad, ribbed slabs or pre-stress concrete slab.

Slab could be one way spanning or two spanning slab depending on the ration ly/lx less or equal to 2.

AIM AND OBJECflVES

1.3.1 AIM

The aim of this project was to get acquainted with design of structures as a structural engineer and to produce a structural design of residential storey building using simple arcthitechural designed to form a safe aesthetic complex, economic and comfortable building for residential functions.

1.3.2 OR.JECTJVES

The objects of this work are

I. To ensured that the structure is safe under worse condition of loading

2. To ensured the structure is economic (i.e. the factor of safety should *not* be too large to the extent that cost of the structure becomes prohibitive with no advantages)

J. To ensured that under the working load, the deformation of the structure does not impair the appearance, durabi lity and or performance of the structure

1.4.0 SCOPE AND LIMITATION

The scope of this project includes architectural drawings. structural layout, structural analysis and detailing of the building from roofto the foundation,

Consideration is given to safety, cost of construction, materials and labour review and largely the laboratory test to determine the safe bearing capacity of the supporting soil.

1.4.1 LIMITATION

The limitations encountered are

I. expensive nature of architectural design and professional consultation eg books and practioner(engineer)in practice during the process

2. Limited access to internet services and poor electricity supply to work at night.

1.5.0 METHODOLOG

In order to realize the objective of this research, the scope of the design shall be treated step by step using a specific method.

I. Limit State Method

The limit state design method over comes many of the disadvantages of elastic theory and load fsctor design methods. In this method the working loading are multiply by partial factors of safety and the ultimate material strengths are divided by further partial factors of safety with this method the design of each member or section of a member must satisfy two separate criteria of

A. The ultimate limit state which ensures that probability offailure is acceptably low

B. The limit state serviceability, which ensures satisfactory behavior under service loads

CHAPTER TWO

2.0 LITE ATUR E REVIEW

A building structure is either framed or not framed, A domestic building (i.e a bungaJow or two store building) founded on a very good soil may be built without frames

Here the reinforced concrete slabs may be supported by the walls below which must be treated as load bearing walls.

While such load bearing walls are recommended to be at least 25 blocks from every bag of cement and adequately compacted with machine.

In other hand buildings that are 3 storey in height (or less but built on a very poor soil) must be framed (v.O Oyenuga 1999)

The framed will consist of slab, beam, column and foundation joined together rigidly so as to act as one structure, the loads from the occupants are transmitted through the slab, beam and column to the foundation, thus each element of the frame must be design effectively to handle it wn selfload and imposed load been transfer to it

The analysis of the structure as a whole component is very tedious and the advantages may out weight the disadvantages. The analysis can be done manually or with computer programs.

Basically they are two types of building as follows

a) Building supported on load bearing wall and

b) Building supported on framed otherwise called framed structures.

2.1 DESIGN METHOD

The design of reinforced concrete has gone through various stages of modifications; the major three (J) are;

A. The modular ratio method in which the loads are assessed as the (actual) working loads but limiting the permissible stresses in concrete and the reinforcement to fraction of their actual s resses in order to provide an adequate factor of safety, this is guided by CPI J 4 J 957.some design e.g. water retaining structure are still done using this method today, this method is consider as an alternative method and it is known as elastic theory method.

B. The load factor method in which the section is analyzed at the failure, the actual strength of a section being related to the actual load causing failure. With the later being determine by adding factor of safety to the design load. In the load factor method the ultimate strength of materials is used in the calculation, hence no variation in materials strength is taken in to account for this reason it cannot be used for serviceability states of deflection and cracking.

C. The Limit state method of design here overcomes many of the disadvantage the previously two methods, and that this method is used for this project in view f designed objecri es in both economic and safety.

The relevant materials used help in the procedures and enable me to obtain the general concept of the purpose: however the methodology of which this work is presented complies with the newest code in practice.

Moreover. for the purpose of simplicity and easy, I shall summarized the work procedure in more comprehensive terms recognized or directly given by the codes on design, analysis and detailing of structured designed for certain purposes(i.e. residential building)

2.1.0 Reinforcement

The section 7 of BS8l1 0 part 1 specifies that reinforcement should comply with BS449, BS4461 and BS4462 which explains that different types of reinforcement may be used for the same members, hence for a beam the tensile(main) reinforcements and comprehensive reinforcements might be high yield bars with fy=460,4 0,450 and 2S0,whiie mild steels are used for the links.

It may be mathematically cumbersome to use two types of reinforcement as main bars or links since their strength are not the same .Reinforcernent should be kept clean by stacking them of the ground prior to as age, free from mud, oil paint because all these weaken the bonding between the bars with concrete, except if the bars are rigidly fixed in the concrete in correct position and special care should be taken in fixed reinforcement in their correct positions especially in cantilever before the concrete.

At 28 cays section 3.1.7.2 of the standard specifies minimum grades of 25.0N/mm2 for the project work in both economy and safety of design in view of researches made on BS8110 via books as reinforced concrete design by W.H Mosley and 1H Bungey, reinforced concrete design handbook by Charles Reynolds and James saleeman, Simpli led reinforced concrete design is highly

base on safety and economy, hence the lise ofCPllO and CPI J4 are becoming highly a solution as they direct their design procedures more to safety, therefore, the coming of BS811 0 of 1985 and 1997 are concentrating in how to cut down cost as the design has been introduced and with this method, design of each individual or section of a member must satisfy two separate criteria's which are:

a) The ultimate limit state which ensure that the probability offailure acceptably low

b) The limit state of serviceability which ensures satisfactory behavior under service load(i.e. working loads)

Also wing to economy for instance, the lise of steel in compression is always uneconomical when the cos of a single member is being considered of the depth of the concrete of that member: they may offset the extra cost of individual member, finally the design procedure which is employed I;", this project has taken in to consideration factor such as economy and safety simultaneously.

In BS81 10 part I 1985 under table 3.14 and 3.15 for the slab design codes say that when the ratio of Iy/lx <, 2 the *slab* is said to be spanning in two way and if lyllx is > 2 the slab is spanning in one way, the table 3.14 and 3.15 help to determine the span and the edge coefficient of the slab in order to obtain the span and edge moment.

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I „l,le 1 I I ,Suppr'(1 moment I c32 t:Nm
1"'TrclN' depth otl-cam. IIiI I 10 min
11 .\/
F,: lyl't" 0 Ot119
11 II I.I'\\'f .11111?_ tI ▷< cl
ill 55 ITII11
1111 1\IC<I of steel requu cd. M
0.95/," t:
::2 mm y I~ or roo
371 mm!

r"bk 11 I :-':Urpf'l1 moment cocfficrcnt 0 n.17
ml-lc 1 I I SUPI'011 ITH'TII-rll I .c;20 f~NITI
lffccnve depth of beam . loll 1."7 mm
1111 ,\I
K hl'f,
11 II I eve urrn. ?_ 0o1 d
IJO " mill
11 II M
0951;=
")mm Pro\'Jd(: Y1~ at .100
377 mm'

I------J(,J.v(; .\I'A.-{MmS(':('~i
l.rblc 111 ";lidc;pan moment cocfficrcnt () ()~R
r.,)'k111 :'hppor1 moment I~I) [Hm
EITech\ c dl'l'lh of beam . 1'! mm
\{
F,: Ixl'./,. n n0"2()
.1 1 II 1.'.'\'.'ann. ?_ n 91 cl
1101<; mill
III' t,ea ()' vtccl ""1I111ed. M
0.95 /; z
::~ mm Y12 at300
)17 ITIm!

1l<;~IIO Riol' C,\LCULATJONS OI'TPIJT

IIIOFI.ECTION UIECK

Inhlc 19 R:lsic minimum effective dcruh
liir short "run ISt) ~ 111111
Moment rcdtstnbution tacmr In
I cusiou rciuforccmcnt nrca rn1\ idcd 1]"" nHn~
Tension reinforcement area required 22 fnm'
f"..:!.~",
~.,(:! It
1(, 20 I"R~N/IIIIn2
0.55... (.JT7-U ,If :<;:20
121)0.9 I It/')
C.OI)
Modified minimum effective depth ~-!'()15JX5 mm OK
1.12.11 2.7 n~ACKJNG
(,.ICkil1g i..controlled hy limiting bar "pacing
~. M,"xil11Ul1l spacing allowed for reinforc@:Rient 44"1 nun OK

1I'i~IIIII!JT CALCIJL.\TIONS (IIJTI'IJT

SL.\B "ANEL p~

I J IRon I1 1III
J2f() IIIII

I)N[-IVA Y SPANNINIj SLAB

Longer span of vlal-		I ~O ttl
Shorter span of ~Inb		I RO m
I'Incl.ncss 01 ~1<1h		I it; mill
I "hamctctrwuc stt cuath of concrete	=	30 N'fTln12
"haractcnsuc strcnatf of' steel		110 . mnl
I)cllSllY of concrete		~ Ino y'(!,/llt\
i Jraruatcr of' stcc! propos"d	=	12 111111

J.J IJURABILITY AND FIRE RESISTANCE

Table '\~ Nominal cover for mild conditions of exposure - :!f)mm coc cr fu == mm

'hIlk3 I I ehr '. 1til Fire resistance (\L

1.1 IADING 1 IN SLAG

Self weIght Cf "Irlb	I ~ KN'm'	
Finl"h("	12 f:"!fml	
I':lr"',f'nc: [munmum I	111:1-1101'	
I" :h;1f1lCrcn<:llc dead load	Ii 9 f:N m!	69 ,:N on'
|| haraciensuc uuposcd lond	15 KN'm'	1.1,:N/m'

\ :! I ~ , irlcSlgn 10001 II Ip" . I 6~, I

DESIGN~" IMENTS AND REINF, IIWEMENTS

A!;peCI ratio or slab 2333

I ()NG SPAN {SUrp()RTj

Iable 1 I I Support moment coefficient 0 fP7

I,tbk 1 II :-AIIPI'OT1 moment 11(,I;Nm

ll-tfccuvc depth ('\r"(,~I11_ 1,11 1,'7 nun

, I .11

t: M'r. n 1t()~6

'1: ; Lel es 111111_ i

130 1~ 111111

, I II vrca nf<;lc(" required. M

0.95(:

VI, at lno

377 mm1

LONG SPAN {UIDSI'.4NJ

I':lhh._,111 Midspun morncnr rocfflciem (I.Inx

I'ahlc '14 Support moment 1.094 KNill

Fffecrive dcptf of bca.n , ,,~ I~~ II1ln

14 14 II IJ 0(119

t: hl'/,

_| J 4 j I ever arm. 7. 0.05 d

110.1" 111111

1.1 II J\rca of steel required. I'd

0.951; ::

22 nun' Provrdc YI1 at 100

,T' 11I".~

CALCLJLATIONS ()UTP{ IT

fIf'FLECTION CHECK

\t,v'.k ,,.,..,;nim",,,,, clTt:t\'·';1.'.. dt.'j\\t\

r,,. ..hnrt "P:H1 (,91111111

r.. .oment rcdtctrtbutiun tacror III

-r..:llsinn rciuforccmeu! area rrm ided 29 1III n2

Tr-neion reinforcement urea required 22 11111-

2!,A~.,,. !_

'A".,. /1,

2()6.X4(i~,N'mrn2

Modification factor ().S5~ (477--f.) ,;20

12()O<)J ..:'!,I

(x(-

2.(1)

Vodificd minimum effecuve {{t'p,ll) !.615385 uuu OK

;.12 II ~.7 c/<ACKiNG

Crilckin,l! i..rontrotled hv limiting bar "raclnJ.!"

\13.'11;1\1111 spacing allowed for remfor ccmenr

SLAB PANEL P5

I -f)(I nun

301)1) 111m

l'NE-IVA Y SPANNING sr.xn

i ongcr ~pall -r slab = 3 (10 m

ISIIOr1cT spill! of slab I 20 m

"'C':"''' d ''"h .' ... TIII1I

"ltaructct"11,e stt cuath (,l" couctete = In N 111m2

'haracicnsuc ..treneth of steel = 110 N mmı

rcusuv of concrete ~ Inn ~'~ 'm';

[IJ.1m:'fh_~1 1·«Jed 1111't·—,J I':!mm

1 ------, 7 ,,'I'llRJ\RIJ,ITY AND FLRE RESISTANCE

Fable 1 , | '001111<1C0\ er Ill! !(lilci cmriilio,," cf exp(~1II-e - ~1)ynrl1 cover ~O= mm

l,,l>10 ,1 I ,l':hr 1111 Fife rco-tance OK

'SdfwC1P.hloI"5I<111 I 2 KN/m!

F1n,~he" I; J:.Nm!

Partitrous [uriuimum] = I < f:N m'

rhaructenstic dend lead (, () f~N/m: 69 !:N/m'

rharactcnsuc unposed load I ~ KN m' I ~! : 1m'

, -: 1 ·ı .... Design load II 11'<'I 6".1 1206 !:N1m'

Aspect rauo of slab 2,~nn

t.osa SPANISIIP/'OR7]

rahk \ 11 Support moment cocmcıcTII n 0:11

'\, ,\.\, II ~."f'l"\~m'{'1Tj~"" ''~n KHm

P'fccnvc d"r'h of t-eam . IJI 111 111m

1.44 ·1 II

j,: M(, (J.(1(111

1 1~~ I r-vr-rarm. .,. n,Q, , I

IJII.J:' mill

1.4 A ~ vrcaotetcc! required. M

0.95/;::

I.' mm" Pmvrdc VI2 at 300

377 mOl'

UJ,\'(; Sf'," \' IM/{}Sf'.'/'\'i

r:ll1lt' '14 IMtct."pall moment coefficient n,02R

r311ft- .. 14 ""urrfIrl moment OAR!' KNm

I Ifccuvr depth of hC;1111 ~ 'I I17 111111

\ 44 J If

K Ix/'(0,01109

\ 1 1J '",1t ı ann. 7 0,95 d

1..J.4 -l M

,\,:a of stce! required. O.9Sf=

10 mill'" Prnvule VI2 .U 300

:'7'1 mrn1

n~XIIII REI CALCULATIONS Ol!TPUT

DI;FIECTION CflECK

H1 ic minimum effective denth

ltlf <;horl "'I'~III -4"_~ 111III

1\1l'menl redistribution ':1(,lor 1,0

Tcncton reinforcement area rrovickcl 1111111"

Tension reinforcement area required 10 mill.'.

2/, ~(,,,, ''' ~

,_1~.," /~,

2/,_"t., "' ~
~A...,". ~,
= '06 S1(I~~ N'mml

H.55- (-ITl-fJ <1..1\
M
I2.rxo.'J+ ,~/)
~ 00

Modified ı11J1UllUm effecuve depth -31176923 mm

.1I: II : 7

If 'rnckiug "' (,OOlf)11("0 ov hrnitmg bar spacing

K laxtrnum spacmg allowed for reinforcement 1)9~30769 rnm ()K

IIS~" IIREF (IUTPUT

SLAB PANEL 1'6

(iO()l) rtun

60(10 111m

~, ~

rW'-I-\\'A Y SPANNING SLAIl

I.onger ~W'rll\·,f <lab		6fl0 ın
Shorter "pall "f~'iII1		r,W) m
II1lcl·Jl(,<:~ of slah	=	11\ nun
('haraCl!lnrllC strength of concrete		~n N nlln!
, 'harnctcnstic strength of "feel		lin N 10m!
f)m<:,t" of concrete		21'i() k~ m!
Dtarnatvt ofsteel I"f'jlt)';cci	=	I~rum

33 DUIL\BILITY ANI) FIRE RESISTANCE

Iahlv \ ı Nominal cover t~lfuuld conditrons of exposure 20ml11 CCl\'Cl ~,)= mOl

rclhlc.\ t I' hi I hr Fire resistance (lf~

I.' IADI'iG (1N SLAB

Self we!~hl of "lab		1 ~ f..~l'llll	
lrmsbes		1 ~ F:J\ mı	
~"..rti.hQ(\··~~,;,.~{hm\-	=	I, c ~:~ .~./	
t 'haractcristic dead l"atl		(\Q KN I1,1	o,Q K"Ilm'
{ haractcrisuc ill1po\cd ln:)d		I ₀ KN m-ı	1.5 KN/m~

; 2 I 2 C j;,",ign Inod Il. 1,,- ' l,"<l,l 12.(1(IKN/m'

DESI(jN I\!UMEN'I S ANII Rt.INWRCEJI.IENTS

I"pee, ratio of slab 1.01)/1

S.:IOR7 SPA V [SUPPORT}

rahlt· 31.1 "HIPPClr1 runmcut cocflicj~11[11.11411

fahle 1 1~ Support rllOIHL..lt! 1-t.Jfl(' KNill

f recuve depth of'bcam . ldl 14C) mm

14,,1 I .If

K n II ı(I!

ld'l.~

I ,I~.~ lcver arm. ı. 11.9.i d

1~l.55 111m

t 1~ I An'3 of ';lLcl required.

O,')Sl;=

.115 111m'::

yl2 at JOO

~' -i~,~~~~~ ~~ ___~ ~ ~~ __1~7~7~1~1I~m~' ~

Minimum rcmforccmcm are!'! 227.5 111111

[lSR II 0 flJ;F C.\L,UL/\ nONS orrnrr

SIIORT SPAN [1IIDSPAN}

Iable 1.1~1 Midspan moment coefficient 0.01(1

i":Jnk J 14 Sur-non moment 1~.025 KNm

I'Ffcerivc depth of bc.un . [tl] IJC) 111111

1 ~ 4 J II

K

ı JA I Lever arm. z. (IQ.; ci

141.55 111111

AI

0.9."1,::

		_ _M	
		0.95/,.z	
		~36 mm1	Provide Y 12 al")OO
			377 rum
	lu),w; IF·IS /SUIT'ORT/		
T.lhl< 11 I	tSUPI)I'fl moment coefficren!	00.17	
rahJ.- I I	ISUPP011 moment	161)6~ f.:Nm	
	i"lfecl1\'c depth (If beam .	1~7 111m	
1111	K =	I) 1)2R;	
11 II		II 9; d	
		130 I; 111m	
1 I I I	/' .rca ol' steel required	M	
		0.95/=	
		J 17 mrn'	Provide yl2 at 300
			377 mrn
	I ONe; SPtIN IMI/).\PAN}		
I,,",," 111	I\tidspan morncut coefficient	(I ncR	
I'Ihll' \ 11	Sl'PPOI1 moment	I~ 1_"6 I:iJlll	
	Fffccuve depth of heflin	117 tum	
11 II	If /y/' I	(I (\:!I(\	
11 II	I..,\ cr arm.	I) 9; d	
		1'0 1" mm	
"\I I \	/'I~f1of' steel requncd	,1·/	
		0.9·V;.=	
		21P nun	Provide YI2 at I'00
			)77 111m

BSRIIII HliF	CJ\LCULJ\ TIONS		1)t.:TPUT
	IJEfLEI'TInN CHECr::		
	II.I'II: IIIIIIIIIIIII elfec+lvc dt!l,n,		
	If'I ~hor1~:rall		
	'vloment redistribution factor	If!	
	'I r-nsron reinforcement area provided	377 10m2	
	rI'II~jI'IJ1I'ilfil)(,t'J1)\'Jl! rJJt';.I !!'r;uilt'd	2."\(~mill!	
	I'I'~J!n !ICT\lC'i! stress f	!J; /I~.,u.,*_!:_	
		3.-1" ~.. H	
		1-1.2' ....' N/mm2	
		I) ," ,_j_!_77-I.)M <20	
		12(W.91 ,'£,,)	
		20(1	
	iMClJiricd minimum effective depth	= 115..18462 111m	OK
1 I~ II 2.7	CRACKING		
	('t';lcking. it: controlled hy limiling bar <pacing		
	Ma'(illUIII "pacing allowed lin reinforcemcru	4~- 111m	OK
IIS~f 10 RFI·	(".\LCUL~TfONS		rn.TPUT
	SLAB PANEL P7		

!!- 1 !! !!!!
'')

_J~O(J IIIIII

TWO-W VV SPANNING SLAB

I.onger span of slab	4.~O rn
Shorter span IIf clah	4.20 III
fi" ..l:,,·w..t' t'tf ...:.bh	',:5 mn)
Ch.uncteristir strength of concrete	J0 ~IIIlm2
('il<ll:lClCnf.;tic "{rell~lh of 5 leel	410 N/mm2
Ikn"jly of concrete	240{1 "'g III'
f)la uater of ""I" rrnp")~'d	I? nun

r--.-----)~\I~J)~Ui~{I~\U~II~.I=T\=·~AN~,O~fl=~==R=ES=IS=T~AN~''-E---------------.-----------------~

Volllillal cover i0f nnld conditions of exposure - cOm", cover cO = min

~1,~II~,I,~,-|~I------!~i-',~.h~r~l~h~r~~~~~~~~~~~~~~~~~~~~~~~~~~~fI¹~"ir~e~r~c~~l~'t~a~nc~c~.,~I~~~

U.l'i\[)IN'UNSLAB

""clfW\'l~ht of'slat- 12 t':N'ml

F1l1i<;h~'<; l:! f:"'J'1ll2

1'(H1lth"'fl-[mininnuu l 1.5 ~:N'll1'

, 'haracten-tic dl.!r1d 10;.u1 (,91:N m' 69 f:N/m!

. "hamcrensric unposed lnnd = , .~~:N '|. = l c f:N/llll

=

DESIGN M''~[ENIS A.ND REINF' ,RCEHENTS

I I 13

SI/ORT SPAN ISI:PI'OR IJ

l Hh!t· 1 l l	Support moment coetficicnt		0 (lc;~
"11l1'h' '11	Support moment		11 ()1)2 f:"'JllI
	l' tfccu- e depth of beam .	ltil	l 19 mill
\ I I I		M / Me	1(1)16(>
ı I II	l cverat m.c-,		r) Q, cf / III cc; nuu
1111	.\ rea 01 steel rcquii cd,		",-/ 0.951;;; / ~')1 mill!

yI2 at 300

~.--. __----t-~~~~~~, -- +---------==----J~77~m~l~n-' ~

Minimum reinforcement area 227.511101"

!1SSIIRRIEI' C'ALCUI.AT1l1NS ,)l'TPUT

\'1I0RTSP.·'N fMfI),PANI

			nOVI
!""hlt,1 l l	S'lPl'OJ1 ııomen [		S ~f)tl f:r--:m
	IErfeoc1 depth ,'f l"""1.	Ld] \1	J1Q mill
ı ttl	t:	hl'/ =	i) 01 ~1
1 I I I	i,\'\'1.'1 ann .. _	=	0.9" d
		=	I II ,t; mill
J ı ! t	\lC~1ofS1Crl required.		M / 0.951:z / l-lCJ l1lm~

f'ro\'u.k y 12 at 100
377 mm~

t-axa SPA \' fSUl'POI/T/

l able \ 14	S~pport moment coefficient		(l.11.1"
l:1I,1l.: ltd	SllI'lWrJ moment		-.~-l KNm
	I flCXlt\ c depth of hl.:'U11.	l,n	l.t - ıııııı
.UU	K	.II / hJ'(.	0(141)
',·lAl	\ _t\t~ .\YIlI. /		(\.t.\~ d
			1.10.15 111m
3 1.,1 l	Area of ~1('el required.		M / 0.95('.:: / l;;';; l1lm~

I'rovidc Y12 al300
377 mOl'

/.()VG SP,·'II·lMIDSPAN/

Table 1.14	Mlljsp~nmoment coefficient		0 1)]~
l',,1,,".1 l ,	Silprorl uuuncnt		5,057 KNm
	rn-'cliH' d~Pfh of hc.un .	l,li	1.\- 111m
14.4.·1	K	.II / Me	n.1I106
1.1.4·1	lrv cr ann.v.		n.Q; d
			liO.15 lll.lll
.'ı I l	\ll'l of steel required.		M / 0,95(::: / llR mm

Provrde VI2 at 100
"',' mrn"

I!~RIIRRIT CALCULATIONS OtJTPUT

DFf'LECTIONCIlEt'K

~

Ihl~IC minuuum effectiv c depth 1(,1 vnuu
I~lr,h"l1 'PBII III
\I01I1('I1' rcdrstribunou factor 177 I11m!
Tension rcmforcemcut area provided I 19 I11m~
r('n~lnl1I'IllfolC(,II1C'I1t mea required

.r: = 2/; .-l,.... , ... _!_ 3A~..". 4.

