## LECTURER NOTES ON STRUCTURAL DESIGN-I



PREPARED BY

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1 Digil4:02.2023 ptroduction to design and detailing Trange - Moores Stabeletspoore) (Moun poor of To provent over turining sliding or buckling of the structure under the action of load (2) strengthis on pound 23 operate le baltan filly To regest sately the stresses Enduced by the load in the various structural member. stress enothed PULSM A B COSCUMUE (3) Serviceabelity sinthom DYLUT LINT l'apacit serevice ability to; ensure statistactory perthe under a searcy the load condition it e (that is) provieding adjequate stiffness to contain deflection, vibration with--En acceptable limit and also providing imperemeabelity durabelity. is the isarted of strength of materical to the 1590 20 of Reinforced Concrete; Advantages -ssève stress (pecause of concrete) compriesserve stress Tensele stress rendeng Diverseep Thorito ( concrete) . MITOLOUS (because of (2) RCC also has high tensile stress steel). (3) It has good recesterice to damage by faitre stanihethering c'because of concrete it an pro! (4) RCC protect cteel bare (66) prece) from buckling and twesting at high temperature. (Rotate) (a) Reconforced ( Monorato is disting. (35) (6) Reinforced, Concrete is durable. (7) Maintenance of RCC is practially nel (zero).

Defferent Method of Design () Ultimate load theorry wind of matrice (2) Worching stress Method (WSM) (Beforce 1980) (3) limit state Method. (15 456; 2000) ( (16) Compression & limit clare : Working stress Method ythis method of design is based on linear elastic theory, whelly the streeses induced if your ten the various structured as 4 in working stress method ewism) it is assumed that structural matercial the concrete & steel behave in linear elastic manners Safety can be ensured by restiructing Stress in the material induced by working load on survives load on the Structure. acceptentie timet and also proved eng Emperance 12ter durech 215,251 4) The reater of strength of material to the permessible, street is called as factor of sabety. 29 Patritov pf-· perimissible = - Ultimate structs rice Kom () Reenforced 4 Whele appling with the stress condere applied loads are analysed by stople bending theory where strain compactibility to assumpt. Ultimate load theory (Method y with Encreased understanding of the behaveaux of meinforced concrete at ultimate load method of dsign CULM, evolved crowl. uicm. de bécame le alternative two Contration The method & also called as load factor. method or citemate strength method. of foc is practically nellare.

polate trait rate. Emp In this method the stress condition at the state of collapse of the structure is analyséed & non-lénearc stress-strain curve of concrete & steel and use of modulare ratio. Weisster 10 pourano sento buzzan The mostle of elastic modulus of steel to the elastic modulus of concrete. indiradis. modular & defined as the ratio of elastic modulus of steel to the elastic modulus of concrete il a condere il altera -bara and enceanted pd entroduced by a load factor, defended -as (the tratic of ultimate load to the working load ) factors of safety. 4 This method generally results in morie stender section and more economical design of beams and coloums (compared to wsm). · monoil and another an 2.2023 Limit state Method (45M) ton' nost 2 2 sall of Limit state method is of deeign represents to the deceased prioblers by considering safety at ultimate load on envicebility at working load. ONT Lythe LEM we method use a multiple satety factor which attempts to provide adequate satety at ultimate load as well as adequate servicebility at Servives load by Eonsidering all

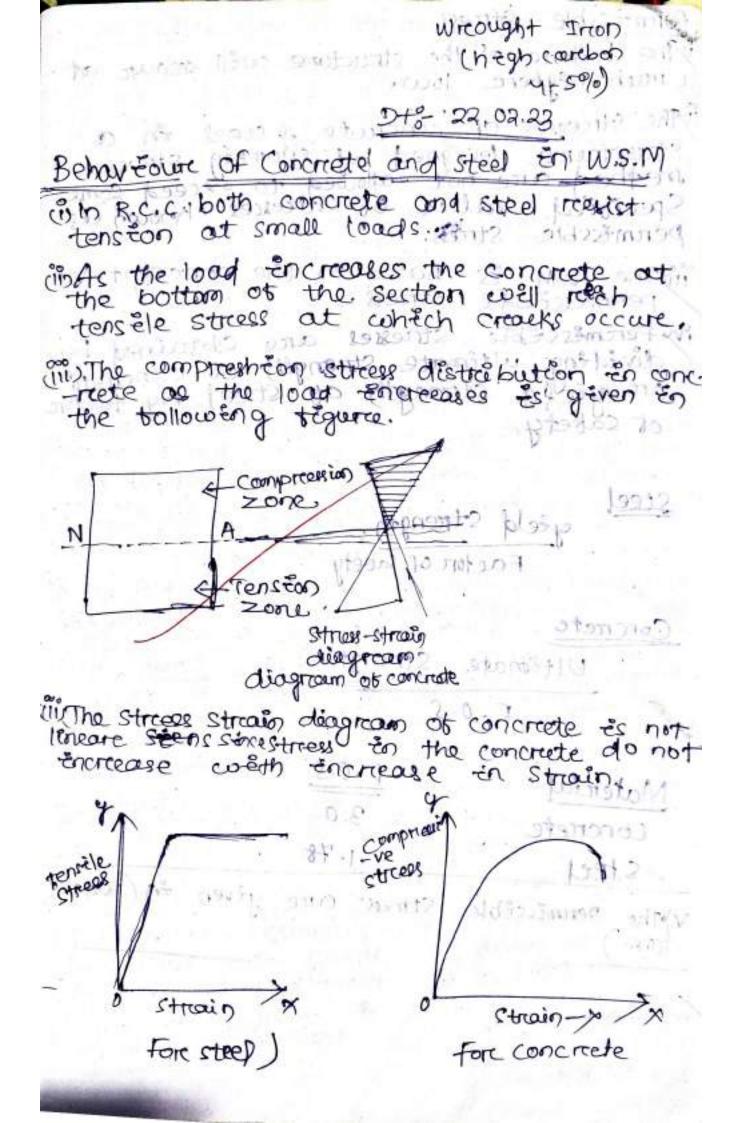
posseble limit state, in the method the stress condition with gente of colupse of the streethyre. 3 Barryhun new - Brave Street Street to see private of story chapter-1 · 0.13457 Working stress onethod of Design the restion of plastic motuly of steel to Introduction in colubor straps our behaviour of a cection cender the load the load to be workston is defined as by it during it. Survives percent, the Strength oncrete in the tension Tone ef. Tremberc és negletabled: of the 4 The material bothe concrete & steel. elastec. ) elastec. ) (MOW at porregran) 2000000 pass 20000 L'The strain distribution across a section to accomed to be linear. 4) The section that are plane before before bendeng remain plate after bendeng It Strees at any point is properational to neutral axes of the point from the at working load. mp The distance between renes of action of resultant resetieve forced es Knowningto leverarin . Jotant \_ 1219102 provide adequate sabety at ultionite as well as adequate service belicht 1000 at Servives load by concedening all.