1()7R6~11 N'JI11T,l

I „lll(" ~ Il) \rC'l(hflCallOIl factor = O"S' (-177-(.) <20 / 12O'O.\I~ M')

= :!flO

f_lK

Cracking I~ controlled bv limiung bar spacina.

~.fa;,"l\u!ll spacing allowed for rCliltorcemcnl 117 nun

IISSIII1 REF	CALCULA TI(JNS	uUTPUT

SL,\B PANEL PS

loon mm

12nD I11Ilt

TWII·WA Y SPANNING SLAB

I ›tI!!t'! "P;'l1 of sinh 1"')()m
Shorter span of~l"h 100 III
Thicl.nc-e of slab I"" I11nl
Charactcnsuc strength of concrete 1/1 N/mI1Il
charactcrisnc etrcnath of ..reel 110 N ITIln!
I)"nSII\' ot' concrete .: I£'" ~ 01'
Dtarnatcr of ..reel propose(I I~ mill

.1.J DUR,\SIUTY \ND rlRE RESISTANC[

\ ';o\'\t. ""-' Nr·.m\t"l{'t\ cover for m\~{((\nd,\,,,,,,~{'0r \:'p<'<;\.\I"C = 2!'."\l"f, mm
Table 1~ !ı -hr .....fhr Fire resistance OK

1.0A OING ON SLAB

~t"(fwe!g."'t ('If,l:1h 4 ; KN/FlI~
FillishL'S 1.2 KN'",'
Panirionv jmininuuu] I.:' KN I1I1
(haractcrisric dead load 6₀ KN/m' 1\.9 KN/m'
Characteristic imposed load 1.5 KN m' 1.5KN/m~

, 2.1 2.: 1206 KN III

DFSIGN MOMENTS AND REINFORCEMENTS

A..peer ratio of slab U(J(I
SirON I' SPA N {SIlf'PON'1
1':11,1(' J 14 Support monu-nr l'ocffi(icnl f).1l6R
I,,"k.\ 14 Support moment - ..1RI KNm
ITlccti vc depth ofheam . I"J ,1/ 1-I9111m

Me OfIII I

I ever ann. ·ı.

I~I 55 I11111

1.4 4.1 i'vf

o.9~/;,.::

1.l4111111" Provide Y12 at 100
377 mm'

Minimum reinforcement area 227.5 rum

BSXIIO I~"r	C \ LCLILATIONS	oin PUT

SITrJR ,. .\.,.,1A {III/)SI'A .\j

0.051

~

1.,1,,,"1 l l . ~llppm moment ".16 KNm

Fn~,ctlvḑcrlll oll-enm . [(~ 119 nun

11 ıı K ıı h:l'Ju

11 ıı l ever .ıııı. •_ = 0°' rf

= 111 '\5 rum

1 l l l vrca <'l steel required. M

0.9,';1:=

10f) mnl Provide y 12 at:300

377 mm'

10/1'(; SPAN ISUPPORT)

rol.,," 1ȷ l ~lll'p("rl10('ııl.!111 coefficient

r"hlo 1ȷ l Sur!",(.\f l moment l'1161:Nm

!"ITr.:e"c depth or bcam . l'~ l~7 nHll

11 l l M n (H171

J.: hl'[,

1 ı ı ever arm. z. 09' rl

1.10l' mm

1111 \ len of sux-l reqtnred, M

o.95f,~

"1 n'll',2 'y-,:' :ll:100

)77 mm2

l ONC SPAN {MIDSPAN/

T"l,l,,1 l ı ~lidepart moment coeffic.cnt n 02:\

r:,bl\, ı , ı ,uPl'nrt ıılılllı'ıı' "n,q~:Nm

Effrc!J\l' depth of beaut . iJl 111 TlUll

11 .11

J.: ITl'(.

ıı l .:vel .irm. :'_ 0'" d

lJO l c 10m

11 ıı 111

'\lca ofetcel rcquired. 0.951,"=

(.f) flHn! Provide YJ:! ar ioo

177 mm2

llSSl 10 REF ell LCUl.ll T1()NS l'vTPUT

DF,FLEl'TtON CHECK

Hasi.: l11lni1l1111ıffccuve depth

ltır short~pnn 115.4 mill

Ml1lHt:nl rcdistrilunion factor 10

'll n~ipll rciuforcernent :lr~:1prov ickrl ""i- 11l11l~

J m.C;.Jf)JJ r~;nff)rct!ml"'!! .JfCJ n:qllJrcd lno JHJll.'

f = 2J~,!'!*≈

M.-.,-. /~.

-.2.7M~145 l'1'l11m1

lahle 1.Hl 0.55-'- ,tT1-I:) :;;20

12("0.9 ı .!!.

/xl)

2.0(1

"7.(\'J21()X mill m;

1.12.11.2.7 ("R/lC'KlNO

C1'"1.:klllg is cornroued hy limiling har "'pacing

___ ~."jmull1 sl'aclllg allowed for reinforccmenl 4~'" lllm OK

1l~~110RrT CALCl'LATIONS OL:TPUT

SL:\B PANEL P9

l R00 !11m

2S-5 trnn

'l WO-WAY SPANNING SLAB

=

~

=

C;;;hOJ1t'span of !tlflh = I so rn

Thicl,ncss 0l' slah 175 rum

lc 'hnractenstrc etreuath of concrete \0 Nimm1

\,~h~,~-:t~';\r.t\c.rC(-,-.- "f ~tc:d tlfl~! mm!

l'rcnsuv of concrete ~'()(ll'~ nf;

1Jiamater of steel IWOJ)('lscn 12 Inn!

3 J DUIL\BILITY AND FIRE RESISTANCE

rilhl{, , 1 "Iomtual cover for mild condition!' of exposure ,...~{)fTlm cover ~O = mm

J'able J I I ,hr' Ihr Fire resistance Qf~

l.()ADING ,,IN SLi\Fl

Self wcn!hl "'f dal- 1:2 ~:N'm!

rlni~hec:. 1 :! ft~N.'ml

, arttuons jnntunrurn] = 1 5 }:N/m1

tharacrcristic dead 10 It! ()9 f:N/m! e, 69 KN/l11/

('haracrcrieuc lnJl'l()<;ed load = I .' f: 'ml q, 15 K m'

l:: I l)('slJ!ll load II I", 'I ("1,l 1206 KN'm' le 06 Y.N/m'

DESIGN ~I()~IENTS AND REINFOR, 'E;\IENTS

I 5o1

~/f()R7 SPAN{Sl'PNJRTj

Fable .' I , Surp<'lt; moment coefficient (1077

-'ilblt· 1 11 ':::lIPp\'li moment ~nn I F~NIll

Fffccuvc dcruh of Ill.!dl II ldJ J 19 nun

.'1 II II

t; 1rI'(

11 II l.rver ann, 7_ ,)n~ d

'11 ""mm

11 II J'''

0·95/>

<j4 mOl! Y1" at.100

377 mm2

\IIIIIIIIIII\ remtcrcem ent area 217,\ mm

IISSIllfREF ':Al/ .LILATI, INS III'TPUT

SHORTSPAN{MIDSPAN}

'J ahh- "' I..J Mrdspau moment coefficrc«: O.llSR

\',,hh. " \-\ S'T'l'r\'" mfom.::-m

rnCCII\'{.' demh of'bcaru . lnJ

1444 .If

K "',!, 11,0031

~.1 J J I ever ;lrl1l. ~ = l)<)id

= 1..t1.55 rum

\ J4·1 l\r:a of steel required, M

0.95 t;z

tllllll11.! y 12 at J00

377 111m.!

IOW; SPAS{SL'PPOR7}

I',hle .1.14 Sunron 1110mem coefficient l).or

l:1111c ~ 14 Sl1ppc1rl moment 1.44(1 KNill

l'OL'CIIYC depth of bcnm . l'~ 1]- 111m

11 I I II

K hl'(()002(,

1.4.4 J Lever ann. 7. 0.95 d

i:;,U':; mm

1JA J Arc-aof steel required, M

()95t:=

2Q 111m.! l'rovirte v: Z at 300

177 111111

f.()VG SP4N{Mlf)Sf'ANj

l":,hll' 1 ! 1 Ml(l,,;p:ln moment coefficieru n.02~

Inhle 1.IJ SIIPl)tlrl moment 1.094 KJ\m

Efh-ctive depth of henm . /J! 13- rnm

1 I J 4 If

K lrl'l,

1.-14.4 l.cvcr nrm.o. 11.9ãl

1301-' IIIT!

A.f

0.95(=

II II

$$M$$
$$0.95.l,".Z$$
= :::2 mm" Provu ic

IISSIIO REI'	CAI.CUI.AIIONS		,'UTPUT
	,I)EFI.ITTIUN CIIEn:		
	1:~;J.~IGmmmum cIT!"c'JI'cncrrh		
	111'f short span	69:! mm	
	h, foment redistribution factor	10	
	I enston rcmforccrnent area provided	1'17 mm!	
	I eneton remforcerucm are-a required	II mm	
	r:	2.(~A~=...:!:_ 3A~.", ~.	
		:=9711':"12 N'III111z	
lnbh- 1 In	"fc)(iTfictlllt'lI factor	0.55 (477 fJ M <20 I~O,')I ,,<l)	
		::: (10	
	}\Iodr ficd minmuuu effective depth	, I 615)S5 nun	
?, \"!" 2 1			
___ ~	~ la:-"1111lllt! !'pt\CIIIg allow en for reinforce;;;ent	1t7 nun	

IIS~llll REF	CALi:Ul.ATTONS		, 'UTPUT
	SLAB PANEL PI (I		
		1:!(IOIIIIII	
	I~(lihru		
	rWOWXY SPANNING SLAB		
	Longer span of ..lab	I SO In	
	~lrot1cr "p:m of ~Iah	L:!(llll	
	'j flld .llc"" or sInb	1-5 111m	
	('haraCICrl'ili.; t;(ICI1,p11dtconcreie	.10 N'IIImI	
	(h~t(it..:ILfj'licllrcngthof"cd	410 NinIln2	
	Ikl1!'ily .,f concrete	24(1) k~II11'	
	Di;ullakr (If steel proposed	11 mill	
	.U mJl(ABILITY AND FIRE RESISTANCE		
I'nhlc .11 '1':1\'\(: :_\,	N~trmnal cover for mild conditione; of exposure ""20mm ü.ı /ru _, \hr		cover 10 == rnm Fict 1~"·I~Wlt(.:nK
	I.OADING ON SI.AU		
	S('lf \Vcrpht('lf ~lah	42 KNI11I2	
	I ini,hc..:	I:': KN"I1'	
	I':I,'1111(""<; lmj,~jmuml	I."' KN/m'	
	Charactc j"Ijc dead IQ,l(I	(1.9KN m::l	(I Q KN/m~
	Characteristic imposed load	1.5 KN'1II1	1.5 KN/m'
~1.1. '.::!	Dc rign load 11..1"" 11.64.1		1~.()6 KN'm'
	DESKiN MUMENTS AND RELNFORCEMENTS		
	Aspect rano of stab		
	SlfORT SPAS fSIIPrORl"/		
1,lhll'", ı.j	SUI'I'nrt momentcoefficient	0.052	
r:1hlc 1 1.1	SIlrrmrt moment	II,O~2 KNm	
	I.n'·I:tj\cclqllh of br.uu . fdl Jf	1~9 IHIII	
	K hf(..	(101(>(,	
',·111	I ncr ann. 7.	1195 d	
		141 55 111111	
		'Af	
		n.'J_S/:-=	

il,1
0.95/;;:
c0, mm'   VI2 : I 300
377 mm!

",1inll1111T111!1I1foICClllelll .1h!(I

IlS~II(lREF	C;\I.CULAliONS		uU'1 PUI
	SIIORT SPAN IMIDSI'A,VI		
Fable , ↓ 1	. ~lidspan moment coefficrcnt	0039	
r.,Hc ' , ,	."ul'P<Y' moment	:(~n6 ":!'!m	
	F tfccti vc tlerr h of bearn . ld]	119 mill	
'I II	.\1		
	K /"(/'L =		
1111	Level .um 7.	0.9' d	
		ltl1 ~"l1lm	
\ III		M	
		0.95 t;z	
	=		PnWIl{C y 12 aI.]00
			377 rnm!
	I O.W; SPAN ISlJrI'()R77		
I'aldc 1 I ,	SUPI1('fi moment coefficient	'111'7	
'I nl-lc 1 I I	Support moment	7811 K"im	
	I Ifccuvc dcpffl0r l-earn .	1:7 1111ll	
\ I II	f:	ıı 'Il 10	
] I I I	111.!\~l ann. 7~	09' d	
		!.W ! ~ mm	
1 I ı I		M	
		0.951;=	
		I"" mrn!	yJ" at)OO
			::'77 mOl2
	UJNG SPAN /,lfl/)SI'ANj		
ruble ı I ı	t~ udspan moment coefficient	1102H	
r:-thk 111	lS'lppot1 nn-nn-nt	'9'1 KNm	
	'Iccuv- der,th of l-cam .	\1,7 mm	
\ I II		" Oln6	
\ III	Lever a1111. 7.	11.9' cl	
		130.15 mm	
\.·11.1	A rca of "Ieel required.	M	
		0.95/;:::	
		I lk Il1m~	VI2 ntJOO
			l77 flll1'

n~SIIOREF	CALCULATIONS		(IUTPUT
	DEFLECTION ('IIECK		
	rJa'\ic mrnimum effective depth		
	f')1 "hf)rf "P:Hl	!(it " mil1	
	Mlm1C11! r\'clio;;trih!1ti(ln factor	1.0	
	Tension reinforcement area provided	SI' 111rll~	
	Tensiun reinforcement area required	149 mOl"::	
	,"	2(A.,,, ... I	
		"Aᵥ.. /~.	

Tahle.1 ln

		2.0n	
	Modified minimum effective depth	80.-69231 nun	OK
.1.1211.2.7	CRACKING		
	(j'tl't..il1g i..c()!l{mHed bv fimirillg har ",:lcillg.		
	~1 .xiuturu o;;pacing allowed for reinforcement	447 nun	OK

]4011 1111)1

IS7, mm

i 11'110-\\",\ Y SI'ANNINli SI ..\8

[l.onacr span of slab ... m
lSho'1cr span of slal- ~ m m
II1Ic~lh!ss '.lf elah = I '75 mill
, "haractenstfc <ll!cnarlr of COTlcTC'le = .~0N mlO1
! "haracrensuc strcuath "l' steel 110 N "nnl
Densuv of concrete ~ I(\() k~ 'nf
llimllakl «l sreel llf('IJ'()"cd 12 llllll

:1) IlURAIlll.ITY AND FIRJ, RFSIST!\N('E

l'al-lc 1" ~lcunnnl cover for mil" conditions of exposure ~f)I1lm cover 2(1- mm
Tohlc.l I I' .hr lhr Fire resistance ()I~

I i)ADING ON SLAB

Self werght of slab 11 f:Nlm!
Fuuslrcs } 2 l~N ·'m!
PH111iOll!i [miumuun l ,; KN/m!
Charactensuc dead load (',9 KN'm2 = 69 KNhn1
, h<lP1Ch!n"11(' lHlppo:.l'd le-ad I' f:N'm' 'l' I ~f..N,m'

" I

DESIGN Mll~fEN1S AND REINl'i_'R' 'E~rEN1S

Aspect ratio of slab C 0.11
t OSC SPAN /SUI'I'OR77
I :J"l~ ~1 I Support Il1O1OCni coefficient oon
l'abk , ll Support ntoruent ::5'1fl KNm
J tfccrivc depth of beaut _ ldl 11'1 nun
, I ll ~I
„" Il '1f116
hi'f,_.
, I ever arm 7. ')9.' d
IJO 15 mm
, I ll M
\l...:a of steel required. 0951; z
51 111111' Provide Yl2 at .100
377 mOl:

I {JNr.SPAN /MI!)SPANj
!:lhJc: :1.14 ,\~h'sr:mrm'mcnt cl1cmciclIf
l.rh!c 114 Support moment 1.94_, KNm
rffcclivt.· depth of ht;!,1111_ |'| 137 FIIITI
1 .1.~.1 II
K t.{ t.
1.I.J I l ever arm. /. 095 d
I HJ,I5 mm
1.44.1 ;l..{
,.\r,:a of steel required. 0.95:1:=
_l}(111111' Provide VU alJOO
177 mm'

I3SHIIO RET C.~LCL'LATIONS UL·TPUT

1lr1'U£ nu" t 111:.lK
R,l'iic minimum effective depth
10r <:h(1" spau Q2, ~nun
Mil lent rcdictnbution f.rctor 1.0
'lc...f.,..«tn .c...·i"tc1r·cemc:rrr .1re.l P"(1\';,fed 5/ llTm':
'l c.tcion rrmforccmcnt area required 3~ nUll:
2f;A~.., * !_
1_.(,." It
~06,~4685 ~.J'lnmz

r:lhk Jill 0..55-'- (477 l.) <20.
}d
lyxo.q 1/,,,')
2 00
~(,.15]R"6 nun OK

1 1 C II C 7 CRAI'KLNG

r'i~ckiJJ~is emlrolled hv lilTliljll~ bar SflACIIl,!!.

\~\',.\('\S\mm

IISSIIO REF	CALCIJLA TIONS	UUTPUT
	SLAB PANEL 1'12	

lno() 111m

rw. I-WA Y SPANNING SL,\13

l""l1,l!l" ~"all Of slab	=	1 f)() III	
Shortt'!" l>p:tn of sl ah		lon lll	
"llucknсss of !'lal"		175 rnrn	
ll"haractensuc strcnarh of concrete	=	J0 Nlmml	
r 'haractenstic strength of steel	=	llPl\Jimm/	
j)cfl~lty of concrete		2 FlO kgm	
Dramater of steel 111 oposed		12 111111	

.u DURAFIlLI rV AND FIRE RESISTANCE

Tahlc ') \ \]OTlIInal cover for mild conditions of exposure ~0lll111 cover 20 = mm

l"ble 3 1 1)1 :hl l hr Fife resistance (lf:

li.(I/\DLNG LIN SLAJ3

iSclf Wt:1phr of slah		1 ~ f:Nr'rn!	
lrim~h~		\ 1 F~~~lm2	
l\Hl1'1pno;; [numrnum]		1 < ~:"Jn/	
tfeuacrensuc deadload		(I) <) .~N{ml	69 !:Nlm'
r 'hamctcrreuv ltnpf')<:cd loud	=	l'I :Nm'	IS KNlm'

l resrgn load II I", 'I 6'1,1

DESIGN ~I(\MENTS AND REINFOR(-EMENTS

A<p.;:Cl ratio of slab = 1.200

.\//OIITSPAN [SUPPORT}

l~hl\l l !	Support moment coefficient		00,6
'10"" \ II	SIlPl'Ol1 moment		('07S KNm
	Fffcenv c n('pllt of l-earn .	ld/	↓ 1(1 mill
'111		lf	
		hf(,	r t O(),)l
111 I	1.~vcr arru. 7~		09, d
			1 II S" IIITI
			AI
			o.95./;z
			IIOmm!

ylc at.100

377 mOl'

Mnutuurn o-inforccrnenr area 227 ~ rum"

IISSIIIIREF	l"AL('JfI.A11()"IS	',IITI'I)T
	SliORfSPAV /,II/DSP4X)	
raill,' \ 11	f\ll1t~f'l1lmoment coefficient	(10'12
rahlc 1 l 1	Sunpcrt morncnt	1 ""9 t:Nm
	Fftccuvo depth of beam . ld)	llt) mrn
, I I I	,lf	
	K l't/c =	
3 I I I	lt" el ann. 7.	09' d
		lll ..".''mm
'11 I	Area or eec! required.	AI
		0.951:=
		8,l mrn1

Provide y 12 al)()()

)r I IIIII}

IBVC SrA/I' {S/iPPORTj

rabh' '\ 1 1	SI("P("lf1 moment CoeffiCICl1!	0.0)7
l"III,l\ 1 1 1	Su, pott tnomcnt	101(,I:Nm

I f If	\;ffec II\ c depth of t-eam .	[,~	=	1.'7 mm	
	K	If ,·ii,	=	\',~d	
"\ \ \	\ e-,t t1: .11" n . r;		=		
			=	130 I' 10m	
,1 II	,\rca ofsteel required.		=	A-f O.95(z	
			=	19 ",m2	Provide VI2 !I1100 377 mm/

I.oN a SPAN [MJI)SPANj

1"I,k'II	r..firt<;l~TI moment coefficient			0 112R	
I'"1,1" 1 I 1	:-:IIPI'f'Tt ,"(,ITH'1I1			1 (119 ~:Nm	
	rfTeCII\ c depth of heam .	~I		137 rum	
, I I	K	M Me			
11	I ever arm. 7~			119<; cf	
				1.10 I' mm	
,I II	vree <'I '1<'" rcqutreri,		=	M 0.951,'::	
				60 milt}	Pro v ide YI:! at 300 311 mm1

11SNII" REI'	rAL(,ULA Til'NS	nUTPUT

IpEFLE' 'T1<'N ~IIE'.I.

lahfto t o	ipm.,(' "111;""111 cn.·ctl~·depth			
	ti,r ~h("lft spnn			'I" t mm
	~Iomcru rcdistnbuuon factor			I n
	r~'I1$W'reinforcement area provided			J77 mill!
	'' ;'11"1011 reinforcement area required			~1 mm!
		.r:	=	2/, A~., ..._!_ 3..1",.,", .4.
			=	co 92~()(,1 N 1'11m!
	~Iodrficanon factor			0.55· (-1n n <2(1 M I2(XO.Q 1/)(/;-) 20(1
	Modified muumuru effective deptl			57.692308 mm	VI-:

1'\\"CK1~~I;

Ctackiuu j.: controlled hy limiling bar spacing.

IISSIIORFF	C~[_CUI ATJONS	J)I'TPIIT

SLAB PANEL P13

10no mill

~(IO(I IIIIII

TWO-W.\Y SPANNTNG SUB

I.ongcr span 1)("Iah	1.60 ru
Shorter span «F o;;lah	.1.00 III
"I hickucv .. of ..bh	17~ IIIIII
('bnractcrretic strength t,f concrete	.10 N.'I11ml
('haracteristic <trenpth ('I' stec I	410 N/mm2
Ikl1!"it~of I.:OIH.:n:IC	1400 Irg/I1I~
I y.atlIJ(("f of ~Icl'proposed	11 mill

' .1 IIIJRABJI.JTY ~ND rJRE RESJSTANCE

r.lhle 1 I T"hlc:U	NOhlil1JI cover for mild conditions of exposure - lOmm)\ ,hr ...lhr	cover 2.0 == mm Fire rcsrstancc OK

I.() ~IJIN(; ON SLfIII

Self weight or "lab	4.2 KN'III"
hI,i':hI'~	1.:2 KN'JJI~

Pfirl,tU1Il:" [rrunimum l = 1.5 KN/m'

ı'Iwractcn,hc oeno lond 69 f:N/ml 6.9 KN/m'

eharactcristic imposed loud l ~ F: ';,'012. = 1.5 KN/m'

I ~I I'e<I~1I load I' 114 ı I 6q, I 1206 KNlm'

DI;SIGN M(I~1.ENTS AND REINF()RrEME!'-'TS

Aspect ratio of slab 1.2110

.IIIORTSPAN (SUPPORT]

r.IM 111 t;:\lppon moment coefficient ıı 1156

reb,," 111 Support moment 6 07S I:Nm

"ffccn- c ('krlh of l-earn . 119111m

K = [rlJ III / hfl.,, = n'~191

.1111 I ever arm. 7_ 09' d

= 111 c;c; 01111

{III vrea ofsteelrequired, lv! / o.~f,z

I 110 mill' Provide y12 a 100

I .

I– L;':m""\\\\ ,,~\\\{<.'I~\\w :t\\ ';l.t;"e'i\\ ::'2.7 ~ mm"

IIS~ 111 II! I\I' 1~i\L<'ULi\ TfONS ,'liTPIJT

SIIORTSP.IN {MmSI'AVI

I',"I< 111 "Iieispnn ruorueul cocfficrcut ı) 01 ~

r.,b"" \ II SIIJJIX1,IIIHIJIICni 15-'0 Kl':111

Effective depth of l'caru . lıc) mrn

II II K = InJ \1 / M'L ı) Onfi~

1 I I I = on' cl

111.<;" mill

\ I II \ rea of steel required, = M / 0.95t;z

,,1 mITIl Provide y 12 aOOO

377 mmı

t ot«: SPA~' {SUPPORT}

rahll.! , I I Support moment coefficient 11037

1.rblc J ı<ı SIlProc1. moment 1.016 f':Nm

~ i\"C:t.:'i,\l ot"p'lh nfhC':.uTI. \.11 \.- "'!Wl)

14 1 I K ,1/ / hi'l:"

1 everarm, r. 1l.<J\d

1."0.15l11Jll

14.J .1 \1:'=.1 of steel required. lt" / 0.95.1;::

79 mnl Provide yJ2 III ~OO

377 OJm'

I ()W; .\'/'4,\ {'f/l).IPA/IY

Fable 1 14 Midspan moment coefficienr n.02R

r,~Il' 3.1~ Su.mort moment 3.039 KN",

Fffcefive depth of bcam . 1:\" ııııı

14.4 I K If / MI. 1).111)<;4

I J..1.·1 l.c\'cr:lrln.7, (J.9; d

1.10.15 nun

M / 0.95/,' z

(\()mm' I'rovide Yl2 at 300

I1~RII()HI'/' CALC! ILA IIONS OUTI'liT

DEFU'CTION CIIECK

lb. ic minunutu effective depth

for -hort span ll t4 111m

Moment n:di~lril)\\liiln factor 1.0

I cnsion reinforcement area provided 'l..7- Il1nl~

Tcncion rcintflrcemenl area required ~nm1

r\ ,.. i,,., ... _. 2!,:.4...,~,.",I

,'/lv~:" I(

~

|' '<"~" ,c,·'" "'C," t:

19921061 'IIm(}

\' Iodrficauou f"CJ0J = I)S<; (477-f) <20

1""0,')-1- iH)

"'. IxI'

~ no

Modified IIIIUimtUII effective depth :'7.692308 mm OK

_I I:, II : '

If 'rackma r\ controlled hy linutmg b", spacing

,

1 -------; ,– :\la:,dl111llfl spacing allowe\1 for rdnforce;;;enl

IISSIII' II EF ,---------C-I\-L-"-U-L-"-·-n-O-N-S---------r.---, -'U-·T-P-U-I--------I

SLMI PANEL PI I

I2In mill

IWI.)-WAY SPANNING SLAB

Shorter -:pnll of :·;lll" '\,Olim

t'luckncss of slab 1!c. mm

Charactc-nsuc strength of concrete 10 N/I1II11!

('haractcrisuc strength of steel lin N'lllm1

I1I'I1SIIV of concrete ~,lO(ka.m

I)'(1I1I<t'tT (Ir steel proposed 1~ 111111

,1.1 DURABfLITY AND FIRE RESISTANCE

r~lhll'11 Nominal CCI\'er for mild conditions of exposure ~Omm cover 2()== mm

Tallk.\ f I -In- II" fire resistance OK

j" I,\I)ING, IN SLAII

~·klfwcrght of slab 12 f:N.'m'

I-mishcs I .! ~:N'ml

IP Mtili.(m...\mnmnm\".\ I.5 KN/,,,1

('h:lr:lc!cd"lk dead I":ltl (\() KN tn' p.9 J.::N'lll'

('Pllrilclcri!'lic 1f"IlPOS~load I.';; KN'm1 1-' KN'm!

1.2.1 2 .~ 12.0(, KN !II~

DESIGN MOMENTS AND REINFOHCEMENTS

I\~PCCt ratio of S13\I IAO]

SHORT SPAN (SUPPORT)

I""hII' I 1·1 SUpr(lrt moutcm coefficictu (I.O(>X

I",,I>I.' \ II Support !I10111~nI -.\')9 K.Nm

FP;_'ctivl' depth of herun . 14q nun

K (IOII I

.14,4,J , ever ann. 7. nqs d

1~1.55 mill

/"'f

(\,t):;;f:=

114 Inl11~ Provide VI2 at. 300

377 mm'

MilIIIIIUJ11 remforcenieru area 227.5 uuu"

IISRIIO uur C.,\LCULATIONS OUTPUT

SIIOR7 SPAN (MIDSPAN)

I"JhkJ.)d Midspan moment coefficient (I051

Fnhh- tIt SlIp,mrt tnO!11CIII 5.5'0 KNill

fffcc!iVt' depth (Ifl'cam Irfl 14() mr»

1.1,4.1 H

K MI.

1.4 4·' I cv..r..ann. 7. (\,95 d

IJI.55111m

ilt

(),9~t:z

i r : ! J'vf

0.95/,"z

10J 1ll1ll~ y l~ a1)OO

311 lOrn!

/ O,\'(, SP.I,v (SliP/'OR)}

rl1hll4 l l SUpPN1 rnoruent coefficient 0.037

lnldc 111 ~lll'p('ltt 111C'lTl('nl 100n,:Nm

'"fTl'~U\l~ depth OffiCiU!!_ l"l 1,17 nun

'! ll If 0.0071

K h/'r..,

I!! ! n 9' cl

l~o! c. Tlll"

M

! ll 0.95(.:-

79 mill VI" at 300

377 1ll1ll!

l'ot«; SPAV{MfDSI'-lf>.}

r"l>1<l1 ! 'l\ hdspan moment C'(('l1icl(,1l1 I) O-~N

T"l>l,' 1 l l Support moment :l 0.19~:Nm

(tTeclJ\c depth of+cam . 1~7 nun

"\ \ \', K -

'll! :. .cver arm. Z.. 09' d

1.101' nnn

1111 M

0.95/."z

00 11lll! Yl~ at 300

J77 mm2

llSS ll llREF C\LCULA TluNS

DEFLE("llt>N CllEn:

Table "\q 'b~ic minimum effective depth

for o::h011 ~p<1ll 115 101m

b loment redtstubution factor 10

Tcuston r cinfor cement area provided 377 mOl!

Tension lClllf01CCTllcni area required 101 mm!

2/ .....1":0r ,.,

~Av .." · /3"

-2.l,l5(,JX~N/mm'

r;rhlc till Cl.SS-'- (r.n-f.) M <2.0

121,,0.9!lx!)

2.0(1

Modified minimum effective dcpl" == .57.(lQ230X lllll OK

1.12.11.2.7 CRACKING

Cr~f('"king: controlled hy limiling bar <:pacing.

l\aximul1l spacmg allowed for rt!inforcemelll 44 r 111m OK

llS~llO)(Er SLAB P.\NEL rl5

2400 min

,}7~g mrn

ONE-WAY SPANNING SLAB

l l'Hl:!cr "l"an l,f ~la"" 9.7e) lll

Shorter span of "lah ~ 40 lll

Thil'kllc<;~of~lnh li5 111m

(·r.~lraclcri"li(' strength of concrete JO '1'llltl11

(·l-:\t·~v.::t.cn\ufktn.:f\~th«f ~v:.~l J.tll /m",1

1l1.'1'<ily l,f concrete 240(1kg.rn'

Dra-nater (lf steel proposed 11 111m

3.1 IJURi\I3I1.ITY ANIJ FIRE RESISTANt'E

NOllliliaI cover I(~mild f(llldl I10" of exposure COllltll | C.,\ er 20:::: | 111m
I' -hr Ihr | Fire resistance Of:

I.('i\DINli ON SLAB

	Sclfwcraht 0r"l"h		I :! t:N':llll		
	Fini!'he"		I 2 r:Nilll '		
	t'arunons [minimum		=	I " KN'm Z		
	ı "harae-teustic dead load		(,9 hN/m!	~,	69 KN'II1'
	Chnmcrcnsuc rruposed toad	=	I 5 KN rn Z	~, =	I 5 f:N'o,!
ı ~ I 2 :!	licsrguload II ·I14 'I 6~d	=	1:!,f)6 KN'm '		1206 KNlrn'

DESIGN MuMENTS ,'-ND REINFtJR':EMENTS

	Aspect ratio of slab		·1.07S	
	I.(JN(; SPAN {SUPPORT]			
Inblc J I I	~:IIPp01 mom en I coefficrcut		0 11:17	
I"H, ·III	Support morncru		2 '10 ,;Nrn	
	Fffecnc e depth of heam .	I(~	1}7mm	
I I I I	K	M / V;	n 111)I6	
I I	·vcı arm. ~·._		filiI c!	
			1J0 1~ TITIII	
.11 II	,\ ıca 01 !'tel..ı required.		M / 0.9.5/,:	
			~I IIIIIII	yl" atJ()O
				377 mm2
	I ON(; SPAY {MIf)SPA VI			
T~"IL" I I	:~11('i!>'1fI1lmoment C(~niCI\']11		o.nrs	
Iublc '\ I I	S'IprO,ı'llnlTll:nt		191' f:Nm	
	Fffccuvc dt'plh of beam .	i'~	1.'7 mill	
11 1 I	K	,If / M'!.	I) onl~	
11 I I	Lever cnn. 7_		0.95 d	
			130.15 mrn	
1 I II	At ca of<tee! rcqmrc d.		M / O.95/,'z	
			)~ mill!	Y12 at ~rJ(1
				177 111m2

IIS~ I lOR I.F	C., LCUIA TIONS		OUTPUT
I–	+I_':TI H TJ()N CIIECJ.:		
	H:t(iit.: minimum cffectiv c depth		
	~Ir short span	tl2.3 rum	
	M'l".cnT rc(lio.;lrihllliPI1 f:ICtf1r	1.0	
	Tension reinforcement area provided	51 rnm	
	I"., ..i<lII reiuforccmeut area required	JR 1111II~	
	DCI.;ign scrvirc stress	2/,.A.,,,,!_ ",..!_ / 3",1"..... I~.	
		:!f)n.R4(lR~ N.'nun!	
T"bk.1 It)		0.5.5, 1~77 fJ < 20	
		12(XO.9+ A'~) / "d"	
		2 (I(I	
	Ml.ldJflc,l muumum cflccuvc depth	~".1)384(,nun	UK.
3.1-'.1 1.27	I'R ~CKI'J(j		
	Cracking is controlled by limiling bar spacing.		
	'-f:I\';mwII "p.l(.';ng al/owed lor rcinfcrceruerıı	IJ~.46154 111m	

IISRI 10 RI:I	CALCULIITIONS	OL'TPUT
	SI.AB r~NELPI~	

~ 24Ot) 111m

2RRF. rill"

I\I'O-WAY SPANNING SLAB

i.onger span of slab		~S9 m
Shorter span (If~1<1b		2 10 m
Ihicl-uose of slab		175 mm
"traractenstic strength of concrete	=	30 N'mn/
'haractensuc ~heueth of steel		110 N/rnm!
Dcnsuv of cone-felf.		2 Ii)O ~:~"nI
		l:;l11111

1 1 IlliRMliLITY AND FIRE RESISTANCE

T,~hL'?, "\	~'crrunal cover ((!('' rruld r:Q(\rtiti..ooef e~:~lI')l:\.\re ::l1rnm	<::,=,,,,!t21)	=	mm
I'nhlc 1 I	I '·,h.. I hr	Fire resistance Ol~		

LOADING ON SLAn

Self weight of slab		12 KN ",'	
Imtshcs	=	1 2 KN/Ill2	
I'arnuons l111al1111 0111 1		I ,li ~~N/ml	
'haractcristic deedload		t) 9 f:N/ml	6.9 KNlnr'
'haracrcrisnc unposed load		I 5 K'J1m'	1.51:N'm1

=

DESIGN ~In~IENTS AND REINFORf'EMENTS

	Allpccl ratio of stab	=	120)	
	.\IfORT' SP,(.V (SUI'I'OR7j			
I'rlhk 1 II	Support 111(1fn(.111 coefficient		n 05(,	
('ahie 1 , l	Support moment		3 906 t~Nm	
	Effective depth of l-eam .. fd]	=	1,1Q mm	
'\ \ \	K = ,If lrf (,		000'9	
.II			0''' d	
		=	In r;," mm	
1111		=	l'vf 0.951;.::	
		=	"11 mml	PrO\IHlc YI, at)00 317 mm'
	Minimum reinforcement mea			

IISNIIO RI·.r	CALCULATIONS			OUTPU r
	SIIORT SPAN [MIDSPAN}			
r"hlr ~14	Midspan moment coefficient		n 042	
Iable .1.14	Support momeiu		2.Q2Q KNm	
	I"flc('tlvl' depth OrflC:i1111. [a,/		'-Iq nun	
14.4.4	K .If Me		0.0044	
,4.4 4	f.c ver ann. 7.		0.95 c1	
		=	\ ~\5~ """	
1 Id 4	Area nt steel required,		M 0.951,'=	
			) \ 11l111~	Pm\idC' y 12 anOO JT! 111m!
	I'() 1'(;SI'.4/\· (SUPI'ORl/			
I:rhle 1.14	Support 111011l~11l coefficient		0.0_F	
T:rl>k 1.14	SUI'rort moment		2.:;-;'0 KNm	
	E'TI'CTivc dent h n f beam . 1,11		13"7 mill	
1 ·14 ·1	K .If hi'r.,		() 0(J4~	
11.1	Lever nnn. 7.		OQ5 d	
			IJU.15111111	
\.144	Area of ..:(celrequired.		til 0.95.1:z	
			51 111m;'	Provide Vl2 at 300 .177 mm2
	f O.'IG .~I'.('I).ff()Sf'.l~.'1			
l:rhle 1.14	Mid<.;J13n1Il0JIll'1l1 coefficient		(I ()~~	
Table .1.14	Support 1111linen!		1.945 KNill	
	FfTct:li\c deplh of be.un . ~1		I ~-.tnlH	
	If M'l ..			

=

II II A 0 noll

I111 Lever "nil, 7_ = 095 cf

\:'0 \~mm

1111 AI

O 95.f;:c

31': nlnl Provide Y12 al300

"J77 mOl!

I3SSIIOREF	CALCULATIONS	uUTPUT
	DEFLECTIIIN <'HE("K	
	Haste mmiruum cffecnve depth for ..11('111 span	9:!_3l11m
	Moment rcdrstribuuon factor =	10
	TCII!o=ll'11 reinforcement area provided	.'\77 111m!
	Tension temforceruent area required	(j) fl1llll
	r = 3./:;:..1.;1'-0'1 ... .L 3/(,.,. fi.	
	~~ ~O·'2:!9! mnl	
	= () 5 ' -~_'_'_" (4TI-f) \''''f< 2,(J 1200,9+ ',') "d'	
	2 no	
	i\fexhfil.!d nuninuuu effecuve depth	16 153~ 161010
1 12 " 2 7	"RJ\("KJNU	
	~ fa.xilllilm spacin~ aJlowed for reinforcemcnl __ ,	I_I_7_m_n_1 I J

-- ~

REF	CALCULA nON	OUTPUT
	3'".1 Stair Analysis and Design-s Half Turn	

Tread =	300 mm
Rise =	ISO mm
Waist =	175mm
Ist Flight Steps =	10
2nd Flight Steps =	10
Ist Landing =	1800 mm
Floor Landing =	0 mm·
1st flight	
Span = (IOx300)+ 1/2(1800) =	3900 mm
Therefore, Lx =	3.90 m
Basic Loads	
230mm Wall =	230 mm
Concrete: r =	24 kN/m J
Finishes =	1.20 kN/m2
Cone height: h =	175 mm
Live Load: LL =	1.50 kN/m 2
Load	
Cone own = r x h =	4.20 kN/m2
Steps = 112x 0.175 x r =	2.10 kN/m 2
finishes =	\ .20 kN/m2
Live Load (Library Complex) =	1.50 kN/m2
Slope factor'S' = (J 50 2 + 300-) ? II) - 1300 =	1.118

F=«4.20+ 1.20) x I.IIX+2.10)x 1.40+(1.60x 1.50)

F= 13.79 kN/m per m

F:::: 14.00 kN/m per m

2nd Hight	
Span = (IOx300)+ 1/2(1800+0) =	3900 mm
Therefore. Lx =	3.90 m
Fz 14.00 kN/m per m	

\ la\r Landing	
Length: L =	2400 mm
Width: B =	lROO mm
Span = 2400 + 1/2(230 + 230) =	2630 mm
Therefore. Lx =	2.63 m
Loading	
Cone own = O.\ 75 x 24 x \ .\l,() x 1.4 =	10.58 kN/m
Finishes = 1.20 x 1.80 x 1.4 =	3.02 kN/m
Live Load = 1.50 x 1.80 x 1.60 =	4.32 kN/m
Flights = lsf night x (steps x tread) 12 =	20.69 kN/m
Per I.ROm width of stair: F =	38.62 kN/m
F::::	39.00 kN/m
,"e, metre width ~ F I \.30 ~	21.45 kN/m

~

REF	CALCULATION	OUTPUT
	3.4.1 Stair Design and Analysis	
	3.4.2 Materia's Loads and Assumptions	
	I) Concrete	24.00 kN/m3
	2) Wall (230mm)	2.87 kN/11l2
	3) Finishes including scrccding	1.20 kN/m2
	4) Design Breadth	)000 mm
	5) Rendering / Wall finishes (both sides)	0.60 kN/m2
	(1) Light Partitions	UO kN/n?
	7) Live load: Residential	1 50 kN/m"
	8) 175mm stair thickness	175 111111
	9) Cover	20 mm
	10) fv 410	N/mml
	II) feu	25 N/mml
	12) Bar Size - (Y bar) i.e for stairs	12 111111
	13) Bar Size - (Y bar) i.e for stairs	l(i mm

REF	CALCULATION		OUTPUT
	3.4.3 Stair Design		
	Parameter s:		
	I-Ieight' h ' =	175 mm	
	Cover' c '=	20 mm	
	Reinforcement diameter' 0=	12 mm	
	8:ign breadth' b ' =	1000 mm	
	fy=	410 N/mm2	
	feu=	25 N/mm2	
	Loading / Analysis:		
	b=	1000 mm	
	Effective depth' d ' =	149 mm	d= 149 mm
	1st Flight:		
	Span 'Lx'=	3900 mrn	
	Lx =	3.90 m	
	F=	14.00 kN/m per meter	F = 14.00 *kN/m*
	I'vf	26.62 kNm	M 26.62 kNm
BS RJ J0: J997	Fire Resistance		
Table 1.4	Provide for 1.5hrs		1.5hrs
	Design		
	~	0.05	0.05
	8:ign = Yalid 'h'~il!1l		
	Z= d (0.5 + "';0.25 -{KO.9» =	140.59 mm	
	max = 0.95d =	14J.55 mm	
	Usc 7F lesser of zor max =	140.59 mm	7F 140.59 mm
	As = mO.95 Iy 7F	486.09 mm2/m	
	Asmin = O.13'liJh =	227.50 mrnvm	
RCl1ith	Asreq= faater of As or Asmin =	486.09 mm2/m	As = 486 mm2/m
Edition.table A.3	Provide if ı ,ann, '. -Btrn: Asprov =	~('!! !)I) mm2/m	"if) 2r, J1
	Distribution Bars		
RCD5th	h=0.13'lih=	227.50 mm2/m	As = 227.50 mm2/m
Edition.table A.3	Provide Y? "1OIl ı. (-Btm: Asprov =	~T 11f) *mm2/m*	"if' ,1(>" ·11
	2nd PUg/I':		
	Span'Lx'=	3900 mm	
	Lx =	3.90 In	
	F=	*14 kN/m* per meter	F = 14.00)d'~/m
	M FLx 2/10 =	21.29 kNm	M 21.29 kNm
	Design		
	~ 0.04		0.04
	C);ign = ,':"ill flt'"i!!!!		
	Z= d (*0.5* + ';0.25 -{*KO.9»)* =	142.35 min	
	Use r.= lesser of zor max =	141.55 mm	7F 142.35 mm
	As = MO.95 fy 7F	384.05 mm2/m	
	Asreq=Gaier of As or Asrnin =	384.05 mm2/m	As = 384.05 mm2/m
RCD5th	Provide)f',i1fH), r -Btm: Asprov =	::;(,(; ,l() mm2/m	)f-' i.]r)!' .r~
Edition.table *A.3*			

REF	CALCULA nON		OUTPUT
	Distribution Bars		
	As = O.\3% b h =	227.50 mm2/m	
Reo. 5th Edition.table A.3	Provide Y I ... - Still: Asprov =	\77 nil	Y I' ...
	3.4.3.1 1st Flight Deflection Check		
	Moment 'M' =	26.62 kNm	
	Design Breadth 'b' =	1000 mm	
	fv =	410 N/mm^2	
	Effective Depth 'd' =	149 mm	
	Asrcq =	486.09 mrrr'zm	
	Asprov =	566.00 mm2/m	
	Span effective depth ratio 'BR' =	20	
	Short span 'Lx' =	3900 mrn	
	// The stair is simply supported.		
	liellfetioll :		
BS R II 0.PI I: 1997.3.4.6.1). table 3.10	Service stress 'fs' = 2/3 (v x Asreq / Asprov =	234.75 N/rtlltt2	fs = 234.75 Nzmm:
	Factor' r = M / bd^2 =	1.20	
	Modification factor = 0.55 + (477 - fs) / (l20(O.9+(Mlb<t)))		
	m!' = 0.55 + (~77 - fs) / (\ 20(0.9+(Mlbd2)))		
	Modification factor =	1.51	
	Permissible modification factor: III~ =	2.00	
	mf = Lesser of mf or m~)=	1.51	mf = 1.5J
	d.-eq = Lx / (BR x mf) =	128.98 mm	
	~r(1\'=	149.00 mm	
	Deflection condition =	\TIt;;FIEO	

3.4.4 Landing aign

Landing:

B: Half Landing is designed

REF	CALCULATION		OUTPUT
	Span 'Lx' =	2630 mm	
	Lx=	2.63 m	
	F=	21.45 kN/m	
	Breadth: b =	1000 mm	
	M FLx 2 / R =	IR.5S kNm	M 18.55 kNm
	Height: h =	175.00 mm	
	Effective depth: J =	149 111111	
	8;ign		
	~	0.03	
	8;ign = ;\lid n·.j"ll		
	Z= d (0.5 + ...f0.25-{ KO.9)) =	143.25 mm	
	max = 0.95d =	141.55 mm	
	Use F lesser of zor max =	141.55 mm	c= 141.55 mm
	As = N10.lJ5 fy F	332.40 mm2	
	Asrnin = 0.13lh h =	227.50 mm2	
	Asrcq= (tater of As or Asmin =	332.40 mm2	As = 332 mrn'
RC05th	P sprov =	1~_'.!1(1 mrn"	
Edition.table A.3	Provide ,l:-> J-;" t ı -Btm: Asprov =		'Il ı JIll
	Dtribtion Bars		
RC[1:ith	As==0.13lhh=	227.50	
Edition.table A.3	Provide -)1' ,ilirı (-Btm: Asprov =	'I ıııı mm2	
	Landing fflectiol1		
	Mnent 1M	18.55 kNm	
	aign Breadth 'b' =	1000 rnrn	
	fy =	410 N/mm2	
	Effective cpth 'd' =	149 mm	
	Asrcq=	332.40 mrn'	
	Asprov =	452.00 mm2	
	Span effective depth ratio 'SR' =	20	
	Short span 'Lx' =	2630.00 mm	
	lJ: The slab is simply spported.		
	Won:		
BS 8110: PI I:	Service stress 'ls' = 2/3 fy x Asreq' Asprov =	201.01 N/mm2	fs = 201.01 N/mm2
1997_J.4.6.6.	Factor' r = Mbd 2 =	0.84	
table 3.1 ()	b41ificationfactor = 0.55 + (477 -ts) / (120(O.9+(Md 1»)		
	mf = 0.55+(477-fs)/(I20(0.9+(Md 2»)<=		
	b41fication factor =	1.88	
	Permissible modification factor: rn~=	2.00	
	111f=	1.88	mf= 1.88
	d_{rcq} = Lx / (BR x rnf) =	70.12 rnm	
	d_{prov} =	149.00 mm	
	fflection condition =	'; . f! (~IIF 1)	