Materical Safety Stantonan' trans 0 bourstains aconcrete Reinfonredskif ment concrete is a completed material compacition of concerct construct ricini armenint coumption OF WSM. Imimply wood it along sm imp 1 (some) . ... inconcrete és assume, to be homogeneous in At any cross-section, plane section before bending remin plane after bendring. in The stress strain tealationship for Concrete és à straight (ine under So working load. in the stress strain relationship offere Steel és a stranghtentine unidere Asteel reinforcontent ched as mulorikeng on tension Sette Vi Concrete area on tension serve assume to be to-abbective. Vi All tensile stress are taken of up, by right steep arcea is assume to be concentrate of the centroid of the steels no about in the modulate rates has the value 30che where, (a.(cbc) Ec perimècrèble stress on Comptresseron due to bending) en concrete En N/monto of proposed for themend (1) as Moment 30 firesectance bood brown (e) (4) E arcthorizate cond ( ( for the monimum ( Rechtung (5) Freection, Load Scale pool wone to it intomotion is

Introduction OF R.C.C Section. Dt: 21.2.2023. Reinforced Cement Concrete 2100 54 Reinforced Cement concrete is a composige material compressing of concrete and star reinforcement in which concrete indistant relate low in tensile, strength, & duetility are counterlacted by the Inclusion of addition and be buggered Calddition) .-Of meinforcement having htghere tensile 0.-220210 strength and ductility. bendraig reention plane obten parcedien tro/ composition of RCCI will will (onenete (1) Aggregate - poor 5007- 1000 28 (2) Cerenitization me l'arten citarte 2222212 all'arte (3) Steel / Reinforcement (bat) 4 Steel reinforcement cised to coment-concrete ts of following types. (in Medium tencello deal -1), anono V (i) Medium, tenstle steel HYSD A High gield striength Deforemation) (N) Harca drawn steel weres Concentrat ny the cleet area Loads on Rec 10 the st to promition and to The various loads lating on the concrete Structure gressing 23 (2012). UNDead load & CiDite) and at auto more proton (2) rive load (i. 1) (Imposed loading in (3) Imposed toad DOWNERS AND CEREMON (3) Wind load (4) Etercthqueake cood (Stand) measure (Richtery (5) Frection load (6) Snow loag (7) Tempature load

Dreaw backis of Working Stress Method Fels CNI/ MUN Distudiantage i) It fails to provide uniform over load capacit -y for all the parts of types of structure. (is it does not take into accust the non linear relationship between stress and strain: is it also does not considere the reedistribut. -eon of forces & moments in statically indeterminate Structure. ev) This method does not priovide true margin in for factor of sabety. (V) Effective of crip and shreinkage of concrete is ignored. Ngo EM Grade of Conete Concrete grades are expressed by letter a numbere. M followed by Concrete The letterer of referes to the mix M. and the number represents the character. compressive strength of concrete -istics En N/mit abtere 28 days strength Checking is characteristic compressive straight; Xinhat characteristic compressive striengith means doesnot fall given compressive strongth. (0,2(0.3)) FR - 20 P. 57 Atensate Mart 2113 (CAPE -1050 10012 lugaroint 02:01 i wrep enclose to h 300 005, 24 main anual bet Rent 007277170 band loads Anni-125

chanacteristics Gridup Designation Comprissère Strong FEK CNIMMP) Orcidaring Concrete Mig ... otois Pirco de Nongen by ri 10 11.22 20107 310+ MIST 13 Structure. 10 15 to the chestory 2XV2 the non tenent 51.0.5 Mao standard concrute Massianco DECAS COL 0210 Sticker Plastonly 30 PC0 500 storserurstable. Masa son se HELLE TRUTTE Ob bention is draw MUDEDZ and a Mo 10 33.31 Mysno rinkage of corriet din ? 10 45+20773 (V) Mgo 50 nor 02 MS of Binete intode Hego stringth M'60 2 270 Concrete 00 ades concrete Mester per 65 swollol. M702 119 FM Xim sit M 70 attel the phonactor. MAS Nondera ONO 9tononon 710 205325-M80 Checken atgreen - 08 but Nona 80 135 ar 2,5321 chance chair the tonux. Uncade of stee OY THEFTY ONE Type of steel 10 Strade ng characteristic ? trength (NIMP) grela Mild steel (02503) Fe 250 250 High strength Fe 415 415 (Heys)) Fe 500 deported steel Fe 550 Theremo mechanically Fe STO COD treated bars Gmp or correction Mesistant steel CCR welted steel Fe 480 480 fabric



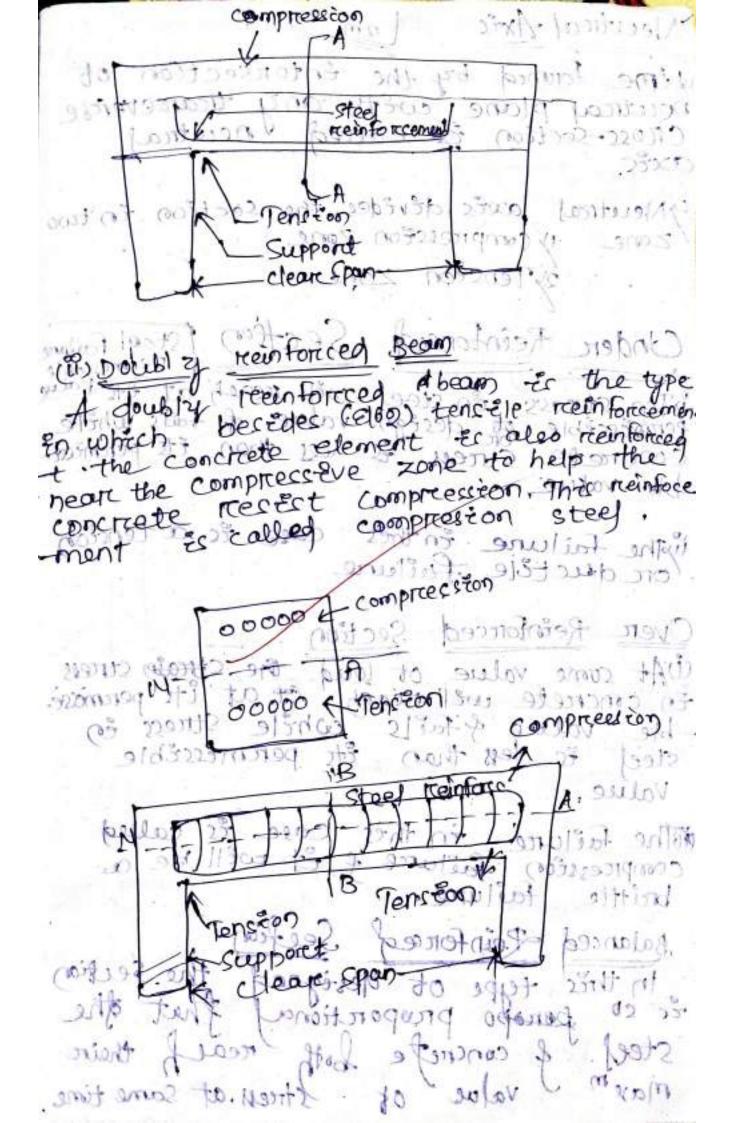
Permissible stress The failure of the structure will acour at a much heghere low. in the streesses of concrete & steel in a structure designed by working strees method are not allowed to exceed come specified value of streeses known as in the way is based on the concept of permitiséble istrieis. and de mathadi iv Percmesseble strieses are obtained by dividing ultimate strength of concrete ore yield strength of steel by factor of sabety, (WINSTROMW). tee yeld s-treng# 1 Factor of sabety oncrete 1657 Ultémate Striength gion Figer Straig diagram & Printe all Incore See of Street Unerty the the ritisas 080000005 2.0.70.5 Nateria 3.0 Sy21. 78 concrete steel stress are given 20 (15:456: V) The permissible 2000 nienti K-ment? 19952 210t ton photo not

permerceble striedes en concrete ithe permissible stress to of concrete to direct tension is denoted by Tig. The value of the fore members en direct tension for different grades of concrete are geven in the che cil B-2.1.1 of 456 (pgNo-80) 2) Actual tensele stress of concrete Ful en cuch memberes chall not exceed respective permaceble value of Uty to prevent any creack. The factor carety of concrete in direct · tension is from 8;5 to 9.5. The permissible stress of concrete in bending compression Tebe in direct compression -on rec and average band for plaine bare En tension of arce given en table no-21 OF 15 456 (PR NO: -81) for different grade OF concrete. 200000 4) The factors cafety of concrete to benden g compression, direct compression & average bond for plain bare are 3,4 & asto 35. Fore plain bare were side obtained value of avarage. bond stress are obtained by tenereouring respective value to tenetion by 25% at the stress are obtained of concrete. 5) Forthe deforements bare the value OF table no are to be increased by 60% up o to cony desired shape Perenticiable streeses in steel Reinforcement l'perimésséble striesses en steel reinforcements for distingment grade of, steel, diameter of barr & type of striese en steel rienforce-ment arre génes es table no az of 19,5455 Pg no :82 ever ere.