.1.' Dro:S(;N OF ROO!' SLAB

IISRIIO REF	CALCULATIONS	OUTPUT
	SLAB PANEl. PI	

.<750 mm

-1200 mm

TWO- \VAY SI' ANNING SLAIl

35.1 Dlntj"lll(ir~ ,hiTi(

I ongcr span of stab	=	4.2 m	
Shorter span of slab	=	.1.75 m	
Thickness of slab	=	150 mm	
Characteristic strenath of concrete	=	20 N/mm'	
Characteristic strength of steel	=	-110 N mrn'	
Density of concrete	=	2400 kgm'	
Diamatcr of steel proposed	=	12 rnrn	

.U DLTRAIHLITY AND l'IRE RESISTANCE

Table .~.!	Nominal cover for mild conditions of exposure ~ 20mm	cover 20 = mrn
Table 3.-1	1',11r . Iltr	Fire resistance OK
	r.o ,IOrNCi ON SLAB	

3.5.2 Design Prncedure

	Sdf"cighl nfs Jal>	=	3.(. K:"\/mZ			
	Finishes	=	1 KN'rn'			
	[aspahlic Felt]	=	I KN/m'			
	Characteristic dead load	=	5.0 KN/m'	g,	=	5.6 KN/m²
	{,h;\f2Ic.1eT~1"c;myw.ve-d k/3{\	=	').~K':m'	lh	=	9.%\ K~:'m'
.'.1.U.1	Design load 11Ag, 11.Ii'hl	=	2.1.536 KN/rn'	n	=	23.5:16 KN/m'

DESIGN MO/l.fE"TS AND REr.\TORCE/l.fENTS

	A:<pc'..'rat in ofsla~	–	1.12			
	S/fORTSI'AN/SUf'P()Ilrt					
Table .1.14	Support moment coefficient	=	0.0574			
l able 3.14	Support moment	=	18.997'J65 KNm			
	E11",'li\"e depth ofbeam ,	=	124 mrn			
1.-1.·14	K = ,\I /1[,	=	0.06177K			
.1.-1-1.-1	l.ever ann. 7.	=	O.925RIi12 d			
		=	114.80679 mm			
.1.-IA I	Area of , IceI required.	=	AI () 95(,:.:			
		=	~24.8~6:j9 mrn²	Provide	y 12 at 250	
					3t52.57143 mill'	
	Minimum reinforcement area	–	195 rnrn²			

BS8110 REF	CALCULATIONS			OUTPUT
	S/fORTSI'AN[MIDSPAN}			
Tahle .U~	Midspan moment COCmC1cnt	–	0.043	
Table .1.1-1	Midspan moment	=	14.231925 KNrn	

	!EITective depth of bcarn . ltfl	=	124mm	
1.1.4.·1	K = Al / lrll;"	=	0.0462797	
'.-1 ~A	l ever arm. z.	=	O.9~56211 d	
		=	117.25701 mm	
1.~AA	\rea of steel required. .1	=	M / O.95t;.z	
		=	:111.61428mm 2	Provide v iz a1300 377.14286 mm
	U)NG SPAN [SUPPORT]			
l'ablc .1.11	Support moment coefficient	=	0.045	
Tahle '.11	SUPP(Irl moment	=	14 ~Q3R75 KNm	
	Effective depth ofbeam , ldl	=	112 rnrn	
'.~.~.-l	K = ,V / lxlit;"	=	0.05936(,5	
-'-"1.1.-1	Lever arm. z.	=	0.9289956 d	
		=	104.0475 mm	
'.~AA	vrea of steel required. !!!!	=	114 / 0951;;;	
		=	367.50951 rnm 2	Provide yl2 at .'00 377.14286 mJ11
	I,ON(i SPAN IMIDSPAN]			
r.hlc .1.11	~1id'ran moment coefficient	—	0.034	
Table '.11	~lidspan moment	=	11.25315 KNm	
	Effective depth of beam . ll	=	112mm	
'4~.1	K = M / 1>1'("	=	0.0~48547	
q~.~	Lcvci arm. 7.	=	0.947394 d	
		=	10(,.10813 mm	
'.-1.-1..1	\rca of steel required. l	=	M / () 9:'> I: z:	
		=	172.281~ mm 2	Provide y12 <ll. 300 377.14186 rnm'

m;~111'R!'.l	C,\LC\JI ,,\TIONS			OUT1'UT
	t.<.5..1 Deflection Check			
Table 3.9	r1a<ic minimum effect ive depth for short span	=	144.23077 rnm	
	!\[omenr rCt(i!'1rihwilHI factor	=	I	
	Tension reinforcement are' provided	=	.177.14286 mill 1	
	Tension reinforcement area required	=	311.61428mm	
	brsien service slrec;;s /	=	2,f;./~~ "' ! / :1/1,,,,,". fJ"	
		-	225.841(,7 Nrnm 1	
Table .1.11)	Modification factor	=	0.55+ (477-j) / "')(O"',:/""x;'M) :0:2.0	
		=	1.(;964689	
	Modified minimum effective depth	=	85.018222 mm	OK
.'.12.11.2.7	J.5.~ Cracking			
	Clacking is controlled bv limiting bar spacing.			
r--	Maximum spacing allowed for reinforcement	=	.172 rnm	OK

IISHIIO REF	CALCULATIONS	OUTPUT
	SLAB PANEL P2	
	1200 rnrn	

1950 mm

TWO-WAY SI'ANNINGSLAI3

Longer span of <;Iah	=	1.95 OJ
Shorter span ofslah	=	1.2 OJ
Thickness of ,I. h	=	l~fl mm
Ch"T acrcrisric strength of concrete	=	20 Ntmm '
Ch~taCleristic strength ofsieel	=	~IO N'mm'
Dcnsitv uf concrete	=	2400 kg'mJ
l1itmater "f ~ted\'f-'"V~$J!<..l	=	12mm

.1.3 DURAB ILITY AND FIRE RESISTANCE

Table .1.1	Nomina l cover for mild conditions of exposure - 20mm			cover 20 =		mOl
L,hk 1.1	1',I" Ihr			FU'e resistance OK		
	Ll).\DIN00N SLAB					
	Self weigh: ofsl.,h	~	3.6 KNlm z			
	Finishes	=	I KNlm '			
	\.,p.hli, l'dl\	—	1 KNlm1			
	Characteristic dead load	=	5.6 KN l m'	g~.	=	5.6 KN'm 1
	Characterisiic imposed load	=	9.81 KN/m '	'II	=	9.81 KN/m z
.;.1.1.2.2	I)~"ign lund ".-Ig, ' 1.6""	=	23.5,16 Kj\,' ttl z	n	=	23.536 K:-;:m '

DESIGN MO~.J:ENTS AND REINFORCE~lENTS

	A::pcCI ratio of slab		1.625		
	snORT sr ..1N ISI1J>P()R7]				
T.hle .;.I~	Support moment coefficient		fl.07S		
Tahle .;.I~	~SUPJlOrlmoment		2.6'l.ı56.15 KNill		
	l'l~cctivc depth of he am .	[dl	124 mm		
~I ,....	K =	.lf	fl.0085904		
	l ever arm. z.	=	0.95 d		
			117.8 rum		
3.·IA..l			M / O.95f..z		
			~7.615IQ mill'	Provide	YI 1 at 300
					~7.14286 mm'
	t. Iinimurn reinforcement area		195 mm		

I1S8110 REF	CALCULATIONS			OUll'UT	
	SIIORT SPAN [MIDSPAN]				
Tahle-.l 1~	1\Iidspan moment coefficient		0.0585		
r.hk 1.14	Support moment		1.9R2672(' KNill		
	Effective depth of he am .	[dl	124 l1lm		
	K	M / itf(, =	0.Ofl6-l473		
	f ever arm. 7.		0.95 d		
			117.8 mm		
.uu	\re., ofsteel required.		M / 0.95(:::		
			4.1.2113<)2 mOl'	Provide	y 12 at300
					377.14286 mm'
	t.ot«, SI'AN /SlJPPORT]				
r.l>k t lJ	Support momcnr coeffic ient		0017		
lahlc 1.1~	Support moment		1.25.1Qn I KNm		
	tffective depth of beam .	ldJ	112 mm		
1.1 JA	K	M / frl't:.,	0.0049984		
1.11 I	ever ann. 7.	=	fl~5 d		
		=	106,4 rnm		
			M / 0.95(,=		

1,1·U	.uca "r steel required,	=	$\frac{M}{0.95f_yz}$		
		=	30.258527 mOl'	Provide	y12 111300 377.14286 mill''
	I ot«: SPAN IAIIDSPANj				
Tahir 1.11	~Iidspan moment coefficient	=	0.028		
'I,bk -' II	Support moment	=	0.9189715 KNm		
	Effective depth of beam , i,'I	=	112 rum		
q~.1	$K = \frac{M}{W('' }$	=	0.0037826		
-'.-1J.I	I.ever ann. 7..	=	0.95 *d*		
		=	106.-1rnrn		
1 1-1..1	,\,<"aofsteel required,	=	$\frac{104'}{0.95f.z}$		
		=	n.89R345 mrn'	Provide	Y12 at 300 377.14286 mrn'

nS8 110 REF	CALCULATIONS			OUTPUT
	DEFf.ECnON CHECK			
Tahk 3.1)	Basic minimum effective depth ror short span	=	-16.153846 mm	
	Moment redistribution factor	=	I	
	TCI1s1nnreinforcement area provided	=	.H7.14286 mm'	
	Tension reinforcement area required	=	-13.211]92 mm'	
	I)cc;ign scrv icc stress *f*	=	*2./;.·4_n" '" 1* *:1A.7"~· /3"*	
		=	11 1171-18NI",m'	
rabtc-'.10	Modification factor	=	0.55+ *(4T7-.I)* / 12((0.9+ *M* *I-.1')* :52.n	
		=	]	
	Modified minimum effective depth	=	23.076923 rnrn	OK
3. 12.".2.7	CRACKfNG			
	Cracking is controlled h~' limiting bar spacing.			
_	I\[aximlllll spacing allowed for reinforc@iilcnt		372 rnm	OK

IIS811() REI:	('AL('ULAI'IO"S SLAB PANEL P3	OI.:'Il'UT

D 1~1)" rnm

1800 mill

TWO-WAY SPANNING SLAD

	il ongcr 'pan of slah	=	1.8 m	
	Shorter span of slah	=	1.8 m	
	I hickness ofslal.	=	ISOmm	
	Characteristic strength ofcnncrcre	=	20 N'mm'	
	Characteristic strength of steel	=	0.110N1mm'	
	Density nf concrete	=	2400 kg/rn'	
	Diarnater of steel proposed	=	12 mm	
	3.1 DURABIT.ITY AND FIRE RESISTANCE			
Tahle , .,	Nominal cover for mild conditions of exposure - 20mm			cover 20= mm
Table 3.-1	1₁₁lu I hr			Fire resistance OK
	LOA[)fN(; ON SI.An			
	Self weight (Jr,I,h	-	*3.6 KN/m'*	

	!I:inishcs	=	I KN\n,'			
	[aspahtic l'elil	=	I KN'm 1			
	rharactcristic dead load	=	5.6 KN'm'	g,	=	5.0 KN'm '
	('haracteristic imposed load	=	9.81 KN m²	'I,	=	9.KI KN m²
.' 2.1.1.1	Design load 11.·ig,+ 1.6qll	=	2:'.536 KN'11I'	n	=	23.5.16 KN m²

DESIGN IvlOMENTS AND REI1\TFORCEMENTS

	vspcc: ratio 01'51ah	=	I		
	SHORT SPAN {S{'I'P()RT}				
Table 1.1.1	(supporl moment coefficient	=	0.0-1		
T,.hk ~ 11	'\u\'\''lflrf.mnfl:i.enf.	=	1 n~nlh~(, KNm		
	IEneClivC depth of heam . ltil	=	124mm		
1.1.1. I	$K = \frac{Al}{M't;''}$	=	(1.0099189		
.'.1 I I	/l ever orTII. 7.	=	0.9 d		
		=	117.8 rnrn		
'.·IA.I	\rca ofsteel required.	=	$\frac{1\4}{().95.f:z}$		
		=	fTfl.·rl'Jnf,5 from 1	rr,r.;id~	')'11 I'll :.I)()
					~7.14286 mm²
–	Minimum reinforcement area		195 mm		

nS8110 lU~F	CALCULATIONS			OLnl'UT	
	Sf/ORT SP.tS {M1DSP.tN}				
'I'.1hl<).11	Midspan momenl coefficient	=	0.03		
Table).11	Support moment	=	2.2876992 KNm		
	Effective depth of beam . [tfl	=	124 mm		
<.-I-IA	$K = \frac{.,'f}{Mr''}$	=	0.0074)91		
q.-I.I	J ,C\TI arm. 7..	=	0.95 d		
		=	117.8 nun		
.. 1.1.1	Area of steel required,	=	$\frac{M}{095(z}$		
		=	-19.859299 mm¹	Provide	y 12 aOOO
					377.14286 mm¹
	LOM; SPAN {Sl'PI'OR7j				
'lahle .1.1I	rupp''rl mnmenl coefficient	=	0.037		
Table 3.1-1	Support momenl	=	2.8214957 KNm		
	Effective depth of beam . lin	=	112 mm		
1.·IA I	$K = \frac{,1/}{Mt;''}$	=	0.0112-16-1		
.1.4AA	Lever arm, z.	=	0.95 d		
		=	106.-1mm		
1.·1.1-1	.Ire. ,,1'.leel required.	=	$\frac{M}{0951;;;}$		
		=	68.081686 mm¹	Provide	y12 at 300
					377.14286 mm'
	LON(; SI'AN {MWSPAN}				
l'ahlc .1.1~	:<lidspan moment cnellicienl	=	O.O2~		
l'ahlc .1.1·1	Support moment	=	2.1.151859 KNm		
	Effective dcplh nf bcam , llll	=	112 mm		
.1.-1.-1·1	$I\ = \frac{M}{l'd'f.,}$	=	0.0085108		
1.-1.-1.1	J .evcr arm. 7.	=	0.95 d		
		=	10(,4 mill		
1 1·I.t	l\rca ofsteel required.	=	$\frac{i\,f}{0951.7.}$		
		=	51.521276 mm¹	Provide	YJ2 a300
					'?1.Ul~(; mm'

nS8110REF	CAI ,CIIL'\ TIONS	OUTPUT

DIOf'I ECTION CHECK

Table 3.9	nasic minimum effective depth for short span	=	(,9.210769 mm
	\Momcnt redistribution factor	=	I
	I'cnsion reinforcement area provided	=	~77.142R6 rnm[2]
	Icnsion reinforcement area required	=	49.X59299 mm
	I)e~ig.nservice stress	=	2,f;A... 3.-1;_.,. n.
		=	.16.135401 N'mrn
	Mod,[ic.twn factor		
	Modified minimum effective depth		~4.615.185 mm
.1.12.11.2.7	CRAC":ING		
	CmckinlJ ;r, controlled h~limiting bar .C;p.1C;llg.		
	Maximum spacing allowed for reinlorciiilent		372 10m O":

C;\LCULAT'.01~~

SLAB PANEL N

IR00 mm

4200 mm

ON1O-WAY SPANNING SLAB

Longer span of slab	=	4.2 m
Shorter span of slab	=	1.8 m
Thickness of sian	=	150 mrn
Characteristic strength of concrete	=	20 N/mm
Characteristic strength of steel	=	410 N'mrn
I)cft"ity of concrete	=	*2400 k~/m*
Pia mater of steel proposed	=	12 10m

.UiDURADU_ITY AND r1RE RESISTANCE

Tahir .1.1	Nominal covel' for mild conditions of exposure - 20mrn		cover 20 =		10m
I'ablc .1.4	I'lhr Ihr		rire resistance OK		
	LOADING ON SI.AfI				
	Sclfwcight nf stab	~ ~.6 KNlm			
	rFinishc'\	= I KN/m			
	[aspahtic Felt]	= I KNlm			
	Characteristic dead load	= 5.0 KN/m	g,	=	5.6 KN.m
	Characteristic imposed load	= 9.RI KN'm	'1,	=	9.81 KN/m
'.2.1.2.2	Design Inad jI.4g, ' 1.6'1d	= 23.5.10 ":N/m	n	=	2:1.536 KN/m

DESIGN MOMENTS AND REINT'ORCEMENTS

	I\.f,\"'~\uti<> <lf .l.b	—	1.3333333
	LONG SPAN {SUPPORT}		
Tahlc 1.14	Support moment coefficient	=	o.on
Tahk 11-1	Support moment	=	2.8214957 KNm
	Effective depth of heam . [dl	=	112 mm
~.4.1.·1	$K = \frac{M}{/\text{-}d'\text{t}\{|}$	=	0.0112464
	I.C\·CI' ann. 7.	=	0.95 d
		=	106.-1mm
.1.IA.I	" .." .... I· .... "I .." .... ;.... I	=	$\frac{M}{()95(: ;::}$

.UL.11 *. :'1 ...1..1 ,L.IIUUL.U..   – $\frac{M}{095/;z}$

= 68'()81686 mm' | Provide y12 at 300, 377.14286 mm

I.ONI; SI'AN [MIDSP,1N}

Tahle 3.11	Midspan moment coefficient	–	0.028	
Table 3.11	Suppor! momenl	=	2.1351 R59 KNm	
	Effective depth of bcarn . [l~	=	112 mm	
q.·I.1	$K = \frac{M}{/yfI_{,,}}$	=	0.0085108	
~.·I·1.·1	r .evcr arm. r:	=	0.95 d	
		=	10~~ mm	
1.-1.·11	vrea of steel required,	=	$\frac{M}{o95/;.z}$	
		=	51.521276 mm'	Provide Y12 at 300, .In.1 IISI\ mm

nSSl1J IU:,F	CALCULATIONS			OUTPUr
	DEn,ECTION CflECK			
T,\-.Ic t.:	Hasi!. minunum effective depth for ,l1(l1'1 'pan	=	69.2.107(,9 mrn	
	~10men I redistribution factor	=	I	
	Tens~on reinforcement area provided	=	68.081686 mm'	
	I f'c.:I1"inn rcinfiuccmcnr arca required	=	51.521271\ mm'	
	IDe'i!!n service stress r;	=	21;...1"", .,_!_ ~A.7>'~' !'J"	
		=	2(16.84(,85 N|mm'	
lahlc 3.10	lodi fic arion factor	=	n.55+ (4T7-f) / 12fXO.9 +~!- ixl') <2.1) = 2	
	[\!ndilicd minimum effective depth	=	3~.6153K5 mm	OK
,~.12,11.2.7	CRACKlNU Cracking is controlled by limiting har spacing,			
	Mn x imum spacing allowed for reinforcement		.1(17rnm	OK

SLNl PANEL 1'5

ONE-WAY SPANNrNGSLAJ3

	longer span of ,Iah	=	3 m
	~Jli\IJ(.·r "PM1 "r"I:I,,,	=	!? m
	Thickness ofslah	=	150 mm
	Characteristic strength of concrete	=	20 N'mrn^2
	Characteristic strength of steel	=	·110 N|mm^2
	n~I'.~·.\tf~(..\w.T~!.r.!	=	2.~()(1I·,g|m'
	Diarnater of steel proposed	=	12 mrn

J.~ DURABILm' ANDrnu, I~SISTANCE

'L,hk 3 ~	;\'0111 ina I COWl tor mild conditions of exposure	20ml11	~over 20= mill
lahk .l. I	1',hr Ihr		Fire resistance OK
	LOADING ON SLAB		
	Self weight of sla h	3.6 KN|m^2	
	fl~inishes =	i KNfll'	
	[aspahtic Felt] =	1 KN:m'	
	ICharacterislic dead lrtad =	5.6 KN|m'	= 5.6 KN/m^2

Characteristic imposed load = 9.81 KN·m[1] 'II = 9.81 KN/m'

1.1.1.2.2 Design load (1Ag, ₗ 1.6q, I = D.536 KN/m[1] n = 23.536 KNim '

DESIGN MOMENTS AND REINFORCEMENTS

Aspecl ralin of slab – 2.5

UW(; SPAN[S(I[,PORT)

Table ~.I~ Support moment coefficient – o.on

r,blc .1 I~ Suppnrt moment = 1.25.19981 KNm

Effective depth of bcarn . I,fl = III mm

\.,U~

$K = \frac{M}{IrIt}$ = 0.0049984

qA.~ 1 ever arm. 7. = 0.95 d

= 106.4 mm

I...I ~A Are, ofsteel required. = $\frac{M}{095(>:}$

= ,0.258527 mm ' Provide)'12 at 250

452.5714} mm'

LONG SPAA {MJI)SI'AN}

T.ble I IJ ~Iidsr.n momem c·pellicicnl = Q.n28

r,hle .1.14 Support moment = 09.t89715 KNm

Effective depth of he am . lin = 112 mm

.1.·1.4.1

$K = \frac{M}{hPC}$ = 0.00.17826

~.~. I I |, (Tel ann, 7. = 0.95 d

| = IOGA mm

.1.4A.~ Area of steel required. = $\frac{M}{095t;z}$

= 22.898345 nun[2] Provide YJ2 at 300

.177.14286 mm'

B,,~\I\)REF I' ALCUI.AT101,,, O\JT1't;T

DEII.ECTION CI flOCK

Table .~.'I n"ic minimum effective depth

for short span = 46.15:1846 mm

!\ Imncnl rt'di~" ibution factor = I

Tension reinforcement area provided = .10.258527 mm[1]

Tension rcinforccmenr area required = 22.898.145 mm'

0C'<.;ipn service stress r = ?[~.!._ ..] ~A"~". I]',

= 20('.84(,85 N/mm'

T.lhk 1.10 I\lodificitfion factor = 1).55+ (477-J:) / 12i),'0.9+,~) "52.()

= 2

Modified minimum effective depth ~3.076923 mm OK

.1.12.11.1.7 CRACKING

Cl3cJ..ing is cnnu olled hy limiting har spacing

_ _ Maximum spacing allowed for reinforcemenl :105 111m OK

IISRIIOREF CALCULATIONS OUTPUT

SLAI3 P AN].L 1'6

6000 rum

6000 111m

TWO-WAY SPANNING SLAB

Longer span of slah = (lm

Shinier span ofstab = 6m

Thickness of sial> = 150 rnrn

Characteristic strength of concrete = 20 N'mm Z

Characteristic strength of steel = ~IO N.'mm'

Density of concrete = 2400 kg/m3

nj~f11ilfr' of ~'erl rr"pn~rd = 1(; rnn1

J .! DURAUILrIY AND FIRE RESISTANCE

TahJc.).3	Nominal cover for mild conditions of exposure	c- 20mrn	cover 20 =	mOl
Tab'").j	I",hr ' lhr		Fire resistance OK	

1 ---- I.OADINli ON SLAB

Self weight ofslab	~	.<.6KN/m 1			
Finishes	=	I KN/m 1			
[."P"l1t;c Felt I	=	I K!'i'm '			
Characteristic dead load	=	5.6 KN'm'	g,	=	5.6 KN'm 1
Characteristic imposed load	=	9.81 KN'm 1	q,	=	9.81 KN'm 2

:'.1.' .2..2 ~;lgnllr,:.t\ '!lAg, ' \ .(,q,l = 2?,~:·6 K~~lm2 n = 23.536 K}~'m2

DESIGN MOMENrS AND REINfORCEMENTS

Aspect ratio of slab = I

SIIORI'SrdN (1'[:rrORTj

l'ablc .1.1_1	Support momenl coefficient	=	0.04	
lahlc.'.I-I	Support moment	=	.1'.89184 KNm	
	Effective depth ofbeam . [d]	=	122 mm	
'AA I	K = .\f / «:	=	0. 1'-'853.1	
.l.-l.'l. I	Lever arm. 7.	=	0.8514205 d	
		=	I0.1.R733 n1l11	
.'.·1.1 I	Area ufstcel required.	=	M / O.9S.r;z	
		=	8.' 7.69081 mm '	Provide Y16 lll. 200 :ttl05.7143 mm 2
	1\tinirnum reinforcement area		195 mm'	

I1S81 10 REf'	CALCULATIONS			OUTPUT
	SHORT SPAN [MfDSI'AN)			
Tal>1c '. I~	~lidspan moment coefficient	=	0.0.1	
rahIc1.1~	Support moment	=	25.41888 KNm	
	Effective depth of beam. [dl	=	122 mm	
'.4A.1	K = M / Mr.,	=	0.0853899	
.1~A.~	l,c\'crann.7.	=	0.8938557 d	
		=	109.050.19 rnm	
-'A.-I.-l	Area of steel required.	=	M / 095/;z	
		=	598.44153 mm 2	Provide y 16 at300 670.47619 mm 1
	LONG SPAN /SUPPORT}			
T.hle 11-1	L""('!;lorf moment coefficient	--	0.0.<7	
T,h'" 1.1_1	Support momenl	=	.1U49952 KNill	
	Effective depth ofbcarn . ldl	=	106 mm	
.1.~A.~	K = M / llllC	=	0.1.195067	
.1.-1..1.1	T.evcr arm. z.	=	0.8082086 d	
		=	85.67010<) mm	
'AAA	Area ofsteel required.	=	M / 095[,;;	
		=	939.50717 min 2	Provide 1'1(, m 200 1005.71<13 mm 1

LONG SPAN IMIDSPAN]

Table .1.1.1	\fidspan moment coefficient	=	O.02R
lahlc -'.I~	Support momcnt	=	23.724288 KNm
	Effective depth of be am . II~	=	106 mm
.1.1.~.1	K = M / Mr,	=	0.1055727
.1.·U-I	Lcrvcr arm. 7.	=	0.8642761 d
		=	QI (,IUliJ mm
.1 1.-1.-1	Area of steel required,	=	M / 095/>
		=	66-1.85567 111m

Provide Yl6 at JOO
670.4 7619 0111'1

fIS8110 REF j	CALCULATIONS	OlJrPIJf

r----.--- DERECT10N (,IIECK

lahlc 1.')	Ilasic minimum effective depth for short span	=	230.76923 rnm
	~lllmcnt redistribution factor	=	I
	Tension reinfurccmenl area provided	=	670.47(,19 mm'
	Tenvion reinforcement area required	=	59R.44IS.1 mm '
	Design service stress r.	=	2/;.-1n'1 ....L / ~A".,n- 11"
		=	24-'.96693 N'mm '
T.hlc1.IO	~Iudification factor	=	0.55+ (477-.f.) / 12(Xo.9 +~~ 1>:/-) s2.0
		=	1.294(,672
	Modified minimum effective depth	=	178.24599 mm OK

.1.12.11.2.7 CRACKIN(i

Cr.lcking is cenrro llcd h)' limi,ing l-ar sPJcing.