dis permerseble streages of steel of grade Females, FEAS in tension (Ist & Tan) & Compression: En colourn (Fcc) arce given En that table. Matukan Ratio (m) DH: 27.02.23 The reation of modulus of clasticity to motion of steel to moduleus of efficiently of concrets (cimit state Method) Ec. m Ec y Consider the long term ettect such as creep modulare reation is taken as geven to table ro-21 951 (Worcking) state Method) different grade 707permactible compressive 280 UCBC 3×606 strees 000 d29010 concrete Advantage 4 Ingradiente of concrete are easily available in most of the places. avarcase 4 Concrete can be menufactured to the descried strength with an econec econmy, liter of concrete Ecoverce withe durability powers and of ano hogh. cost to any desired shape. ć y It can be cost by The maintance cost of concrete is almost negligible: 53552200 2942 22501119 111 Ly concrete man a building fair mi proof \$ or sidest to wood yconcrete Es reststance water.

Disadvantages of concrete yoThe tencile strength of concrete is low y concrete Es less duetle. is the weight of concrete is very high. Beam -le of with standing load primerdly, resisting bendling. in A beam is a structural element i. e capab. (i) Beams are longere in colength compared to its crease crease entimal dimension. (Both call Stopported boom (Both care on Supporte on compression Neietral airs steel bare 125 0017 20mm 3/13 (a) (a) Agrant 21: - 38: 02, 23 N-Rechorceants. passi (100) 29981 esteet of irrendiorcement -Inonao 263.6 barcon 51-DODETC - ALD9d ano Tens 2007 Reinforced Ream There cannent ton stonply supported bears In comply supported beam tensile strescep are of positive bending moment france of positive bending provided neare the steep bake are beam, Contiliever bear Could reinformed (aubline action Corrol

1 sede free's Steel bar other side. enciun Support telejaco ....... N 01033 intertante o 18. moui 1.158 TORGT 127.15 compression. eutra axis Reinforcement in capitelevere beam. 1003.98 66 In a cantelever beam steel bars arce provided near the top of the beam to restit the tencile stresses develop of top layor due the negative bending DT:-28.02.23 moment. of beam based on Reinforcement Types Based on placement of reinforcement beams can be classified place, aswisigly reinforced reinforced beam. (2) Doubly beam (1) Singly Reinforced Beam A sengly reinforced bears is the type in which concrete element is reinforced is reinforced only near the tencile zone & that reinforcement es called las tension reinforcement whech te descinces to destaned nerest the tenseonneed at to reated antificverc single reinforces Compression M N Tension