Maximum spacing allowed for reinforcrn,enl 366 mm OK

IlS8110REF	CALCULATIONS	OUTPUT

SLAR PANEL 1'7

4200 mm

~8f1f1 mill

TWO- \vAY SI'ANNTNG SLAIl

Longer span of slab	=	4.801
Shorter span of slab	=	-1.2 m
Thickness of slab	=	lSO mm
Characteristic strength of concrete	=	20 N'mm 2
Characteristic strength 01 steel	=	~I0 *N/mm'*
Dcnsitv of concrete	=	2400 kgm '
Diarnater of steel proposed	=	12 mm

3.J DURABILITY ANI) FIRE RESISTANCE

·lable .1..1	INominal cover lor mild conditions of exposure ~ 200101		cover 20 = mm
T"hlc JA	I' .hr ' lhr		Fire resistance OK
	I OADfN(J ON SLAB		
	Sclfweight of <lab	–	.~.6KN/m'
	[Finishes	=	I *KN/m* 2
	[aspahtic Felt I	=	I *KN/m* 2
	Characteristic dead load	=	*5.6 KN/II1* 2 c, = *5.6 KN/m* 2
	Characteristic imposed load	=	9.81 KN'm ' q, = *9.81 KN/m* 2

.\2.112	/nCSiQn load IIAg,11.6qtl	=	23.SJ6 KN/m [1] n =		23.536 KN/m2
	DI~SlljN j\.IUl\1],NJ"S AND IO'.INFURU·.1\IEN rs				
	Aspect ratio of slah	–	1.1~2R571		
	SIIORT SPAN [SL'PPOR7j				
T.hle 3.1 I	Support moment cnefJicienl	–	0.052		
Table 1 11	Support moment	=	21.589102 KNm		
	j":tTCClive depth of bearn . f,f]	=	12·1rnm		
lA.-1 ~	$K = \frac{u}{lrt!;.}$	=	0.0702039		
1 1.-1 1	I ever arm. z.	=	*0.9147236* d		
		=	11.1.42573 nnn		
IA.~ I	,\rl'a of steel required.	=	$\frac{Ad}{0.95(:::}$		
		=	~8R.('(!9R5 mm [1]	Provide	YlZ at Z00
					~5.71429 mm [2]
	Minimum reinforcement area		195 mm		
BSRIIO REF	CALCULATIONS				OIJrPUT
	SI(()/iT SPAN (MIDSPAN!				
'J ahle 3 I~	[\ 1idspan moment coefficient	=	0.0385714		
·1.hlc1.14	Support moment	=	1('.0138q~ KNm		
	r:rrrrlj,'t" depth f1fb(~~nl Itil	=	1J~mnl		
11-1-1	$K = \frac{,lf}{/>:/(.,}$	=	0.052074.1		
.11.1. I	Ln'CT arm. 7..	=	0.9383.174 d		
		–	11.r. l!\IIIl ron,		
l.1.-1.1	Are a of steel required.	=	$\frac{M}{O.95(,z}$		
		=	35_1.35.102 mm [2]	Provide	y 12 at 300
					:3 77.14286 mrn2
	LONCiSPAN (Sl'/'I'OR7j				
Table 1.1_1	SUPPMt moment coefficient	–	0.0.17		
Tahle .1.1~	Support moment	=	ID61H6 KNm		
	[ITetI" l lkplh of bcarn . \d\	=	"2 mrn		
1 1.-1.-1	$K = \frac{1/}{hI'l;,}$	=	0.0(,1230-1		
3.1 -I.~	Lever ann. 7.	=	0.926575 d		
		=	1<13.776-1 mm		
.1.-1-I~	Area of steel required.	=	$\frac{M}{0.95 (;.z}$		
		=	3g0.0378R mm [2]	Provide	Y12 1'1(250
					452.57143 mm [1]
	t.ot«: SPAN (MIDSPAN)				
Tahlc 1.1~	Midspan moment coefficient	–	0.028		
Tahlc _~.I-I	Support moment	=	11.624901 KNm		
	Effective depth ofbeam . hiJ	=	112mm		
~.~A.·I	$K = \frac{M}{/y/lf,\_,}$	=	0.0-163.1(,5		
.1.1-1-1	I eyer arm. 7.	=	0.9455502 d		
		=	105.901(,2 mm		
.1.-1-1.-1	Area (lf steel required.	=	$\frac{tv!}{095(,:::}$		
		=	2R 1.82478 mm [1]	Provide	Yl2 m'300
					377.1428~ mm [2]
IIS8110 REF	CALCULA TIONS				OIJ1l'Ur
	DEF! ,ECTION CfTECK				
I'able 3."	Hasic minimum effecti v e depth				
	for short 'pan	=	161.5.184(, mm		
	1\lnment redistribution factor	=	1		

Ilension reinforcement area provided = ,77.14286 mm 1

Tension reinforcement area required = .153.35302 mm 1

Dcsiun service stress r. = y;·~v_ ...L ~/~p.". /"'J"

= 15609171 N'mrn 1

Tanlc.1.10 /"todificatinn factor = 0.55+ (477-.(,) / I2f(O.9+M/ hl,) <2.0

= 1.4981923

Modified minimum effective depth = 107.82225 mm OK

3.11.11.2 7 CRACKING

Cracking i; coutrotled hy limiting hal' spacing.

Maximum spacing allowed for reinforcrn,ent 372 rnm OK

IlS8110 IU~F CALCULATIONS OUTI'I!T

SLAIl PANEL 1'8

L .1000 mm

4200 mm

TWO-WAY SPANNTNGSLAIl

Longer span of slah	=	4.2 m
Shorter 'pan 01 slah	=	3 m
Thickness of ,I ab	=	150 mm
Characteristic strength of concrere	=	20 Nzrnm '
Characteristic strength of steel	=	410 N/mm 1
Density of concrete	=	2400 kg/m;
IOiamater of stee l proposed	=	12 mm

J.! DURABILITY AND FIRE RESISTANCE

Tahlc '.-' !Nominal cover for mild conditions of exposure 20mm cover 20= mm

Tah1e3.4 I' ,In ' fin Fire resistance OK

LOADING ON SJ.,\B

Sclf'we ighr of slab	=	3.6 KN/m 1			
Finishes	=	I KN/m			
[aspahtic Felt]	=	I KN'm '			
Characteristic dead load	=	5.r. KN/m z	gL	=	5.6 KN'm z
Characteristic imposed load	=	9.81 KN'm z	'I.	=	9.81 KN'm z

.;.2.1.2.2 Design load Il·-Ig, ' 1.6'111 = 23.5.16 KN/m z n = 23.536 KN'm 1

DESIGN ~'!OMENrS AND RETNFORCE(\.1ENTS

Aspect ratio of slab – 1.4

SHORT SPAN {S[,PPOR?J

T.1,1c .'.1-1 Support moment coefficient = 0.068

Tahll' ~I1 I~U\'I\,I.\I:t tnnml!n.~ = 1-1-1Il411n KNm

Effective depth of beam , I"l = 124 mm

1.4A_1 $K = \frac{M}{Irl'e}$ = 0.0-168393

1 1.1.1 1 ever arm. 7.. = 0.044°228 d

= 117. 17043 mm

.1. 1.·1.1 (rea of steel required, = 114 / 0.95r..z

= ~.~5.G~S1 film z Ilfl\'ide yn at :,Gn

:l57.14286 mm 2

1 Iinimum reinforcement area 195 mm

BS811()REF CALCULATIONS OU11'UT

SHORI'SPAN {MIDSPAN}

T.hkJ.I~ ,.lidspan moment coefficient = 0.051

Tahle -' I I Support moment = 1O.80.'02~ K 'm

Effective depth nfbcarn , Idl = 114 mm

J ~.~A K = M / iJr;, = 0.0351295

, JJJ 1 <"'Cl arm. r. = n Q~ cl

= 117.S mm

JAA.~ Area of steel required. = M / 0.951;.2

= "~~4Mq m",[2] Provide Y 12 at. ~no
377.14286 mm ,

t.ot«: SPAN {Si 'PPORTj

Tahlc J I~ Supper t moment coefficient = 0.037

L1hk 3.11 Support *moment* = 7.8.17488 KNm

Effective depth of he am . ld] = 112 rnrn

.<.~.-IA K = u / 1r/t:, = 0.0.1124

~ ·1.-1.-\ , I"\ 1:1 ~'TI1.r.. = 0.'):' .r

= 106.4 nun

.U.-IA Mea of steel required, = lv(/ 0.95/;;;

= IR9.11579 nun , I'!"vidt' yl1 f~ 3011
377.14286 10m[1]

U>NG SPAN !MIDSPANj

Table 3.I-t Midspan moment coefficient – 0.Q28

·lahle.1 It Support moment = 5.931072 "Nm

Effective depth of beam. I"~ = 112 rnrn

_'A.-I ~ K = At / Mr" = O.OB6411

.I UA I.cvcr arm. /. = 0.95 d

= 106.-1 trim

.1.-IA ~ I,\re" 01 steel required. = M / 095/>

= 1-1.1.11465 IItIn' Pro\ ide Yl:Z at ~(lO
<77.14286 mm ,

nssuo REF CALCULAflONS OUTPUT

DEJ'U-:CTJONCl-TE('K

T.I,k -' 1) nasic minimum effective depth for short span = 115.3 R462 mm

Moment redistribution factor = I

Tension reinforcement area provided = .<77.14186 mm ,

Tension reinforcement area required = 235.4~669 mm'

Design service stress .r. = 2J>~"'1...L / ~A.r.," fit.

= 170.63939 Nlmm ,

Table .1.In Modification factor = 0.55+ (4T7-jJ / J2fX0.9+-.M/hi) $2.0

= 2

Modified minimum effective depth = 57.692308 mm OK

_<.12.11.2.7 CRACKING

C'nH:kiufl' i..cnnlrnllerl ,",y limi'ing hu "p"cing

Maximum spacing allowed for reinfor~ent 372 mm OK

n~%l \(l REF C!\LC:t'L,\TIIJ~!~ O\.'TPt!T

SLAn PANEL P9

D

1800 mm

2875 rnm

TWO-WAY SPANNTNGSLAB

	J ongcr 'pan of slah	=	2.875 ol
	Shorter span of slab	=	1.8 rn
	Thickness of stab	=	1500101
	(,h:}.u.eterL~tistrength of concrete	=	21)Ntm""
	Characteristic strength ofsteel	=	410 Nzmm 1
	Density of concrete	=	2400 kg/rn J
	Diarnater "I' steel proposed	=	12 mm

3.3 DURABIIXIT AND FIRE RESISTANCE

Table .1.1	Nominal cover for mild conditions of exposure ~ 200101			cover 20=	mm
Table .1.4	I "ihr "lllr			Fire resistance OK	
	1.~)!\mNGON I;L;\U				
	Selfweightofslnb	=	.1.6 KN!m'		
	Finishes	=	I KNtm Z		
	[aspahtic feltl	=	I KN/m'		
	Ch.ual,:h:.risric dead load	=	5.0 Ki\':rn'	gk =	5.(,I(""/m '
	Characteristic imposed load	=	9.81 KNlm Z	'I, =	9.81 KN/m'
.1.2.1.2.2	Design load I1.4g, ~ 1.6q;]	=	13.5.16 KNlm 1	n =	H536 KN/m 2

DESIGN MOMENJ"S AND REiNFORCE1'vIENTS

	Aspect ratio of slab	=	1.5972222		
	SHORT SPAN [SUPPORT)				
Table .'.14	Support moment coefficient	=	0.0768889		
Tahle.' 14	Support moment	=	5.8632883 KNm		
	Effective depth of beam . rJI	=	124mm		
.1.4.4.·]	K = M / hl'J:"	=	00191)(,(,4		
.1.1.4.·1	L",'CI arm. 1..	=	0.95 d		
		=	117.8 mm		
.14 ~..)	*Are.1* of,teel *required.*	=	Nt / o95.1:z		
		=	127.78754 mrn '	Provide	Y12 at .,00
					~7.14286 mm '
	IIlinimum reinforcement area		195 mm 2		
AS8110REF	CALCULA TIONS			OUTPUT	
	SHORI'SPAN [MIDSPAN)				
Table .'.14	Midspan moment coefficient	=	0.0579167		
Tallie .1.1~	Support moment	=	4.4165,04 KNm		
	Effective depth nf beam . [<II	=	124 mm		
.11.-1.4	K = M / I-d'f",	=	0.OI4'61R		
3..1.4.4	, ever arm. z.	=	0.95 d		
		=	117.8 rnrn		
.1.~.j.4	Are-a of steel required.	=	I11 / 095[,;;		
		=	Q(, 2)(,147 mm Z	Provide	Y 12 at S00
					377.14286 mm 1
	I.ONG SPAN (SUPPORT)				
Tahle .1.14	Support moment coefficient	–	0.037		
h~\·,., \\	r'Ji\'i"l<\ m"m~n\	=	B2l'IQS7 ~:Nm		
	Effective depth of l~am_ l"]	=	112 mill		
.1.4.·1.-1	Al / ––	–	n f)l" l.e f		

$K = \frac{--}{lxl\sim r."}$ = V.H' I~"H"

3.HI Lever arm. t. = 0.95 d

= 106.4 mm

.l. 1.4.1 Are. of steel required. = $\frac{M}{095/;;:}$

= 68.081686 mm[1] Provide yt2 at 300

377.14286 mm[1]

LONG SPAN IMIDSPAN]

Table .'.1-1 Midspan moment coefficient = 0.028

T.l>le.< I~ Support moment = 2.1351859 KNm

Effective depth of heam . |dl = 112mm

'<A.-l.l $K = \frac{M}{Mr."}$ = 0.008510X

<.~.IA J .CV('rann. 7. = 0.95 d

= 106.1 mm

.~tAA Aroa of steel required. = $\frac{M}{095./>}$

= 51.52127(, mm' Provide YJ2 at <00

.l77.142g~ mm'

IIS8110 RE!- CALCULATIONS OUTPUT

DEH.ECTION CHECK

T.hlc <.q lla~;c; *minimum t,ffccti,..e,.'* depth

for short span = 69 2'<0769 mm

I\lnmcnt redistribution factor = 1

Tension reinforcement area provided = .<77.14281 lnrn'

Tc,-v,;'\.,n .,.~'"f{),.tcmrn\MtlI lCf.I\\\tc(.\ = %.2%Hlmm'

Desig» service stress .r, = 2!~. ~ŋ, 1 / 3.4"."... fi"

= *69.761399 N/mm*[1]

Tahir .l.10 l\lodification factot = IJ55+ $\frac{(477-f)}{120(0.9+,.\frac{M}{tl'})}$ s2.0

= 2

l\\noif,ed minimum effective depth = 3~.6153%5 mrn OK

3.12.11.2.7 CRACKING

Cracking is controlled by limiting bar spacing.

Maximum spacing allowed lor rcinlor~enl 372 mm OK

IIS8110 REI' CALCULATIONS OUTPUT

SI All PANEI 1'10

4200 mm

4800 mm

TWO·I,IJ AY ,," ANN1NG !\LA.R

Longer span of slal.	=	4.8 m
Shorter span of slab	=	4.2 m
Thickness of slab	=	150 mm
Characferisfic suengrh uf concrete	=	20 NIlllnr'
Characteristic strength of steel	=	*410 N/mlll'*
Density of concrete	=	2400 kg/m[-l]
Diamatcr of steel proposed	=	12 mm

3..1 DURIIIHI.ITY AND FIllli RESISTANCE

Table, .! Nominal cove, fill mild conditions of exposure = 20mm cover 20 = mm

I ahk)A	I',hr Ihr			Fire resistance OK		
	LQADfNG ON SLAB					
	Sclfwcight of slab	=	'<.6KN/m 1			
	Finishes	=	I KNlm '			
	[aspahtic Felli	=	I KNl",'			
	Characteristic dead load	=	5.6 KN/m'	~,	=	5.6 KN'm '
	Characteristic imposed load	=	9.81 KN/lll'	'II	=	9.81 KN/m'
'.2.1.2.2	Design load II.-Ig, '1.6q,1	=	23S16 KN1m'	n	=	2.<.5:16KN1m'

DESIGN MOl'vIHITS AND REfNFORCEMENTS

	Aspect ratio nfsf ab	=	1.1-118571		
	SI/ORT SPAN [Sl.'PPORTj				
I"ahlc .'.1-1	Support moment coefficient	=	0.052		
Tahle'<.I-1	Support moment	=	21.589102 KNm		
	Fffcctivc depth of bcarn , 1"1	=	12~ rrrn		
.1A-I.·1	K = M / Irl't.	=	0.07020'<9		
'A ·1 I	I. ever arm. 7.	=	0.91472.'6 d		
		=	II '..12573 rum		
'.,14-1	Area of steel required.	=	M / 0.95./",2		
		=	4R8.I'69R5 rnm '	Provide	Y12 at ~Oo
					:jtj5.71429 mm '
	Minimum reinforcement area		195 mm'		

IIS81 10 REr	CALCULATIONS			OUTPUT	
	SHORT SPAN [MIDSPANI				
Tahlr .'.1-1	~lidspan moment coefficient	=	00.'85714		
T.hle 1.1-1	Support moment	=	1601.'894 KNm		
	Effective depth of beam. 1"1	=	114 mm		
1.-1-l t	K = M / 1>1' t;	=	0.05207-1.'		
.1.1.1 1	I ever arm. 7.	=	0.93R.1374 d		
		=	116.35383 mm		
, \ I.\	Area ofsteel required.	=	M / 095(;.=		
		=	35:1.35.102 mrn '	Provide	y 12 at300
					377.14286 mrn '
	I.O.Wi .1'/'. IN ISI -rronr)				
·I.hk 1.1-1	Support moment cnefficicnr	=	0.037		
r.hlc 1.1-1	Support moment	=	15.161-176 KNm		
	EfTccliH depth "f beam. ll|l	=	112 mm		
.'U.\	/\ = ,II / lx!'!;"	=	0.0612.10-1		
1.-1.-1.-1	I ever ann. r:	=	0.926575 d		
		=	10.1.7764 mm		
.1.·1-1-1	\rea ofsteel required.	=	/t.1 / 095(,,;		
		=	3RO.03788 mm 1	Provide	y12 ~ 250
					452.57143 mm z
	I.ONG SPAN /,\f/USI'ANj				
Ta"k3.1~	~Iidspan moment coefficient	–	0.028		
Table 1.1-1	Support moment	=	11.02490 I KNm		
	Eflee live depth nf beam . l~	=	112 mm		
1 1.-1 1	K. = M / I~If"	=	0.0463365		
3.-I.-IA	I ever arm. 7.	=	0.9-155502 d		
		=	105.90162 mm		
.1..1.-1-1	IArea (If steel required.	=	/1.1 / o 95.1; z		
		=	2R 1.82478 mm '	Provide	Y12 at 300

У ;:t
~77.142R6 mm'

nS8110REF	CALCIJI_ATIONS	OUTPUT
	DEI·l.E('TIUN CIIECK	
'I able '()	Has ic minimum effective depth for short span = 1~1.5-'R4~mm	
	~Inrnent redistribution factor = I	
	I'cns ion reinforcement area provided = .177.14286 mm	
	I'cnsion reinforcement area required = 35'.35~02 mm'	
	Design service stress r: = 2!>1,."" .._!_ ~r(1""' fit.	
	= 256.09171 N/mml	
'I ahlc , II)	Modification factor = ()'55 + (477-f) / 12!XO.9+f..-;') M S2()	
	= 1.4981923	
	Modified minimum effective depth = 107.82225 mm	OK
3.12.11.2.7	CRACKING	
	Cracking is comrolled hy limiting bar spacins.	
---.	Maximum spacing allowed for rcinfor~,enl .172 mm	OK

USRIIOREF *SLAB* P.\NEL PII

I 2400 mm

~875 mill

ONI:-II'A Y SI'ANNING SLAB

Γ ongci span of slab	=	4.875 m
Shorter span ofslah	=	2.4m
Thickness of lab	=	ISO mm
thar actctistic strength 01 concrete	=	20N'mm
Characteristic strength of steel	=	410 N'mm
Density of concrete	=	2400 kg'm
Diarnatct (If steel proposed	=	12 rnm

3.1 I)lIRAUn .ITY AND nRE RESISTANCE

lablc ' .'	Nominal cover for mild conditions of exposure ~ 20mm		en er 20= mm
Table .',4	I'/,hr 'Ihr		Fire resistance OK
	UMDING ON SL,\D		
	Self weight of slah	– 3.6 KN'm	
	Finishes	= I KNlm	
	[aspahf ic relll	= I *KNlm'*	
	[I 'haractcristic dead load	= 5.6 KNim	g, = 5.6 KNlm
	Characteristic imposed load	= 9.81 KN'm	'I, = 9.81 KN'm
.1.2.1.1.2	IDeSi!!nload IIAg,' 1·('",1	= 2.'.5](, KN'm'	n = 23.536 KNlm'

DESIGN MOMENI'S AND REINFORCEMENTS

	Aspect ratio of'stab	–	2.03125
	I.ONG SPAN [SL'PPORT)		
Tabk;) IJ	<;UI'I""!moment coefficient	–	n 017
Table '.1 I	Support momcnl	=	5.01S992:l KNill
	EfTeclive depth of beam . ldl	=	112mm
.1.4 ..1,4	$K = \frac{u}{M'I''.}$	=	0.01<)9936
.1._1.1.1	I ever arm. 7.	=	0.95 <;{

= 106..l mm

U·u Area of steel required. = $\frac{M}{0.95 f_y z}$

= 121.03411 mm² Provide Y12 at .100
377.14286 mm²

LONG SPAN [MIDSPANj

Tahir '.I~ Midspan moment coefficient = 0.02R

T."1o.1 I~ Support moment = 3.795R861 KNm

Effective depth of beam. ldl = 112 mm

.1A.-U $K = \frac{M}{bd^2 f_{cu}}$ = 0.015130.1

U l..l Lever arm, z. = 0.95 d

= 106.4 mm

U..lA Area of steel required = $\frac{M}{0.95 f_y z}$

= 91.591379 mm² Provide Y12 a 300
377.14286 mm²

13S8110REF	CALCULATIONS	OUTPUT
	DEFLECTION CHECK	
Tahle.' 9	Basic minimum effective depth for short span = 9l.307692 mm	
	~Iornent rr-distriburinn factor = I	
	Tension reinforcement arc" provided = 121.0.1411 mm²	
	Tension reinforcement area required = 91.593379 mm²	
	Design service stress /; = 2,1; /(..,' "' _I ~/("",. /'1"	
	= 206.8~685 N/mm²	
Tahle.' 10	i\[edification factor = 0.55+ (477-.0 $2.0 / 12(J(().9+/~)	
	= 2	
	Modified minimum effective depth :::II6.153846 mm	OK
_'.12.11.2.7	CRACKING	
	Cracking i~COlllrmnCtl bv limiling hal' spacing.	
	J\Iaximurn spacing allowed for reinforcement 387 mm	OK

IISRIIIl REF	CALCULATIONS	UUTI'IJT

SLAB PANEL 1'12

TWO-WAY SPANNING SLAB

Longer span of slab = 3.6 m

\'.h",',o, '1"" "hl>h = ;om

Thickness of slab = 150 mrn

Characteristic strength of concrete = 20 N/mm²

Characteristic strength of steel = ~IO N'mm²

Dcnsil~ of'cuncrcto = 2-100kg,"rn³

Diamatcr of steel proposed = 12 mm

J.J DURABILrlY AND FIRE RESISTANCE

l ahlc -'.:' Nominal cover for mild conditions of exposure 2(1111rn cuver 20= 111m

Tahk.U I'·'hr ··Ihl" Fil"eresistance OK

LOADING ON SLAB

	/ScJfWCight ofsfab	=	3.6 KN m'	
	Finishes	=	I KN/ml	
	[aspahtic Felt I	=	1 KN m^{2}	
	Characteristic dead luad	=	5.6 KN'm'	gk = 5.6 KN m^{2}
	Characteristic imposed load	=	9.81 KN'm^{2}	qk = 9.81 KN/m'
S.Z.r.Z.Z	Design load r1.4g1 I 1.6qll	=	23.536 KN m'	11 = 23.536 KN m^{2}

DESIGN MOJI.IENrS AND REINFORCEMENTS

	Aspect ratio of slab	=	1.2	
	SHORT SPAN /SUPPOR7j			
Table ~ I-I	R'.I\'!\}nft moment coefficient	=	n 1)56	
Table 3 1~	Support moment	=	11.862144 KNm	
	Effective depth of heam . 1"1	=	124 mm	
.U.t.-t	$K = \frac{M}{Irl7}$	=	O.0.~857.~(,	
.1A.-I.-t	Lever arm. '/.	=	0.95 d	
		=	117.8 mm	
.1.·1.-1.4	.\rea 01 steel required.	=	$\frac{A/f}{095j::;:}$	
		=	258.5297 mm^{2}	Provide Yl2 at 300 ~7.14286 mm^{2}
1 ---	Minimum reinforcement area		195 mm	
DS8110 REF	C\LCUV\ rroxs			OUTPUT
	SIIORT SPAN Itlfl/)SPANj			
Tahle .~.14	Midspan moment coefficient	=	0.042	
Tahlt- .'.1-1	Support moment	=	8.896608 KNm	
	Ufcctil'C depth of beam . 1"1	=	IHmm	
.q..1.~	$K = \frac{M}{l-l' t;}$	=	O.0289.~O2	
.1..1.4..1	I.cvcr arm.v.	=	0.95 d	
		=	117.8 mrn	
.1-1.-1.1	Area of steel required.	=	$\frac{M}{095/>}$	
		=	19.1.89727 mml	Provide Y 12 at300 377.14286 rnm^{1}
	U)/I'G SPAN /SUPPORTj			
Tahle 3.1<1	Support moment eoeflicient	=	o.on	
Table .1.1_1	Support moment	=	7.8.17488 KNm	
	Effective depth ofbeam . Itli	=	112 mm	
1.·I.·U	$K = \frac{M}{1rl'1,'.,}$	=	0.03124	
.14.4..t	'ever urn.".	=	0.95 d	
		=	106.4 mm	
.1.-IA.-1	Area of steel required.	=	$\frac{M}{095(,.;:}$	
		=	189.11579mm'	Provide y12 rrt 300 377.14286 mm^{2}
	LONG SPAN {MIf)SPANj			
Table .1.14	Midspan momenl coefficient	–	O.02R	
Tallie .1.1-1	Support moment	=	'.931072 KNm	
	Effective depth of beam . |d|	=	112 mm	
.1AAA	$K = \frac{M}{h:l'l''}$	=	0.0236411	
1 I1 J	Lev .lr "1'01. .t.	=	0 q, cl	
		=	t06A mm	
1..J J <1	Area of steel required.	=	$\frac{A4}{095f,z}$	
		=	\.1'.\ I.\(,~ mm1	P-:twid~ Yl2 ;i ,()0 317.14286 mm'

BSRIIO REF CALCULATIONS OUTPUT

DEH,E('TION CHECK

Tahle.1 9 Ih~ic minimum effective depth
for short span = 115.38462 mm
I<lomenl redistribution factor = I
Tension reinforcement area provided = 377.14286 mOl'
Tension reinforcement area required = 193.89727 mm²
Design service sires!'; r. = ./:.1-"<1 ",_1 3/(,."n' /3"
= 140.52656 N/mm'

·I.h"'- , III ~.t(\<1.iftClt\!\t\f:v.:tor = n.55+ (477-.f..> $2.0 12<X().'}+~) lxP
= 2
Modified minimum effective depth = 57.692308 rnrn OJ.;

3.12.11.2.7 (·R. \CI\.TNG
Cracking is controlled hy limiting bar spacing.

Maximum spacing allowed for reioforc~lcnl 372 mill OK

BS8 110 REF (',\LCULATIONS UIJfPUT

SLAB PANEL P13

.1000 mm

3600 mrn

TWO·WAY SPANNING SLAB

J !logel -=f!anof c.:lah = 3.6 In
Shorler span of slab = 3m
Thickness of ~Iah = 150 mm
Characteristic strength of concrete = 20 N'mm²
r...·h?~a-;:\e{\f.\kC'~\"~"g.\lC\f('.'~d = 11'1 "!'mm'
Density of concrete = 2~OO kg/m ³
Diamater of steel proposed = 12 mm

.1..1 /)LR\IHLITY .1 1\'1) FUU; RESIST,\,\'CE

Tahle .'.1 Nnmina l cover for mild conditions of exposure = 20mm cover 20 = mm
Table .1.-1 I'ihr:- Ihr Fire resistance OK

LOAUfNG ON SL...B

Self \\ c·'gll' of slai> = :'.6KN'm²
Fjl1i~hel.: = 1 KN'm²
[aspahtic felq = I KN'm²
Characteristic dead load = 5.6 KNm² g, = 5.6 KN/m²
ı.haractcristic imposed 'nad = 9.81 KN:m' q, = 9.81 J.;Nim²

.12.12.1 Design load (lAg. ' I.liq,) = 23.531i KN'm' n = 23.536 KN/m'

r---' IJtSIGN I<.[O~II~NTSANIJ kl:INFOKCEMtNTS
Aspect ratio of slab = 1.2
SIIURTSPAN {SUPPORT}
Tahle .~I,I Support moment coefficient = 0.051i
r.hIc3.'~ Support moment = *11.862144 KNm*
Effective depth of "cam. = 124 mm
.1AAA K = ltfl u hl'r,,, = O.0.1857~1i
.1.-1~.~ /I.ever a"11. z. = 0.95 d
= 117.8 mill

REF	CALCULATIONS			OUTPUT
."'1 1.1	Area of steel required.	=	$\frac{NI}{o.95f.z}$	
		=	258.5297 mm²	Provide y12 at .l00 :tl7. I4286 mm'
	~linimum reinforcement area		195 mm'	

nS81 10 REF	CALCULATIONS			OUTPUT
	SNORT SPAN !MIDSPAN}			
T.ble 1.14	Midspan moment coefficient	=	0.042	
l ahlc ~.I~	Support mnment	=	8.896608 KNm	
	Effective depth of he am . fdJ	=	124 mm	
.1~AA	$K = \frac{M}{r.lf,.,}$	=	O.O2893()1	
.1~J..l	l ever arm. 7.	=	0.95 d	
		=	117.8 mm	
1.~~A	,\r.-e af..1c:cl required,	=	$\frac{M}{O.95(z}$	
		=	19:1.89727 mm ¹	Provide y 12 at..100 377.14286 mm '
	LONG SPAN ISUPf'OR7)			
lat-lc .1.l~	Support moment coefficient	=	o.on	
)'.hlc .'.1_1	Support moment	=	*7.8n488* KNill	
	Effective depth of beam . ldJ	=	112 mm	
1~AA	$K = \frac{M}{/rl:r..}$	=	0.03114	
qA~	I ever arm. 7_	=	0.95 d	
		=	106.4 mm	
14·1.1	Area «lsteel required.	=	$\frac{M}{0.95(;:}$	
		=	189.11579 mm '	Provide y12 at 300 377.14286 mm '
	I.ON(; SPA/,.' /11Jf.lSP.1N)			
Table 1.14	i\lidspan moment coefficient	—	0.028	
Tahlc 1.1~	Support moment	=	5.931072 KNm	
	Effective depth of bcarn . 'til	=	112 mm	
.'<.1.1.·1	$K = \frac{M}{«.:}$	=	O.023(t~II	
3.~AA	Lever arm. 1..	=	0.95 d	
		=	I06.~ mm	
, ~.·IA	Area nl steel required.	=	.<\4 0951;:::.	
		=	I~J.I 1465 mm '	Provide Yl2 li JOO 377. 14286 mm ²

nS8110 REF	CALCULATIONS			UlJrPUT
	DErLECTION CHECK			
Table .~.9	n as ic minimum effective depth for short span	=	115.38462 mm	
	i\lnment redistribution factor	=	I	
	Tension reinforcement area provided	=	.177.14281\mm '	
	Tension reinforcement area required	=	193.89727 mm '	
	J)f-.'~ignservice stress l':'	=	2,/>1"" *_I 3A_,.. n' ~,	
		=	140.~2656 Nimm '	
Tahle .1 I()	Modification factor	=	0.55+ $\frac{(4n-.(.)}{12Q(J.9+\sim)}$ 52.11 !xl2	
		=	2	
	Modified minimum effective depth	=	57.692308 mm	OK
.1.11.11.2.7	ClUCKING			
	Cracking is controlled by limiting bar spacing.			

Maximum spacing allowed for reinfurcrn,enl :'72 111111 OK

nsu io REF	CALCULATIONS	UUTPIff

SLAT)PANEL I'll

.1000 mill

~210 mm

rWU-IVA Y SPANNING SLAB

Longer span of slab	=	4.21 111
Shorter span of ,Iah	=	.3 m
Thickness of slab	=	150 mill
Characteristic strength of concrete	=	20 N'mmz
Characteristic strength of steel	=	410 N/mm'
Density of concrete	=	2400 kg/rn 1
Diameter nf steel proposed	=	12 mm

3..1 DURABILITY AND FIRE RESISTANCE

Tahle .~.l	Nominal cover for mild conditions of expnsure - 20mm			cover20=	111m
Fable 3.-1	I' ,hr Ihr			Fire resistance OK	
	[OADfNG ON SLAB				
	Self weight of stab	=	3.6 KNim a		
	finishes	=	I KN:m '		
	[aspahtic Felt!	=	I KN'm '		
	Characteristic dead load	=	5.6 KNlm z	gk =	5.(, KNlm'
	Characteristic imposed load	=	9.81 KN'm '	ql =	9.Rl KN/m z
q 1.2 1	Design load J 1 ~g, ' 1.6q,j	=	2.<.5.16 KN'm z	n =	215.1(' KNim'

DESIGN MOI<.[E)\[]·SAND REfNFORCEMENTS

	Aspect ratio of slab	=	1.40.1.1333	
	SII(}RT ,P<II"; {'1I.lPPORlj			
Tahle .1.1·1	Support moment coefficient	=	0.06R 1667	
Tahle.1 1-1	Support moment	=	14.439-'36 KNm	
	Effective depth of beam . 1"1	=	12-1 mrn	
.'.·1.1.-1	K = .11 / Ixi'(o	=	()'0469541	
.1A.'L-l	Lever arm. 7.	=	1).9447794 d	
		=	117.15265 11111	
"U-1	Arc;] ufstccl required.	=	M / o.<J5fz	
		=	316.43728 rnrn z	Provide yn at 300 ~7.14286 mm'
	t\ rinimun1 rcinforccrncnr arc a		195 flint'	

BSRlI0REF	CALCULArIONS	OUTPUT

	SHORl" SPAN /MIDSPANj			
Tahle .1.1~	Midspan moment coefficient	=	0.0511.~3.1	
lable ~ 1-1	Support moment	=	IO.K.11267 KNm	
	Effective depth of bcarn . [til	=	124 mm	
,144.4	K = M / h:fr"	=	0.015)21.1	
.;~J 1	Lever arm, 7,	=	0.95 d	
		=	117.R mm	
.U.4.-1	Area ofstcct required.	=	M / 095(,z	
		=	2.16.0(,224 mm'	Provide y 12 aUOO .177.14286 mm'

/.(INe; *SPAN ISI'PJ'ORTj*

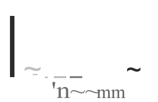
'I able 1.1.1	Support moment coefficient	= 0.037	
f'a"1I' , I~	Support moment	= 7.8:174R8 KNm	
	I.ffective depth of beam . 1"1	= 112mm	
q'~A	K = ,II / !-d:r",	= O.O311~	
~~A~	I ever arm. 7.	= 0.<)~ d	
		= I0tl.1 mill	
1.1U	:\IC:a of stcel icquued.	= M / 095f;Z	
		= IR9.11579 mm '	Provide Y12 at .100 377.14186 mm 2

t.ova SPAN IItIDSPAN)

Table .l.I~	~Iidspan moment coefficient	– 0.028	
"lal,le 1.11	Support moment	= 5.931072 KNm	
	Ul~'('r;,'c depth "fl,eam. I,~	= 112 mOI	
ql.·1	f(= M / Mr.,	= 0.02.'6411	
1.U4	J cv er ann. 7.	= 0.95 cl	
		= \(1(,-1 mm	
'.~.U	.vrca of steel required.	= M / 0951..;;	
		= I~.1.11465 mrn '	Provide Y12 at -'00 377.14U6 mm2

nS8110 REF	CALCULATIONS	OUTPlJf
	DEFLECTION CI IECK	
Fable J.t)	Bas ic minimum effective depth for short span = 115..18462 mrn	
	~lomcnt redistribution factor = I	
	Tension rcinforccmeru area provided = _177.1~286 mm '	
	Tension reinforcement area required = 2.16.06224 mm 1	
	Design service stress /; = ~f;.A~ul ..._!_ / ~/(, ..". /3"	
	= 171.0&551 N/mm 2	
I ahle.I If)	~Iodiljcalioll raclol = 0"<;+ (477-M/hl- ≤2() / 121Xo.9+ -;;-)	
	= 2	
	Modified minimum effective depth = 57.692308 mm	OK
.1.1211.2.7	CIUCKING	
	Cracking is controlled hy limiting bar ~pacing.	
	Maximum 'pacing allowed for reinforceincnt .172mm	OK

IIS&IIOREF	SLAB PANEL PIS	



ONE-WAY SPANNING SLAB

I onucr span of sliih	=	9.788 rn
Shorter span nfc;;lah	=	2.4 m
Thickness of slab	=	ISO mm
Characteristic strength of concrete	=	20 *Ntmm'*
(-)li1Tactcrislir ~Ircnglh of steel	=	·1101' rnrn
Dcnsitv 01 concrete	=	2.tOI) kg/lll \

IIS~IIORI'.F | C\Lt 'ULATIUNS | OUTPUT

SLAB PANEL PI~

2400 mm

--~
lRR8 mm

TWO-WAY SPANNING SLAB

I onger 'pan of slab	=	2.R88 m	
Sh(lrtrr span ofslab	=	2A rn	
Thickness of slah	=	150 mm	
Characteristic strength of concrete	=	20 N'mm'	
Characteristic strength lll'steel	=	~IO N/mll1'	
Dcnsitv of concrete	=	1400 kg m	
I)iamalcr of steel proposed	=	12 mm	

r---'	:,,' m'RAnn.!TY \NO FIRE RESISTANCE			
l able ,l.3	Nornin. I cover for mild conditions of exposure ~ 20mm			covrr 20 = mm
l ahle .'A	I' rhr Ihr			Fire resistance OK
	1.()ADINC; ON SLAn			
	Sclf wcinht ofsJ.,h	=	3.6 KN'm	
	Finishes	=	I KN'm	
	[aspahtic reltl	=	I KN/rn'	
	Characteristic dead load	=	5.6 KN m	g\ = 5.6 KN·m
	Characteristic imposed load	=	9.81 K~ rn	q, = 9.81 "N'm
.'.1.1.2.1	Design load [I ~gl " 1.6q"	=	23.536 KN'm	n = 23.536 KN'm

DES lnN ~IOl\mNTS \ND REINnlRCEI\IENTS

	Aspect ratio of slah	=	1.203.1.133	
	SIIORT SPAN [SUPPOR7J			
rahk 3.11	SUPPOI moment coefficient	=	0.05623:\.\	
't "hll,' .~ II	~_\l'r<"C'l m(\m~~\	=	7 6B~n-'l~ KNm	
	F.n(:ct~c depth of beam. 1"1	=	12~ rnrn	
-' ~ ~ ..t	l(= ,\f / lrl'/.,	=	0.0247899	
, 1.1. I	*I (."\ct* srrtt. *T.*	=	*0.95 cf*	
		=	117.8 mrn	
.1.~.·t.1	Area of stecl required.	=	J\4 / 095.1:z	
		=	166.1'\~'\2 rnm'	'ProyioL' Y12 at :11)0 :l:l7.14286 mrn'
	Minimum reinforcement area		195 mm'	

IIS8110 REI | CALCULATIONS | OUTPUT

	_1s{((!Rr SP.-(iV [MIOSPAA'(			
Table .1.I~	Midspan moment coefficient	=	O.0421nn7	
l'able .\.I~	ISupport moment	=	5.7t6·n~7 KNm	
	Effective depth of heam . 1"1	=	12-'lmm	
.\.~.U	*K* = ,II / *hl f,"*	=	0.0185888	
.\AA.·I	I .cvcr arm. 7..	=	0.95 *d*	
		=	117.8 mm	
1..t.4.~	.\rca of steel required.	=	*M* / *095fz*	
		=	t2~.58669 mm'	Provide y 12 at300 .177.14286 mm'
	UJAG *SPA,\' [Sl'IT'UR1)*			
l'ahlcJ I~	Support moment coefficient	=	0.037	

Diarnater of steel proposed = 12 mm

3 DIXAO[LITY AND FIRE RESISTANCE

Iable ' ..1	Nornina l cover for mild conditions of exposure - lOmm		cover 20 == rnm
Table 3.4	1"!ln Ihr		Fire resistance OK
	I.(JADING ON SLAO		
	Self weight of vlab	- .~.6 J..:NillI'	
	Finishes	= I KN m'	
	[aspahtic Felt!	= I KN'm'	
	Characteristic dead load	= 5.6 J..:N'nr'	gl; = 5.6 KNtm '
	Characteristic imposed load	= Q.RI KN'm '	<i, = 9.81 KN/m'
.1I I? 1	Design load !lAg, q .6<)11	= 2.~.5~6 KNlm '	n = 2_1.5.~6KNim '

DESIGN MmrENrS AND REfNFORCErvlENTS

	Aspect ratio of slab	= 4.07833-'3	
	LONG SPAN {SUPI'ORT}		
'1able 1.1~	Support moment coefficient	= 0.n:17	
Tahlc 1.q	Support moment	= 5.0159913 KNm	
	Effective depth of bcarn . 1"1	= 112 mm	
.q·IA	;.: = M / Mr "	= 001999-'6	
.1_.iU	Il'\CT arm. 7..	= 0.95 cl	
		= 106.4 mm	
.1.-l1A	\rea .}f"leet required.	= M / 095f;z	
		= 121.03411 mill '	Provide vtz at .'00 ~77.14286 mm'
	LONG SPAN /MIUSPANj		
Table 1 I~	~Iidspa n moment coefficient	- 0.028	
rat-Ie .1.1·1	Support moment	= '.795886J KNm	
	Effcctrve depth of bcarn , [J]	= 112 mm	
.1,4·1 ~	1\ = Af / fyi' t:	= O.(\\S\:I(\1,	
'--' ~.--I	LC\w arm, 7.	= 0.95 cl	
		= 10(,.--Il 11m	
1 1.1.1	,\lt:a ofsteel required.	= M / 095(.z	
		= 91.59-'379 rnm '	Provide Yl2 at ~00 377.142R6 mrn '

BS8110RJ,F	CALCITJ.ATJONS		OUTPUT
	DHLECTION CHECK		
Tahk 1 <)	Basic minimum effective depth		
	f(1J „l)l\l" ~"an	= 9) ~076Q2 111m	
	!\foment redistribution factor	= I	
	Tension reinforcement area provided	= 121.0~4JI mm'	
	Tension reinforcement are. required	= 91.59" 79 mm '	
	Dcsia» service stress ./,	= 2f>t., "' ! ~A'7"" fit,	
		= 206.84685 N'mrn '	
T"hlc 1.10	;\r.,difi:"f;nf1 f.'..tor	= ι) ~5+ (477-J) / 1.2fX()9+-~ hd') <?O	
		= 2	
	Modified minimum effective depth	=1o. J5.~846 mm	OK
1,.\2.\\.2.1	l'R.\Ci'-tNt;		
	Cracking is controlled by limiting bar spacing.		
	Maximum spacing allowed for reinforcement	1.18.46154 111m	OK

I ahle .'.14	Support moment	5.015992:1 KJl.:m	
	Effective depth..tbeam . lril	112 mm	
\.-l.~A	K If	0.01999'<(,	
	/rI' ("		
.1 IA,t	J.r\{'1' ann. 'l.	0.95 cl	
		I06A mill	
qA~	.\re.1 (d steel n-quin-d,	M	
		095.t;.::	
		121.0.1-111 mm'	YJ2 at 300
			377.14286 mm'
	I.OVG Sf'4N IWf)SPAN)		
r.h," .~.l~	1\ lidspan moment coefficient	o.on	
l.h", .'.l~	Support moment	3.7\1588(, I KNm	
	Effective depth ofheam. l,n	112 mm	
1.-1.·14	K M	0.0151.103	
	hf("		
.q IA	l ever arm. 7..	0.95 d	
		106A mm	
' 1.1.1	Area (lf skd Jcqulf<..'lt	M	
		095(:7:	
		91.59.,.179 mm'	Y12 rtl 300
			J 77.1-1286 111m'

BS8110 IUT	CALCULATIONS		OUTPUT
	DEFLECTION CHECK		
lablc .'-"	Basic minimum effective depth		
	rut "hOfl xuan	92.107691. 111m	
	~ lornent redistribution ran",		
	Tension reinforcement area provided	.177.14286 mm'	
	Tension reinforcement area required	I N.58(,(,<) mm'	
	Design service stress t:	21>('", >k 1	
		3.-1,"". fit,	
		90.29.1891 N'mm'	
		Cl'i'i+ (477-1),\4.'<7()	
		I2fY0.9+hr.")	
		2	
	Modified minimum effective depth	= ~(,,15.1846 rnrn	OK

.;.IZ.II~.2_.7.~C~'I~(~,\~C~K~·T~N~C~J

Cracking is controlled bv limiting har spacing,

Maximum spacing allowed for reinfo~~ent 372 mm eH APTER FOUR

4.0 Analysis of Roof Slab Beam

Roo Toad -- i.e Flat Roof

Concrete = 24 $KN/m3$, finishesl Asphalt = 2 KN/m^2

Imposed/Water = 9.81 $KN/m3$, Height of Slab = 150mm

Loadings:

Own = 0 I5 x 24 = 3.6 KN/m^2

Finishes/ Asph alt = 2.0 $KN/m2$

Imposed/water = 9.81 KN/m^2

Dead loads: GK = 1.4(3.6 + 2.0) = 7.84 $KN/m2$

Imposed load: QK = 1.6 x 9.81 = 15.70 KN/m^2

Design load: n = GK + QK = 23.54 KN/m^2

4.2 Analysis of Floor Slab Beam

Applied Loading Analysis.