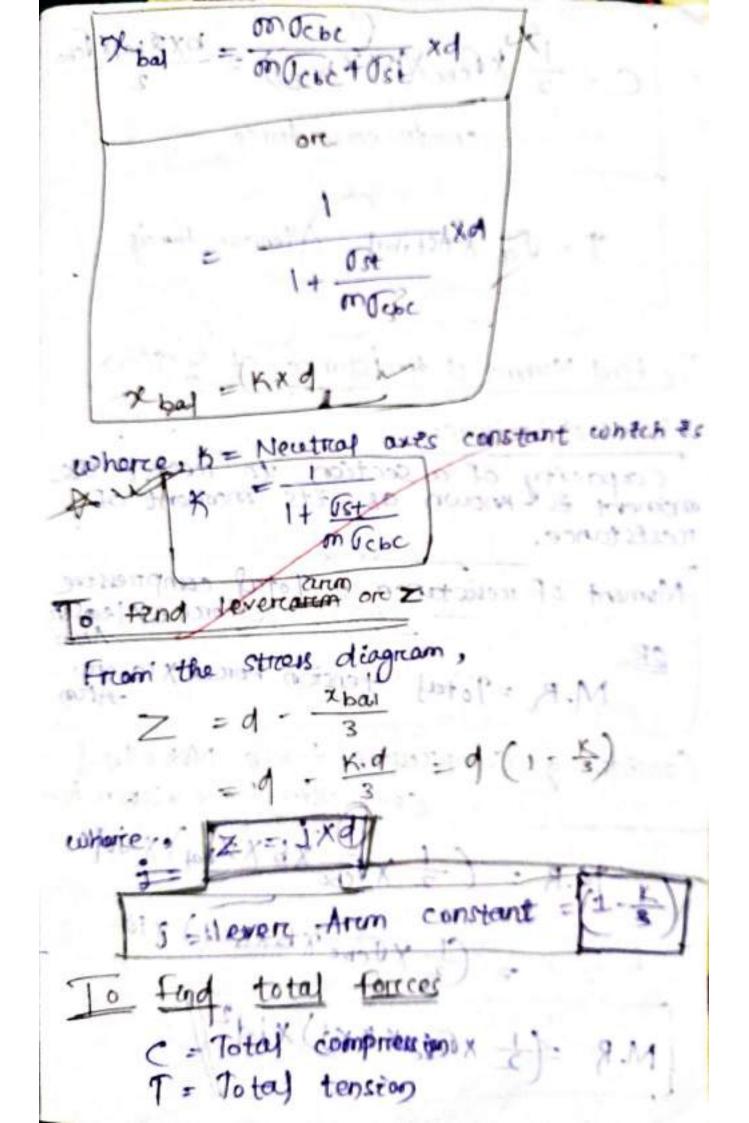


Meutral Aric 05225719/1145 2m whime formed by the Entensection of neutral plane; with any transeverge Cross-section is called neitral avers. Enterentical areas devedes the section in two zone ly compression zone. 2) Tension zone not Under Reinforced Section Steel Failure The stress in steel will reach at the value permission of design value of fails while concrete stress is less than its permission able value norranderas toszan lithe failure in thes case ic a tension or ductile failure 60000 Over Reinforced Section What some value of load the strain stress of concrete well nearly st at its permisse. -ble value & fails while stress of is less than its permissible stee chool trainform Value. in this case is called The failure compression failure à ét will be à failurce 101 brittle Balanced Reinforced Section In this type of designed, the section is so person proportional that the steel & concrete both near their value of stress. at some time, marem

Thus at some of load both the material will fail at the same time D18 1.03 2023 Derivation of soremula for Balances Derigned e con eschreametebere PON TO 60" CHERRY 1.0 Compression) A 112 1.100 (NO DE depth expects ere Ucbc XV) JT TX m 171.4 бсы Compression Zonet Hoay 00 30.51 34 72 CH .25 XTO enton Eg= Zone 05+ Astibal Listress Drage (strain Drogram) (section 7 Consider a singly meinforced beam with stress of strain diagram as shown in figure. ance = 200 Ast, bal = Reinforcement are provided for boilanced section Ucbe = permissible stress in concrete in bending compression. (page NO.781) an +2 steel en (Ist = perimeteriale stries tension.

tc = Modulus of elastisity of concrete Es = Modulus of elastisty of steel = Strain En concrete in extremme fibe Cbc Ec Est = Strain En steel = Ist Ust Es b = Wedth of the beam of = Effective depth which is defined as the distance from extreme compres the distance. on fibrie to the centrold of tensile reinforcement. = Depth of neuetital axis which PX -2's defined as the distance of neutral axis. From extreme filance) Comptrestop 121 2010 5 Z = Levenarion which is defined as the distance bet centraid of compressive force to the contraid Toor ( Hont? OF tentele force workit (month) to find neutral axis From the strain diagram, 10 2 bal UCBC 8-2 bald benderg compression. (), 10 3000000 to Formettereste street 30 +20stee

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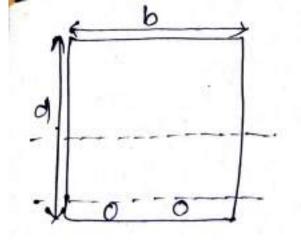
C = - X (cbc X b X X bay) = bx 2 bal X (a compression fonce T = Ost X Astibal (Tension Forces Section 1 To find Moment of Resistance of Section Moment of Repitonce in fortual anoment is known as its moment of resestance. Moment of resistance = Total compressive Forcexleater Arcin OR M.R = Total tension Force x leveres Considering Compressive force M.R = Total Compressive force & leavere Ann M.R = ( = X Cobe X b X X bad) X jod = (1 XOCOC X BXXXd) xid = Inntana o M.R = (1 x Orex Kxi) x bd2/ Con12(19)

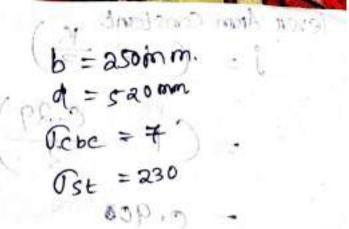
roal a conto 100 m M= Obay X bat where, O bay = Moment registantance constant = ± X Ococ X KXJ Considering. Ténsile 'force M.R = Total tension riever Arino = (Jet X Astibal) X jd = To find steel Arcea For a balanced section Mbay = Ast, ballst id Ast ibal Ost . J. g. Steel Arreed percentage steel, Pt, bas=100 x Act, bas Pt, bay = 100 / Mbay X-1 . bq Ptibel = For C= x Oche KAXi) x brand Per xxxx x x XX 120 balance Ptybal = SO XOCOLXK Jepc Ost To destign a balanced, Section, For a given destign <u>moment</u> M, conceder, M= Mbay, destign <u>moment</u> M, conceder, M= Mbay, IF wedth of the bear, et assumed, IF wedth of the bear, et assumed,  $d = \sqrt{\frac{M}{b}} \frac{1}{\sqrt{2}} \sqrt{\frac{M}{b}} \sqrt{\frac$ 

steel Arrea, Ast = Ast, bal = Mbat TSt XJX9. . 0.712/ UI 10 bay - Monaray realistance Canadian Calculate the destion constant for the Following material considering the balanced destign for singly reinforced Section. The material are M20 grade concrete & mild steel crease RCC (Neutral axis constant.) Robe = 7 Hix ( Loding Ar Kis 1 It m Case Mi=12: 280 3 Ccb2 A = 10011 for a balanced section (Pg No-81 of 15456:2000) Z = ixd Cpg NO-82, total force 15 456:2000 =  $(1 - \frac{K}{3})$ Moment resistance constant table NO-22) pil pu H X 1. SOX OCHCAS palaza x (izza x 1.1.2 - IPX XX KAPS 50 Ost . with fist PE, bal = SO XOCOL X K Parti in the Cepe 120 stigo a balanced Section , V 120 M. Discours IF LUE dth Mhod portrasso the bear only

m= 3 Cobe mont notophilton aline con any spice & shires Manuel restrictionce Constant TXS Lebe XEXJ 198.0XH.0 × 13, 333 F 18-1 = K = I+Bt XX JOD X02  $\frac{1}{133} = \frac{1201}{1+\frac{140}{133}} = \frac{1201}{1+\frac{140}{133}}$ 140 1 + 93.31 Ford a nearly spulation with the prost depth auffaulte musica x shall. Interview deptine of neutrol critic halanced Laboration Front 1 7 105090 (10010 bars material men Men grande concrete and Hard torief a consert of groude . I so ur.  $J = \left(1 - \frac{K}{3}\right)$ Given data liffective depting 200 = 5200mm. j = 0,867