I). B 'am

Size = (230 x 450) mm

Concrete= $24KN/m^3$

Rendering = $0.60KN/m^3$

Loadings

Own --:0.23 x 0.45 x 24 = 2.484KN/m

Rendering = l(2 x 0.23) + (2 x 0.45)] x 0.60 = 0.816KN/m

3.30KN/m

Gk = 1.40 x 3.30 = 4.62KN/m = SKN/m

2) Slab

Height = 175rnm, Finishes = 1.20KNI m^2

Partition Allowance = $1.50KN/m^2$, Imposed load =].50KNI m^2

c_onc._r_et_e24 KN_/m_

Loacmgs:

Own = 0 175 x 24 = 4.20KNI m2

Finishes = 1.20 KNI m2

Partition = 1.50 KNI m2

Imposed = 1.00 KNI m2

8.40 KNI m2

Dead load: Gk = 1.4(4.20 + 1.20 + 150) = 9.66 KN/m2

Imposed load: QK = 1.6 x 1.50 = 2.40 KN/m2

Design load: n = Gk + QK = 1206 KN/m2

4 2. I Floor beam I (fb I) [J Ell beam

bf= [0.1 x 0.7 x 4200] + 230 = 524mm = 520mm

Beam =) KN/m

SI ,1 prnlx=0.29 x 12.06x3.75=13.12KN/m

3m=5KN/m ~m+1R.I?KN

D ~ 6

A 1.20 B 4.20 C

MA= MC = 0

ME = Wl2/8 = 0.90 KNm

MF = Wl2/8 = 40 KNm

Span AB % BC

alXl = 2/~ x MF x 1.2012 = 0.432

a2X2' 2/~ x MF x 4.202/2 = 235

MA (I 20) + 2MB(1.20 + 4.20) + MC(4.20) = LQ_f!I!l_ + 6 a2X2]

1.20 4.20

0+ lO8MB+O = -337_87

MB = -31.30KNm {Support}

SpaI1~:

ME = 0_90 - (MAh + MB/2) = -14.75KNm

MF = 40 - (MBh + MCh) = 2435 KNm {Span}

Shear:

Max Shear n at point B along span Be.

VBe = wl/2 == (18.12 x 4.20)/2 == 38.05 KNm

4.2.2 Floor Beam 4 (fb4) 0 Ell beam

bf'= Beam == {O.l x 0.7 x. 4200} + 230 = 524mm z 5200mm

Beam =:; KNrn

S3 I12n/n = Y2 x 12.06 x 1.80 = 10.90 KNm

S4 Yzl11 x == liz x 12.06 x 1.80 = 10.90 KNm

~+54=16KN/m 3m+53==16KN/m 3m+53=16KN/m

A E I ~0 r0t X G O

420 11 0.60

	A					
K	0.24			0.83		1.67
DF	1.0	0.22	0.78	0.33	0_67	10
MF	23.52	23.52	-1.92	1.92	-0.48	0.48
OM	28.52	-4_75	-16.85	0.48	-0.97	-0.88
COM	2.38	11.76	-0.24	-8.43	-0.24	-0.49
OM	2.38	-2.53	-8.99	2.86	5.81	0.49
COM	-1.27	1.19	1.43	-4.50	0.25	2.91
OM	1.27	-0.58	-2.04	1.40	2.85	-2.91

COM	-0.29	0.64	0.7	-1.02	-1.46	1.43
OM	0.29	-OJ	-1.05	0.82	1.66	-1.43
COM	-0.IS	0.15	0.41	-0.53	-0.72	0.83
DM	0.15	0.12	0.44	0.4	0.84	0.83
M	0	28.98	28.99	-7.55	7.54	0
VS	33.60	33.60	9.60	9.60	4.80	4.80
YOm	-6.9	6.9	17.87	-17.87	12.57	-12.57
V	26.7	40.5	27.47	-8.27	17.37	-7.77
		20.70		-15.9		-3.05

Support moment = 28.99 KNm

Spa.m moment = 20.79 KNm

Max. Shear 'V' = 40.50 KNm (YBA)

4.2.3 Floor Beam 5 (fb5) !J Tee beam

bf= (0.2 x 0.7 x 1880} + 230 = 4800mm

Beai = 5 *KN/m*

SI - prynl x = Y2 x 12.06 x 3.75 = 11.75 *KN/m*

S3- Y2 nix = Y2 x 12.06 x 1.80 = 10.90 *KN/m*

Bm + S 1+ S3

1.80 B

Moment 'M' ~:12/8 ~ I 134 KNm

Shear 'V' = *w1/2*= 25.20 KNl11

4.2.-i Floor Beam 6 (fb6) [-l Tee beam

hf {! 2 x 0.7 x 4200} + 230 = 81Smrn = 810mm

Be.u., = 5 *KN/m*

S 1 l~rxn/n = 0.44 x 12.06 x 3.75 = 19.90 *KN/m*

S3 [i YJ *nix* = Y2 x 12.06 x 1.80 = 10.85 *KN/m*

S4 1!'hn/x=YJx 12.06x1.80= *10.85KN/m*

S5 t , ~2*nix* = liz x 12.06 x 1.20 = 7.24 *KN/m*

S6 [l~ryn/x = 0.33 x 12.06 x5.40 = 21.50 *KN/m*

OF	1.0	0.22	0.78	0.33	0.67	0.80	0.20	0.33	0.67	1.0
~	[illegible]	[illegible]	[illegible]	[illegible]	-0.7	0 7	-15.4	15.4	-0.60	0.60
OM	56'	- 1', .2	-39.78	-1.42	-2.88	11.76	12.94	-4.88	-9.92	0.60
C6rV1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.4 4	4 7	-0.30	~96
		-6.00	-21.30	14.62	9.40	3.10	0.78	-0.40	-0.80	14.96

COM	~, O-rZ	80	-r-r	0 65-	155	-1 470	-0.20	0.39	1248	FO
OM	3.0	-1.12	-4.0	3.0	6.10	-3.6	-0.9	-0.95	-1.92	OAO
COM	-0.56	1.50	1.50	-2.0	-1.80	3.05	-OA8	-0.45	0.20	- 0.96
OM	0.)6	-0.66	-1.56	1.25	2.55	-2.06	-0.51	0.08	0.17	0.96
COM	0.33	0.28	0.63	-0.78	-1.03	1.28	0.04	-0.26	OA8	0.09
OM	0.33	-0.20	-0.71	0.60	1.21	~:J:_r7			-015-	0.09
M	0	69.38	-68.62	-20.27	20.28	16.43	-16.43	10.33	-10.36	L
YS	79_8	79.80	22.8	22.8	6.9	6.9	38A	38A	13~	3.0-
YOm	1652	16.52	40.29	-40.29	6A2	-6A2	2.54	-2.54	8.63	- 8.63
Y	5.28	96.32	63.09	17A9	13.32	OA8	40.94	35.86	11.63	5.63
~M	14910		-37.61		-17.32		9.66		-4.28	

Support moment ~ 6938 ~~m

Span moment = 49.\0 KNm

Shear 'Y' = 96.32 KN

4.2.5 Floor Beam 13 {fbI3} rJEllbeam

bf= {O.I x 0.7 x 4800} + 230 = 566mm z 5060mm

beam = 5 KN/m

S7 - prxn/x = OJ x 12.06 = 13.90 *KN/m*

Bm+S7= *19KN/m*

~ 4.80

A

Moment 'M' = $wl^2/8$ = 55 KNm

Shear 'Y' = wl/, = 45.60 KN

4.2.6 Floor Beam 20 (fb20) LJ Ell beam

bf= {O.I x 0.7 x 6000} + 230 = 650mm

Beam = 5 *KN/Ill*

S3 Bryn/x = 0.33 x 12.06 x 2.025 = 8.06 *KN/m*

S6 r Bryn/x = 0.27 x 12.06 x 5.40 = J 7.60 *KN/m*

S8 l~·1h*nix* = 1h x 12.06 x 3.0 = 18.09 *KN/m*

S 11 11 '1₂*nix* = Y2 x 12.06 x 2.40 = 14.47 *KN/m*

S·i 5 lJ Y2 nix = Y2 x 12.06 x 2.40 = 14.47 *KN/m*

anding = 22 *KN/m;* Stair = 14 *KN/m*

[redacted]

	_,::mding'"beam=:7		, Se+stoir bm:::J7		S8+stair-t'bm=37		S3+sIS+bm=28		IS; 1.,., 15+bm=34		S15+bnF20		S3+515+om =?8	
'--.--Ij	1.80		1 6.0		4'4.20-		9 2.025		4' 4.875		1.275		4 1.725	
K	0.56		0.17		0.24		0.50		10.21		0.78		0.58	
DF	1.0	0.77'	0·;;J··-......-..,I	0.42	0.58	0.32	0 68	1~~7[)	03;-	0}1-1"	'-9_.	0.57	0.43	LO
MF	-7.29	7.29	-Ill	III	-54.4	54.4	9.6	9.6	-67.34	67.34	-2.71	2.71	-6.94	6.94
OM	7.29	79.86	23.85	-23.77	-32.83	-14.34	-30.46	40.42	17.32	-13.57	-51.06	2.41	1.82	-6.94
COM	39.93	3.65	-11.89	11.93	-7.17	-16.42	20.21	15.23	-6.79	8.66	1.21	-25.53	-3.47	0.91
OM	-39.93	6.35	1.90	-2.0	-2.76	-1.21	-2.58	-5.91	-2.53	-2.07	-7.80	16.53	12.47	-0.91
COM	3.18	-19.97	-1.0	0.95	-0.61	-1.38	-2.96	-1.29	-1.04	-1.27	8.27	-3.90	-0046	6.24
OM	-3.18	16.15	4.82	-0.14	-0.20	1.39	2.95	1.63	0.70	-1.47	-5.53	2.49	1.88	-6.24
COM	8.08	-1.59	-0.07	2.41	0.70	-0.10	0.82	1.48	-0.7 4	0.35	1.25	-2.77	-3.12	0.94
OM	-8.08	1.28	0.38	-1.31	-1.80	-0.23	-0049	-0.52	0.22	-0.34	-1.26	3.36	2.53	-0.94
COM	0.64	-4.04	-0.66	0.19	-0.12	-0.90	-0.26	-0.25	-0.17	0.11	1.68	-0.63	-0.47	-1.27
OM	0.64	3.62	1.08	-0.03	-0.04	0.37	0.79	0.30	0.13	-0.38	-1Al	0.63	0.47	-1.27
COM	1.81	0.32	-0.02	0.54	0.19	-0.02	0.15	0.40	-0.19	0.07	0.32	-0.71	-0.64	0.24
OM	-1.81	-0.23	-0.07	-0.31	-0.42	-0.04	-0.09	0.15	-0.06	-0.08	-0.31	0.77	0.58	-0.24
M	0	92.69	-92.68	99.46	-99.46	21.52	-21,52	60049	-60.49	57.35	-57.35	-4.64	4.65	0
VS	24.3	24.3	III	111	77.7	77.7	28.35	82.88	82.88	82.88	12.75	12.75	24.15	24.15
V9m	-51.50	51.50	-1.13	].13	18.56	-18.56	19.24	0.64	0.64	-0.64	- 41.34	-41.34	2.70	-2.70
V	-27.2	75.80	109.87	112.13	96.26	59.14	47.59	83.52	83.52	82.24	54.09	-28.59	26.85	21.45
SM	-35.41		70.43		21.10		-26.65		42.08		-26.93		8.10	

Support Moment = 99.46 kNm

Span moment = 70.43 kNm

Shear 'Y' = 112.13kN

./.3 Floor Beam Design

Pa.'l''31lleteG___

g = Unit weight of materia
b = Design width
h = Height
O= Bar diameter
M' = Sagging mornerr
M- = Hogging momen
c = Cover
As = _i\ rea of stee I
r. = Lever arm
zmax = Maximum lever arrr
Asreq = Area of steel rcquirer
Asprov = Area of steel provider
feu = Characteristics strength of concrete
fy = Characteristics strength of reinforcemen
n = Number of bat
Mu = Design momen
Vu = Design shear

4.3.1 Floor Beam (Fb1) 7 Ell Beam

f)csign (Singly RC)

INPUT:

(1) Section Dimension:

Web: bw =	230 mm
Flange width: bf =	520 mm
Height: h =	450 mm

(2) Assumptions:

Concrete: *fcu* =	30 MPa
Reinforcement: *fy* =	410 MPa
Cover: c =	25 mm
Bar *diameter:* D =	16 mm
links: (2) =	10 mm

Code: *B5 8110: Part* 1,1997

Reinforced Concrete Design 5th Edition by Mosley, table A.l

(3) Applied Load: See Beams Analysis Sheets

Sagging moment: Mb =	24.35 kNm
Hogging moment: Mt =	31.30 kNm

CUTPUT:

lc=h-c-D!2-0=	407.00 mm
SAGGING:	
K=	0.009
z=	386.65 mm
Area of steel: As = Mb / 0.95 fy z =	161.69 mmL
Minimum area of steel: Asmin = 0.13 % b h =	134.55 mmL
Area ot steel required: Asreq -=	161.6'3 mm2
No of bar: n = Asreq / Asbar =	1.00

HOGGING:	
K=	0.027
z=	386.65 mm
Area of steel: As = Mt / 0.95 fy t: =	207.84 mm2
inimum area of steel: Asmin = 0.13 % b h =	134.55 mm2
rea of steel required: Asreq =	207.84 rnrn'
~ o of bar: n = Asreq / Asbar "'	2.00

E>ROVISION:

'ISagging: Area of steel provided -= Asprov -=

Provide 2 Y 16 ~ Btm

LOgglng: Area of steel provided = Asprov = 402.00 mm2

Provide 2 Y 16 - Top

.r;~p.;,; ɸo o~ .. o.o ~ ... o .... -

(1) Section Dimension:

Web: bw =	230 mm
Height: h =	450 mm

(2) Assumptions:

Concrete: *fcu* =	30 MPa
Reinforcement: *tv* =	410 MPa
Cover: c -:0	25 mm
Bar diameter: D =	16 mm
Links: 0 =	10 mm

Code: *BS 8110: Port* 1,1997

Reinforced Concrete Design 5th Edition by Mosley, table AA

(3) Applied load: See Beams Analysis Sheets

Maimum Shear: 'IF	38.05 kN

OUTPUT~

d=h-c-D-0/2=	404.00 mm
Area of steel provided: Asprov =	402.00 mm2

BEl

Shear stress: v = V b d =	*0.41 N/mm2*
Allowable shear stress: vi = 0.8" fcu =	4.38 N/mm2
f 0.8 *v icu »,* then;Shear condition =	SAlSftD
% of area of steel: a = 100 As / b d =	0.43

4.3.1.2Beam 1 Shear Rein/.

It.·PI)

0.47 N/mm 2 J

OUTPUT:

T": -0.4 =	0.87 N/mm 2
Links arrangement: Asv = 2 ~ TT 02 / 4)=	157 rnm'
Noma! Link :	
Nominal links: v -vc -0.4 =	TRB
Nominal links: Asv / Sv = 0.4 b / 0.95 fy =	0.2362
Sv =	665.11
Shear bar:	
l~~ear bar: v >.lC -0.4 =	FALSE
~:ar bar: Asv / Sv = bw (v - vc l/(0.95 fy I =	FALSE
	No Shear Bar

PROJ&/ON:

[i'"f"ovideY 10 (jOOmm ~legs)

~

~-~r'4~3~~-;;m 4 (FbI-t Ell Beam

Design (Singly RC)

LNPUT:

(1) Section Dimension:

Web: bw =	230 mm
Flangewidth: bf =	520 mm
Height: h =	450 mm

(2) Assumptions:

Concrete: *feu* =	30 MPa
~\-inforcernent: *fy* =	410 MPa
Cover: c =	25 mm
Bar diameter: D =	16 mm
Links: 0 =	10 mm

Code: *BS 8110: Part* 1,1997

Reinforced Concrete Design 5th Edition by Mosley, table A.j

(3) Applied load: See Beams Analysis Sheets

Sagging moment: Mb =	20.79 kNm
Hogging moment: Mt =	28.99 kNm

OUTPUT:

d = h - c - D / 2 -~ =	407.00 mm

SAGGING:

K=	0.008
z :::	386.65 mm
Area of steel: As = Mb /0.95 fy z =	138.05 mm2
Minimum area of steel: Asmin = 0.13 % b h =	134.55 mm2
Area of steel required: Asreq ::.	138.05 mrr/
No of bar: n = Asreq / Asbar =	1.00

HOGGING:

K=	0.025
z=	386.65 mm
Area of steel: As = Mt / 0.95 tV 1=	192.50 mm2
Minimum area of steel: Asmin = 0.13 % b h =	134.55 mrn"
Area of steel required: Asreq =	192.50 mm2
No of bar: n = Asreq / Asbar =	1.00

PROVISION:

'Sagging: Area of steel pr ovided ::. Aspr ov =	<\02.00 mm2
Provide 2 Y 16 - Btm	
[ogging: Area of steel provided = Asprov =	402.00 mm2
Provide 2 Y 16 - Top	

--0l' -;._.~.usection *Design for Shear.*

LfjPUT:

(1-Iection Dimension:

'~:>: bw =	230 mm
Height: h =	450 mm

(2) Assumptions:

Concrete: *fcu* =	30 MPa
Reinforcement:fy =	410 MPa
Cover: e =	25 mm
Bar diameter: D =	16 mm
Links: 0 =	10 mm

Code: *BS8110: Part* 1,1997

Reinforced Concrete Design 5th Edition by Mosley, table A.~

(3) Applied load: See Beams Analysis Sheets

Maimum Shear: V=	40.50 kN

OUTPUT:

d=h-e·D-0/2=	404.00 mm
Area of steel provided: Asprov =	402.00 mm^2

B'E!__

Shear stress: v = V b d =	*0.44 N/mm²*
A:i wable shear stress: v' = 0.8" feu =	*4.38 N/mm²*
f C 8 " fcu *"J,* then;Shear condition	SAl5ftD
% of area of steel: a = 100 As / b d =	0.43

4:3.2.3 Shear Reinforcement

,lt·
lfIIPIJ

lli'~Sign shear stress: vc =	*0.47 N/mm²*

"t!

OUTPUT:

vc .fl.4 =	*0.87 N/mm²*
links arrangement: Asv = 2>(IT 0₂ *14)=*	157 mrn"

Nomoi Link

Nominal links: v *-ec* .fl.4 =	TRS
Nominal links: Asv / Sv = 0.4 b / 0.95 fy =	0.2362
Sv =	665.11

S lear bar:

Shear bar: v '>Ie-{).4	FALSE
Shear bar: Asv / Sv = bw (v - vc l/(0.95 fy 1=	FALSE
Sv =	No Shear Bar

PIOJ6ION:

§.ovide Y10 ~Omm ~legs l

---r7--:'·'..' '5'£";5/ :') Ie Beam

V· ... ·1Sinyty RC}

INPUT:

(1) Section Dimension:

Web: bw =	230 mm
Flangewidth: bf =	480 mm
Height: h =	450 mm

{2\ Assumptions:

Concrete:fcu =	30 Mila
'''~inforcement:fY =	410 MPa
ever: c =	25 mm
Bar diameter: D =	16 mm
l; ks: 0 =	10 mm

Code: 85 *8110: Part* 1,1997

Reinforced Concrete Design 5th Edition by Mosley, table A.J

l\ =j Applied Load: See Beams Analysis Sheets

'~~!ggingmoment: Mb =	11.34 kNm
Hogging moment: Mt =	0.00 kNm

OUTPUT:

(I=h-c-0/2-0=	407.00mm
SAGGING:	
K =	0.005
z =	386.65 mm
Area of steel: As = Mb / 0.95 fy z =	75.30 mrn'
Minimum area of steel: Asmin = 0.13 % b h =	134.55 mrn2
Area of steel required: Asreq =	134_55mm2
No of bar: n = Asreq / Asbar =	1.00
tlOGGING:	
t"=	0.000
l' =	386.65 mm
Il.rea of steel: As = Mt / 0.95 fy z =	*0.00 mm2*
i,Jlinimum area of steel: Asmin = 0.13 % b h =	134.55 mm2
/I,.rea of steel required: Asreq =	134.55 mm2
i -;o of bar: n = Asreq / Asbar =	1.00

p'ROVISION:

Sagging: Area of steel provided = Asprov =	402.00 mm2
Provide 2 Y 16 - Btm	
Hogging: Area of steel provided = Asprov =	226.00 mm2
Provide 2 Y 12 - Top	

4~3.3.2 Section Design for Shear.

fNPUT:

!(1)Section Dimension:

Web: bw =	230 mm
Height: h =	450 mm

(...) Assumptions:

Conerete:fcu =	30 MPa
Peinforeement:fy =	410 MPa
C ver·.c=	25 mm
,::':lr diameter: D =	16 mm
!LInks: 0 =	10 mm

Code: *BS 8110: Part* 1, 1997

Reinforced Concrete Design 5th Edition by Mosley, table AA

(3) Applied load: See Beams Analysis Sheets

/Maimum Shear: 'J:.	25.20 kN

OUTPUT:

d=h-e-D-0/2=	404.00 mm
Area of steel provided: Asprov =	402.00 mm^2

BEl:

S ear stress: v = Vb d =	0.27 N/mm^2
Allowable shear stress: v' = 0.8" feu =	4.38 N/mm^2
f :J.8 " feu >I, then;Shear condition =	SAISF£D
% of area of steel: a = 100 As / b d =	0.43

4.3.3.3 Shear Reinforcement

h"tPD

~ sign shear stress: ve =	0.47 N/mm^2 ~

Oi..'TPUT:

vQ-().4 =	0.87 N/mm^2
links arrangement: Asv = 2 >(TT 0^2 /4)=	157 mm^2
Nbmal Link	
Ndminallinks: v -vc -().4 =	TRB
N~bminallinks: Asv / Sv = 0.4 b / 0.95 fy =	0.2362
Sv =	665.11
Shear bar:	
Shear bar: v >Ie -().4 =	FALSE
Shear bar: Asv / Sv = bw (v - ve)/(0.95 fy) =	FALSE
Sv =	No Shear Bar

PROII/ON:

IProvide Y 10 <jOOmm ~legs)

.~~;'4-1 Floor Beam FB6 -t Ie Beam

Design (Singly RC)

INPUT:

(1) Section Dimension:

Web: bw =	230 mm
Flange width: bf =	810 mm
Height: h =	450 mm

(2) Assumptions:

Concrete: fcu =	30 MPa
Reinforcement: fy =	410 MPa
Cover: c =	25 mm
Bar diameter: D =	16 mm
links: (2) =	10 mm

Code: *BS 8110: Part 1,1997*

Reinforced Concrete Design 5th Edition by Mosley, table A.l

(3) Applied Load: See Beams Analysis Sheets

Sagging moment: Mb =	49.10 kNm
Hogging moment: Mt =	69.38 kNm

OUTPUT:

d=h-c-D/2-Q!=	407.00 mm

SAGGING:

K=	0.012
z =	386.65 mm
Area of steel: As = Mb / 0.95 fy z =	326.03 mm^2
Minimum area of steel: Asmin = 0.13 % b h =	134.55 mm^2
Area of steel required'. Asreq =	326.03 mm^2
No of bar: n = Asreq / Asbar =	2.00

HOGGING:

K=	0.061
z=	377.40 mm
Area of steel', As = Mt / 0.95 fy z =	471.99 mm^2
Minimum area of steel: Asmin = 0.13 % b h =	134.55 mm^2
Area of steel required: Asreq =	471.99 mm^2
No of bar: n = Asreq / Asbar =	3.00

PROVISION:

Sagging'. Area of steel provided = Asprov =	402.00 mm^2
Provide 2 Y 16 - Btm	
Hogging: Area of steel provided = Asprov =	603.00 mm^2
Provide 3 Y 16 - Top	

l!J'fUT:

{ll Section Dimension:

Web: bw =	230 mm
Height: h =	450 mm

(2) Assumptions:

Concrete:fcu =	30 MPa
Reinforcement:fy =	410 MPa
C()'J~r: c =-	25 mm
Bar diameter: D =	16 mm
lin ks: (2):	10 mm