O. forgrectiongular beam of since asommy cuide X into \$20 mon 101 20 1 Moment resistance constant = 1. X Coc XKXj = 1 x 7 X 0. 4 X 0.867 = [.2]3 SOX Cebe XK Jastin Ptbal. TSt FX 58 ct +1 50 X7 X 0.4 TX 140 Rene = 1 011 Q. Fore a rectorgular beam of size asome weder shown effective depth find out the balanced depth, of neutral axis. balanced leverarm, balanced moment of reststance and balanced steel aries i? The material arrea · M20 grade concrete and Hysof reinforcement of grade Fe 415.  $J = \left(1 - \frac{k}{2}\right)$ Given data Effective depthe = 5200000. Breadth = 2500000 : 1 = 0. 8G7





leven from (22) . 1 xd . c. goxsae

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Mainer t. Itel Charles E. 8.83 Start - 1 XAXO 29X C. 10

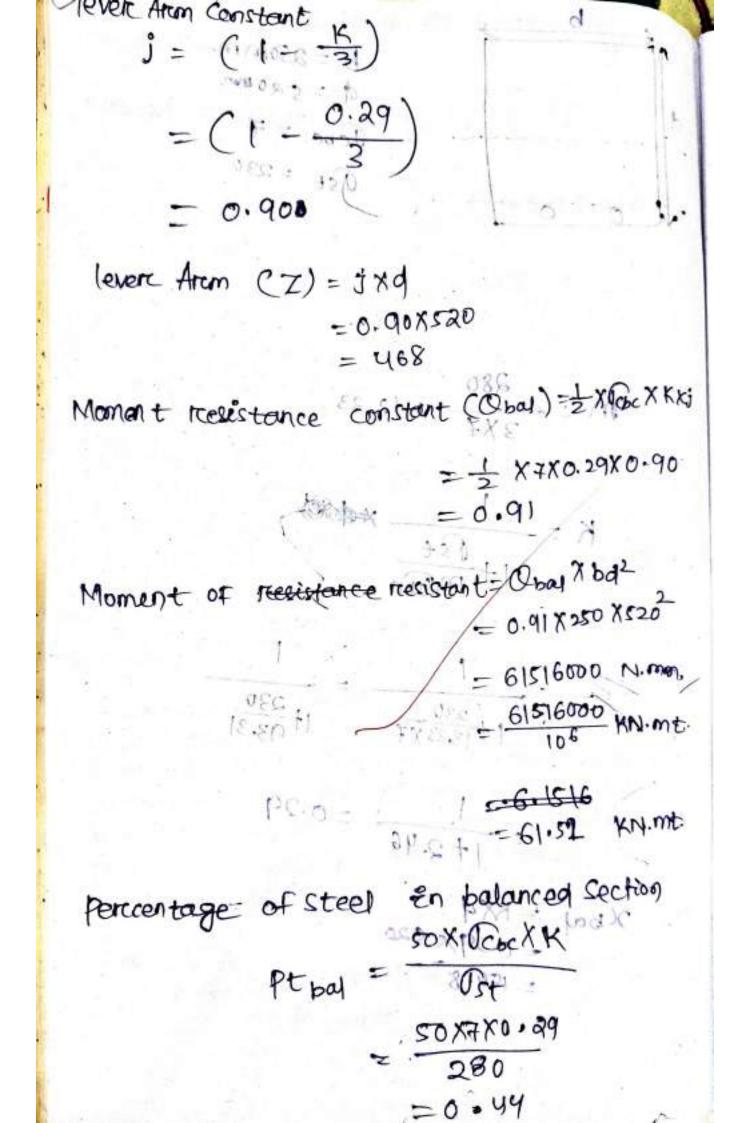
OCIX DZCX1P.0 - 0.900000 DOMOTION TO FRAMOM

HULLY 12.12 1 = 0.29

Raccontage of steel to payaged action Xbal X PECO X Hodx

PR. OXFXOZ

4



Ptbalx bd steel Arrea = " 100 2 1000 100 TS. OAK 0.44x 250 x 520 . IND Barne N Second and a fatter and a fatter U Mariana M = 572. mm2 a self with the manufactor of O. A stompty supported rectangular bean of unt span cannies a UDL of AGKNI mt. The width not the beam ic. 230mm. Find the depth and steel area for balanced design. Oself Mao grade of concrete & mild Steel reinforcement omi start from the start tongolar bran (9) = gerippet W. Max B.M = g of the beam (b) = \$30 mm. contive depth = d effective contract of the start of D bay of (6090 \$ 950 31 bay = 1 1 X Oche XKXj ot mono Obay For MEND Steel SEE : INO CTO NO - 52 (1 cbie 140 - 22) (016 + 1) Mbay Ast = Ostxjx9

Transeformed Arrea Method Dt: 3.03.23 U) A transformed section is a section is which steel area is replaced by an equivalent concrete area. (2) À transformed section constis consist of a single material therefore theory of semply bending can be applied. (s) The transformed section may be of a steel when concrete is replaced by a steel one it may be of concrete when steel tarea is replaced by Concrete. It is usual to replace steel area by concrete hence at transformed section would mean to a Homgenous concrete Section. Ec= Fro - 9.84 X10 ь 12-25 JUN 25 00000 1661M.7-3 3808 M 1. J.S. 18 + 3. 0X 90 1981.8 = Fst pumberes of 16 mon dia bas .Es' period carea of d. 500 for the Crencia Ast " pragnet (Section) 801.06mm 30.108x 2 -

... 'Dt : 4.03.23 W 187 34 . 15 At the section centroid of steel reinfor cement, the sciencounding concrete being elastic and having perfect bond with steel strain in steel: strain in concrete Let a Fist of Fich be the strender in control of control of the level of control of of steel. : Strain En concrete : strain entres  $F_{cb} = F_{st}$ " 63/81 South Thee, => Fst = mx Fcb . marte d Now force en steel = Auriter = Auriter IF this cteel = is to be replaced by an equivalent concrete area, the equivalent concrete will comp the same forme Now the force in equivalent concrete transformed Arrowfes Equating (1) & (1) Transborned Area XFis = Art XMX Feb Transformed Area = mAst To Find Neutral Aris 6x2 x2 = mArt (d-2) leven Aron,  $z = d - \left(\frac{2}{3}\right)$ 

Mat Strees En steel + Fast = (d-3) XASt tion contract of check ration 1. . 1 Stress to concrete, From straig diogrian, Fcb Bannach all. Echentran Echentral and 2 17 Est same stand in concrete of several in the  $F_{Cb} = \frac{F_{st}}{(F_s/F_c)} \times \frac{2}{4^2}$ d-x. di l Modern stress In transformed 2 de tra Fst Secto? X d-z En concreté x (bx x)x R. En Compression = (cx x torive tori vision concice Mouse the fairce Moment of reelisionce is tension = Ost XASTX Clever Arong, -0.917H+ Hormonia Q. A rectangular beam of with anom. & effective depth (d) 460mm, reinforced with \$\$63-16mm dia bare. The is fubjected to a character -Stic anoment of - 30 KN. mt. Determine the maximum stress in steel end

concrete. The materials are M20. grade concrete & meld steel reinfor cement. Also find the moment of resistance of the section Ans: Given data d=4600000 man ( ( monst monst ) b= 2000000 . .. NIN ( 5-107 -For Mao grade concrete, Ccbc =7.0 Fe aso grade steel, list = 140 modular Ratio m = 280 3x0cbc Treansformed. area of steel =00 XAst = 13.33 X 3X J X(16)2. ~ uer X. (00.10 21 80 38 mm2 To find neutral area about neutral of transformed NJ X291.8arts 200 × 2× 2 · = 8038 × (460-2) 100 28038 × (460-2) 01 10 PRODUCT => 100x2 = 8038 × (460-2) => 100x2 = 36987 480 -8038 x 100 x2 +8038 x - 36987480 =0 X = 569.300000 7=1

Leaver Arcm (2) = 
$$d_1 - \frac{2}{3}$$
  
=  $460 - \frac{569 \cdot 30}{3}$   
=  $270 \cdot 233 \text{ rown.}$   
Maximum stress to steels  
Fst =  $(d - \frac{2}{3})XFW$   
 $Fst = (d - \frac{2}{3})XFW$   
 $= (c4 \cdot 04 \times 10^{6})$   
 $= (c4 \cdot$ 

.

Moment of compression = GEDEX ( bx =) NZ busyness show the part of the = 7× (200× 2)

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Moment of tencion = OH XACHYZ 5 140X 3X The K(16) 2 2902

M.R. of the section = 89141.01 N/mm

Analaysts OF the Section

To find out the depth of neutral arts for a given section & specitying the type beam.

is IF the section of steel area are given fend out rentrial axis by taking moment of transford area about neutral axis.

bxxxx = pron Ast (d-x)