Code: *BS 8110: Port* 1, 1997

Reinforced Concrete Design 5th Edition by Mosley, table A.4

(3) Applied Load: See Beams Analysis Sheets

L~imum Shear: 'J;	96.32 kN

OUTPUT:

d=h-c-D-(2)/2=	404.00 mm
Area of steel provided: Asprov =	402.00 rnrn"

5 .ear stress: v = V b d =	1.04 N/mm2
Allowable shear stress: v' = 0.8" fcu ::	4.38 N/mm2
t 0.8 v fcu »«, then;Shear condition	SAI5f£D
% of area of steel: a :: 100 As / b d =	0.43

4.3.4.3 Shear Reinforcement

~

f!?F.signshear stress: vc =	0.47 N/mm2

';d

OUTPUT:

vc .().4 ::	0.87 N/mm2
links arrangement: Asv = 2>(TT (2)2 4)=	157 mm"

Noina! Link

Nominal links: v *<flC.().4 ::*	FALSE
N minallinks: Asv / Sv = 0.4 b / 0.95 tv ::	FALSE
Sv:=	No Nominal links

Sh or bar:

ar bar: v :::vc().4 =	TRfJ
ear bar: Asv / Sv :: bw (v - VC)I(0.95 tv) =	0.3346
::	469.55

PRQI&ION:

Provide Y 10 (900mm ~legs)

~

4.3.5.1 Floor Beam I1Fb..=1r...'_-7~BH Beam

DESIGN (Singly Re)

INPUT:

(1) Section Dimension:

Web: bw =	230	mm
Flange width: bf :::	560	mm
Height: h =	450	mm

(2) Assumptions:

Concrete: *feu* =	30	MPa
Reinforcement:fy :::	410	MPa
Cover: c :::	25	mm
Bar diameter: O =	16	mm
Links: (Z) =	10	mm

Code: *BS 8110: Part* 1,1997

Reinforced Concrete Design 5th Edition by Mosley, table A.J

(3) Applied Load: See Beams Analysis Sheets

Sagging moment: Mb =	55.00	kNm
Hogging moment: Mt =	0.00	kNm

OUTPUT~:~~ ~

d:::h-c-O/2-Ql:::	407.00	mm

SAGGING:

K:::	0.020	
z =	386.65	mm
Area of steel: As :::Mb / 0.95 fy z :::	365.21	mm^2
Minimum area of steel: Asmin = 0.13 % b h:::	134.55	mm^2
Area of steel required'. Asreq "-	365.21	mm^2
No of bar: n :::Asreq / Asbar =	2.00	

1:!OGGING:

K=	0.000	
z:::	386.65	mm
Area of steel: As::: Mt / 0.9S tV / :::	0.00	mm^2
Minimum area of steel: Asmin :::0.13 % b h :::	134.55	mrn"
Area of steel required: Asreq :::	134.55	mm^2
No of bar: n :::Asreq / Asbar =	1.00	

eROVISI=O=N:: ~

ragging, A,~ of st~ lp,"vid.d ~Asprov~ 402.00 mm'

Provide 2 Y 16 - Btm

Hogging: Area of steel provided = Asprov = 226.00 mrn'

Provide 2 Y 12 - Top

---1].3.5.2 *Section Design for Shear*

INPUT:

(1) Section Dimension:

Web: bw =	230 mm
Height: h =	450 mm

(2) Assumptions:

Concrete: *feu* =	30 MPa
Reinforcement:fy =	410 MPa
Cover: c "'	25 mm
Bar diameter: 0 =	16 mm
links: 0 =	10 mm

Code: *BS 8110: Port* 1,1997

Reinforced Concrete Design 5th Edition by Mosley, table A.4

{3} Applied Load: See Beams Analysis Sheets

(\'jaimum Shear: \J:.	45.60 kN

OUTPUT:

d=h-c-D-0/2=	404.00 mm
Area of steel provided: Asprov =	402.00 rnm"

BElt

Shear stress: v = V b d =	0.49 N/mm2
Allowable shear stress: v' = 0.8" fcu =	4.38 N/mm2
f 0.8 Vfeu », then;Shear condition	SAI5I£D
% of area of steel: a = 100 As / b d =	0.43

4.3.5.3 Shear Reinforcement

INPIJ

lQ sign shear stress: vc =	0.47 N/mm 2

OUTPUT:

V.C -().4 =	0.87 N/mm2
links arrangement: Asv = 2 >(TT 02 / 4)=	157 mm2
Noinal Link	
Nominal links: v -*oc* -().4 =	TRB
Nominal links: Asv / Sv = 0.4 b /0.95 fy =	0.2362
Sv =	665.11
Shear bar:	
Shear bar: v "'c -().4 =	FALSE
Shear bar: Asv / Sv = bw (v - vc)/(0.95 fy) =	FALSE
Sv =	No Shear Bar

PROJSION:

Provide Y10 (jOOmm ~legs)

~

1-;.3.6.1 *Floor Beam II (FbII)* ~ Ell Beam

DESIGN (Singly RC)

INPUT:

(1) Section Dimension:

Web: bw =	230 mm
Flange width: bf =	650 mm
Height: h =	450 mm

1~2}Assumptions:

Iconcrete:/cu =	30 MPa
Heinforcement:fY -=	410 MPa
ever: c =	25 mm
Bar diameter: 0 =	16 mm
links: 0 =	10 mm

Code: 85 *8110: Part* 1,1997

Reinforced Concrete Design 5th Edition by Mosley, table A.J

(3) Applied Load: See Beams Analysis Sheets

Sagging moment: Mb =	70.43 kNm
Hogging moment: Mt =	99.46 kNm

OUTPUT:

Id=h-c-D/2-(/J=	407.00 mm
ISAGGING:	
K=	0.022
z -=	386.65 mm
I'c'rea of steel: As -= Mb /0.95 fy z =	467.66 mm2
inimum area of steel: Asmin = 0.13 % b h =	134.55 mm2
Area oi steel required: Asreq -=	467.66 mm2
'No of bar: n = Asreq / Asbar =	3.00
LOGGING:	
11\=	0.087
z=:	362.86 mm
Area of steel'. As -= Mt / 0.95 tv ı -=	703.72 mm2
Minimum area of steel: Asmin = 0.13 % b h =	134.55 mm2
Area of steel required: Asreq -=	703.72 mm2
No of bar: n -= Asreq / Asbar -=	4.00

PROVISION:

'sagging', Area oi steel provided =- Asprov = 603.00 mm2

Provide 3 Y 16 - Btm

Hogging: Area of steel provided = Asprov = 804.00 mm2

Provide 4 Y 16 - Top

--"-"1-;;~'6'2 *Section Design for Shear.*

INPUT:

{:} Section Dimension:

'deb: bw=	230 mm
lHeight: h :::	450 mm

{2:1 Assumptions:

Ccacreie.fcu :::	30 MPa
Reinforcement:fy :::	410 MPa
Cover: (.-=	25 mm
Bar diameter: 0 :::	16 mm
links: 0 :::	10 mm

Code: *BS 8110: Part* 1,1997

Reinforced Concrete Design 5th Edition by Mosley, table A.<l

(3) ~lied Load: See Beams Analysis Sheets

lMaimum Shear: V=	112.13 kN

OUTPUT~

d:::h-c-o-0/2:::	404.00 mm
Area of steel provided: Asprov :::	603.00 mm2
S ear stress: v :::V b d :::	*1.21 N/mm1*
.t..:owable shear stress: v' :::0.8" fcu :::	*4.38 N/mm<*
lf ;,.8 " fClJ~, then;Shear condition	SAEf£D
~ f area of steel: a :::100 As / b d =	0.65

4.3.6.3 Shear Reinforcement

llii.P1J

lO"esignshear stress: vc :::	0.54 N/mm2]

OUTPUT:

1v.<!~-(J.4::: ~	*0.94 N/mmz*
links arrangement: Asv :::2 >(IT 02 / 4)=	157 mrn'

Noinal Link

Nominal links: v -oc -{).4 :::	FALSE
Nominal Links: Asv / Sv :::0.4 b /0.95 fy :::	FALSE
Sv:::	No Nominal Links

Shear bar:

ear bar: v ::vc-{).4 :::	TRB
ear bar: Asv / Sv :::bw. (v - VC)/(0.95 fy) =	0.3937
~ :::	399.03

PROJ&/ON:

[Provide Y 10 (jOOmm ~Legs)

'li

4.4 COLUMN ANALYSIS

Applied Loadings Analysis:

1) Column Type I (CT 1)

Size = (230 x 230)mm; Height = 3000mm

Concrete = 24 *KN/m3*

Rendering = 0.60 *KN/m~*

Loadings:

Own = 0.23 x 0.23 x 3.0 x 24 = 3.81KN

Rendering = [(2 x 0.23) + (2 x 0 23)] x 3.0 x 0 60 = 1.66KN

5.47KN

∴ = 1.4 x 5.47 = 7.66KN = 8.0KN

2.10

__ 1_.5_0_m~f~)q~~1._20 _

Loaded Area = (1.5+ 1.20)x2.10 = 5.67rn2

Loaded Length = (1.5+ 1.2)

J). Beam = 5 *KN/m* {As before}

4) Wall:

Height = 3000mm

Wall own = 2.87 *KN/m2* {230mm block}

Rendering = *0.60KN/m2*

Loadings:

Own = 2.87 *x3.0*	= 8.61 *KN/m*
Rendering = 0.60 x 3.0	= 1.80 *KN/m*
	10.4] KN/m

F wall = 1.4 x 10.41 = 14.S7 *KN/m* z IS *KN/m*

t 'B: For Im design; Pwall = I SKN.

5). Roof load - i.e Flat Roof

Concrete = 24 *KN/m3,* finishes/Asphalt = 2 *KN/m2*

rmposed/Water = 9.81 *KN/m3,* Height of Slab = ISOmm

Loadings:

Own = 0.I5 x 24	= 3.6 *KN/m2*
Finishesl Asphalt	= 2.0 *KN/m2*
Imposed/water	= 9.81 *KN/m2*
Dead loads: GK = 1.4(3.6 + 2.0)	= 7.84 *KN/m2*
/Imposed load: OK = 1.6 x 9.81	= 1S.70 *KN/m2*

Design load n = GK + QK = 23.54 *KN/mt*

2). Column Type 2 (CT2) - long column.

Size = 0225mm; Height = 9000mm

Loadings

Own =*n:d2/4* x h x 24 = n:(0*225)2/4* x 9 x 24 = 8.59KN

Rendering = nd x h x 0.60 ~ n:(0.225) x 2 x 0.60 = 3.82KN

12.41KN

y= IAx 12.41 = 17J8KN= 18KN

~'B: Load on the column = Roof Slab; Roof Beam and column itself

REf	CALCULATION	OUTPUT

4.4.1 Column T~~ 1 {CTI)

Column size: - See the drawing

Length: L = 230 rnm, Width: B = 230 mm

Loaded area: A = 5.67 mill

Loaded length: L = 4.80 mm

2nd Floor - Roof Loading

Type	Area (m_2)	Length (m	f (kN/m)	N (kN)
Column				8.00
Roof	5.67		23.54	133.47
Roof Beams		4.80	5.00	24.00
Total@ULS=				165.47
Total@SLS=				118.19

lst Floor - Znd Floor Loading

Type	Area (m_2)	Length (rn)	F (kN/m)	N (kN)
Column				8.00
Slab	5.67		12.06	68.38
Beams + Wall		4.80	20.00	96.00
Load *from* above				165.47
Total@ ULS=				337.85
Total@SLS=				241.32

Ground Floor - lst Floor Loading

Type	Area (m_2)	Length (m	r (kN/m)	N(kN)
Column				8.00
Slab	5.67		12.06	68.38
Beams + Wall		4.80	20.00	96.00
Load from above				337.85
Total@ ULS=				510.23
Totai@SLS=				364.45

Load Summan

Floor Level	*N@ULS (kN)*	*N@SLS (kN)*
2nd Floor - Roof	165.47	118.19
lst Floor - 2nd Floor	337.85	241.32
Ground - Ist Floor	510.23	364.45

REf	CALCULATION				OUTPUT
	4.4.2 Column Type I (CTI) Desi2n				
	2nd Floor - Roof				
	N=	165.47 kN			N= 165.47 kN
BS8110.199·'·:	b=	230 mm,	h=	230 mm	
Part I. Section	Asc = N - 0.4fcubh / (0.8fy - 0.4fcu)				
3X4.3	Asc=	-1143.17 mm^2			
	Asc < 0: Provide minimum reinforcement				
	Asc =	211.60 mm^2			
	Provide 4 - Y 16 (804mm2)				Provide 4 - Y 16
	Provide Y IO@ 300 Links				
	lst Floor - 2nd Floor				
	N-o-	337.85 kN			N= 337.85 k
RS RIIO. 1997:	b=	230 mrn,	h=	230 rnrn	
Part I. Section	Asc = N - 0.4fcubh / (0.8fy - 0.4fcu)				
3.R.4.3	Asc -:	-601.09 mm^2			
	Asc < 0 : Provide minimum reinforcement				
	Asc -	211.60 rnrn'			
	Provide 4 - Y 16 (804rnml)				Provide 4 - Y l(i
	Provide Y 10@>300 Links				
	Ground Floor - Ist Floor				
	N-=	510.23kN			N= 510.23 kN
BS 8110.1997:	b=-	230 mrn,	h=	230 mm	
Part I. Section	Asc= N - O.4fcubh / (0.8fy - 0.4fcu)				
3.R.4.}	Asc =	-59.02 mm^2			
	Asc < 0 : Provide minimum reinforcement				
	Asc -	21 1.60 111m2			
	Provide 4 - Y 16 (804mnh				Provide 4 - Y 16
	Provide Y IO(~v300 Links				

4.5 Foundation Analysis

Applied Loads:

Soil type assumed = Medium dense sand

Earth safe being pressure 'Qa' = 150 KN/m^2 {Assumed}

Axial load @ SLS = 364.45KN

Axial load @ ULS = 510.23KN

Analysis:

Base Area Required = 3.52m2

Base Area provided = 1.20 x 1.20 = 3 6\m2

DesignlRein forcement:

(i). Axis x - x:

As required = 927.14mm2

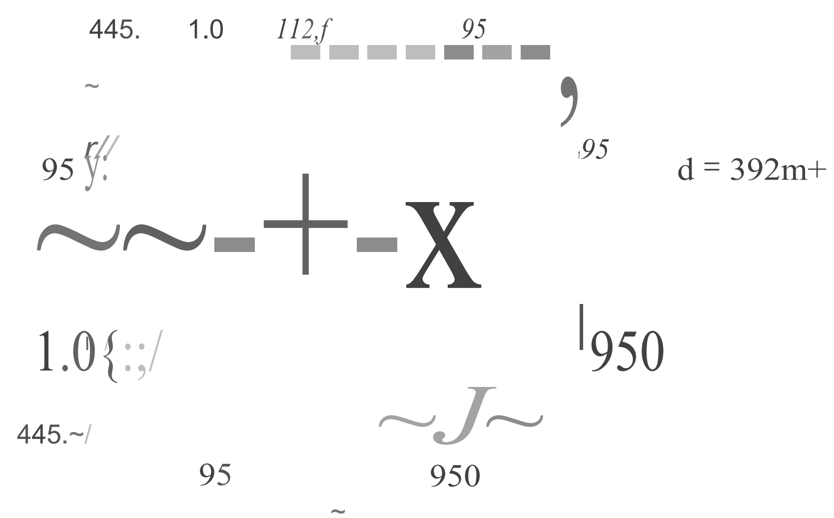
Il\sprovided= \60Smm2 (87\6@2S0)

(ii) Axis y - y

As required = 927.14ml11~

As provided = 1608mm2 {8716@250}

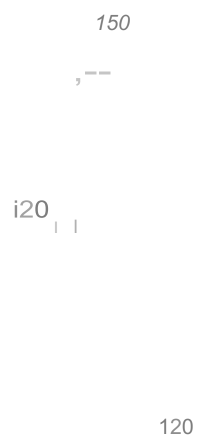
Panelling shear check = OK



At the critical section for Shear: distance = 445.50mm =

REF	CALCULATION		OUTPUT	
-	4.5.1 Foundation Design			
	Foundation Tn?~I			
RCD. by Mosley:	Soil type assumed = Medium dense sand			
51h Editinn. Lable 10.1	Earth safe bearing pressure 'Qa' ""	150 kN/m2		
	Column load i.e unfactored load 'Ncu' =	364.45 kN		
	Column load i.e factored load 'Ncr =	510.23kN		
	Footing own - allow 10% of the load 'Nr=	51.02 kN		
	Factored Load 'N,' = Ncf + Nf=	561.25 kN	N,=	561.25 kN
	Factored Load 'N' say =	740.00 kN	N=	740.00 kN
	Unfactored load 'N1'=	528.57 kN		
	At Serviceability Limit State:			
	Factored Design Load 'n I' =	740.0(1 "'I	nl=	740.00 kN
	Unfactored Design Load 'n2' =	528.57 kN	n2 =	528.57 kN
	Base Area Required =	3.52 m2		
	Length 'L' ~	1.8R m		
	Length provided 'L' =	1.90 m		
	Breadth provided 'B' =	1.90 m		
	Area Provided 'A I' =	J.(j' 012	AI=	3.61 m^2
	At Ultimate Limit State:			
	Earth Pressure 'q' = n 1 ; A I .=	2114.99 ,,;\l'm '		
	Footing Depth 'D' =	450 mm		
	Covcrc' ~	50 mm		
	Bar diameter '0' =	16 mm		
	Mcan depth =	392 mm	d=	392 mm
	Shear At Column Face:			
	CO/lim"parameters			
	Length 'L' = 230 mm			
	Width 'B'= 230 mm			
	Column Perimeter U =	920mm		
	N'='	740.00 kN		
	vc ~ N 'Ud =	2.05 N/mm^2	v=	2.05 N/mll1
	feu =	30 N/mm2		
	0.8 ~feu =	4.38 N/mm^2		
	If v < 0.8 "feu, shear condition =	') U '<;,FlED		
	Punching Shear:			
	Critical Perimeter 'Uc' = U + 8(1.5d) =	5fi24 111m		
	Area within perimeter = ((L + (3 x d)) 2 =	1.98E+06 mm^2		
	Area within perimeter 'A2' in sq meter =	1.98 m2		
	Therefore, punching shear force V:			
	V = q (A I - A2) =	334.78 kN		
	Punching Shear Stress 'v'			
	v=	0.152 N/mm1	v=	0.152 Nzmrn
BS 811O:Part I:	The ultimate shear stress 'v' is not excessive			
1997. table 3.R	h= 450 mm is suitable			

REf	CALCULATION		OUTPUT
	Oesie;n:		
	fcu =	*30 N/mm2*	
	tlghl 'h' =	450 rnm	
	Depth 'd' c-	392 rnm	
	Earth pressure 'q' =	*204.99 kN/rn2*	
	Length' Lx ' =	1900 rnm	
	Iltihg IInjjrcement --> Axis XX		
	I) Column 'col' i.e col across x - x =	0.23 m	
	2) Footing. 's' i.e. LI =	1.90 rn	
	At the column face which is the critical section		
	a = (s / 2) - 1/2 col =	0.835 m	
	Critical breadth: b =	*R35* mm	
	Mu = 0.156fcublf =	I~66.38 kNm	
	M = (q x LI x a) a / 2 =	135.78 kNrn	135.78 kNm
	IfM < Mu, then design =		
	~ M / btl Jfcu ~	0.04	
		375.98 mm	
RCD by Mosley	As = M *10.95fy:c-*	927.14 mm2	As = 927.14 mill'
Table A.!. page	Asmin = 0.13% b h =	488.48 rnm2	
1,75	Asprov	I()oS.OO mm2	Provide 8 *'16* aso
	Brihg llnjjrcement --> Axis YY		
	I) Column 'col' i.e col across y - y =	0.2301	
	2) Footing '5' i.e. L2 =	1.9001	
	At the column face which is the critical section		
	a = (s / 2) - 1/2 col =	0.84 m	
	Critical breadth: h =	8350101	
	Mu = 0.156fcubd2 =	1366.38 kNm	
	M = (q x Lz x a) a / 2 =	135.78 kNm	M= 135.78 kNrn
	IfM < Mu. then design =		
	~ M / btl !fcu =	0.04	
		375.<)8 rnm	
ReD by Mosley	As = M */O.95fyc-*	927.14 0101'-	As= 927. 14 111m'
Table A. I. page	Asmin = 0.13% b h =	488.48 mm"	
175	Asprov ~	1608.00 mm2	Provide 8 'i6 (lffiO
	Final CheclFor Punching		
	At the critical section for shear. breadth: b =-	1900 rnm	
	Asprov =	1608.00 mm2	
AS 8110:Par1 I:	100As / bd =	0.22	
I<)97.Table 3.8	vc :::	*0.38 N/mm2*	vc ::: 0.38 *N/m1ll'*
	Punching shear stress 'v' =	*0.152 N/mn,z*	
	Therefore a 450m thick pad is adequate		
	At the critical section for shear, 1.0d from the column face		
	At the critical section for shear, distance 'a' =	0.446 m	
	V=q(Lx)xa=	173.71 kN	
	v=V/bd=	*0.23 N/mm2*	
	Since v < vc. final check of punching shear =	I..,\ l,I..,FIED	
	NB: Foundation Type] : It is designed for all columns		



4.6 Design of Roof Parapet,

Design Data:

fy = 410 Nzrnm''

fen = 20 N/mm^2

Cc = 20mm

Assume Steel Size = 12mm

Loadings:

Dead load =0.15x24 =3.6KN/m^2

Felts/Finishes = 2.0 KN/m^2

Total = 5.6 KN/m

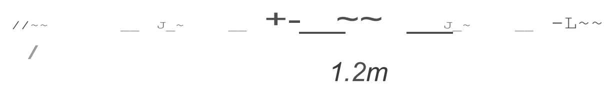
Imposed Load

The wind load on the parapet is small and negligible but for the design it is a s to use 3.0 KN/m

Design load:

1.4 x_: 60 +~ .6 x 3.0

7.84 4.80 - 12.64 KN/m



For Cantilever support.

$\text{Moment} = \frac{wl^2}{2}$

$M = \frac{12.64 \times 1.2^2}{2} = 9.12\ KN/m$

Design Moment = 9.12 KN/m

$d = 150 - 20 - 12/2 = 124mm$

CHAPTER FIVE

5.0 SPECIFICATION RECOMMENDATION CONCLIJSJON

5.1 Specification

1. The *minimum* size of aggregate to be user for *all* reinforcement concrete work should be 20mm.
2. All aggregate should be well grade, clean, and free from impurities such as dirt, dust, clay, silt etc
3. The recommendation Ted mix for the reinforcement concrete is 1:2:4 of cement/sound ground and this have characteristics strength of25N /mm2 at 28 days.
4. Curing for concrete should for at least 7days and this should be under water.
5. All creation of steel work shall be done in accordance with specification.
6. All structural steel member to be use are to be clear properly erection.
7. All sre el should be packed or stalked above the ground level to avoid rusting or contact with water.
8. Concrete should be compacted by poker vibrator or any other type but bleeding of concrete should be avoided.
9. From work to supported concrete should be we!l. tighten at joint to avoid lost of cement slurry and be cleaned and free from dirt.
10. Grade 43 grade shall be used throughout in the steel work.

5.2 CONCLUSrON

The stability of this building under critical worst condition of loading is ensured and economy was taken into consideration as far as possible. All necessary parameters and condition of loading were considered for stability (under ultimate state design) checks are also made at each stage to ensure the serviceability of the structure under applied load and variation in weather and materials

However the most economical design can only be determined by comparing the approximate cost of different similar design. And this includes such an economic comparation as in the area offire resistance, deterioration appearance confidence of structure and availability of materials.

Having consider safety and economy thoroughly in this project work. I confidently said the structure will serve the purpose for it is design for all the information and details provided in the drawing will make erection and site supervision easy.

5.3 RECOMMENDATION

I recommend this project work for construction because it was carryout with the help of my supervisors, lectures, and practicing engineers in confirmation with least code of practice.

In the architecture design the following factor were taking care off.

1. Ventilation
2. Conformability
3. Accessibility
4. Aesth tic and security

1n the structure as a whole. safety is the f rst priority to be consider for follow by economy.

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