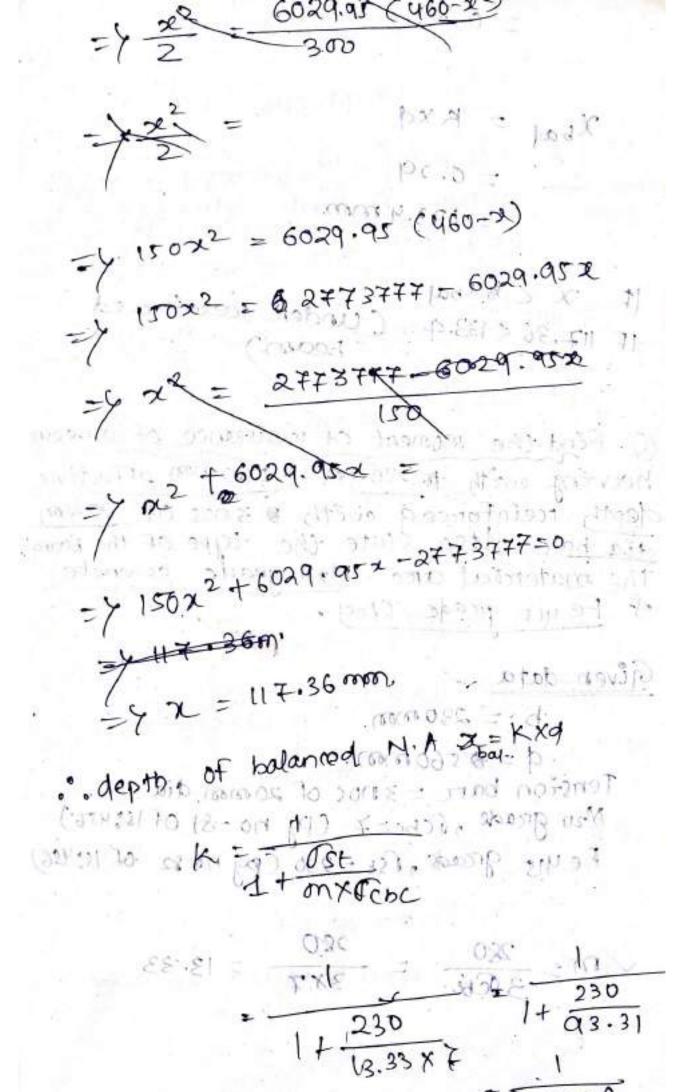
(i) Find out depth of neutrial arts for a balanced section.

2= KXd where K = 1+ mx Ocbe

(iii) IF thattad Lact 22 bas The beam section is under reinforced IF Lact & 7 2 baj (The beam section 13.60 Es over reen forces IF Xact = Isay (The beam section es balanced) Type-2 which him another 10 House To find the moment of resistance for a given section, Xill is Find the position of actual ent of balanced neutral axis. as explained (i) IF rait < 200 (The beam section est. M above. 3.41. In moonent of resistance. Es geron by 25-MO LOTARION 30 Moment of registonce = Ast X Ost (9-3) > kbay OThe beam is over . Treelstonce es geven by (1) IF. Salt  $M \cdot R = bxx x \left(\frac{0 \cos d}{2}\right) x \left(dx\right)$ Section. ritanced NALO

Design of type section-1 0196.0328 Dimension not given 1 20 20 1 Find the position of actual & balanced neutral axis as explained above. in The moment of resestance of balanced section an Mbay = Q bay x bd2. Out of two Variable mut ble bled one must known to us. It is usual to fex the weath to of the section. il) One coedth es tixed, the depth of well be calculated troom tollowing foremula. Mbay "bost Qbaj xb Faur greater, 1 St. in the arrear of steel Ast will be calculated as pere the following following Ast Revis GtXiXd 10 0000 c(x.(-x-),x)) -115532 Type-2 istoply moment Mathe section demonston b arre geven determinance [Mball=Qbal bd2 89 (is IF M < Moal of then the section & davigned as condet , reinforced bears : " (iii) IF M > Muay > then the section Es des tignes or over reinforced beam GUIF M = Mab -> the section is derigned balanced reinforced bears,

Q. An recebears 300 mm. wrae & 460 mg effective depth Es reinforced weath 4 nor of 12000 dea barre ende tenseon, Find out the depth of neutral azes & type of the beam. The material aree Mis grade concrete & Feurs grade steel Given data b = 130000000. 1-115 d = 460mm Tension bar =4 0050F12mm.dia Mao grade, Ochc=7.0 Cpgnd-181 of 15:450 Feur grade, St = 230 Epg No 82 or 15:455 dr. ba D Modular ratio NX (X+2) 0 = 280 ... 1 = 280 = 13.33 3 Cbc 010013X7 10075 ante area Ast = 4x  $\left(\frac{\pi}{4} \times 12^2\right)$ (Arcea of Steel) d assonst = 452.36 mm? Let 2 be the depth of neutral axes taking moment of transformed area about neutral axe CN.A) . Are (d-2) and > M  $\frac{b \times \times \times \times}{2} = m Ast (0^{-2})$   $\frac{b \times \times \times \times}{2} = 13133 \times 452.36 (460-2)$   $\frac{-7}{150} \times 2^{-2} = 6029.95 (460-2)$ 300 22 = 6029.95 (460'-2) 0.0 10 300 22 - 001000 Mt - dom = M 1 munced reinforced bean.



$$\chi_{bal} = K \times d$$
  
= 0.29  
= 133.4 mm.

IF 17,36<133.4 (under treenforced) IF 117,36<133.4 (beam)

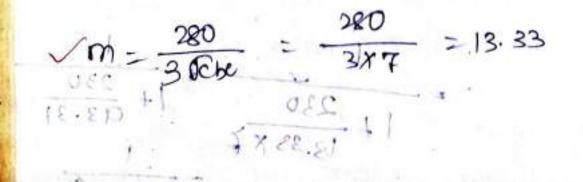
= 0.29 20.000

Q. Find the moment of resistance of a bears having with to 230 mm of 560 mm effective depth reinforced with @ 3000 OF 2000 dia bare: Also state the type of the bears. The material are M20 grade concrete of Feys grade steel.

Given data . issue de. In

b:= 230 mm.

d = \$ \$60 mm? Tension barr = 3 nos of 20 mm dia Mro grade, fiche= 7 (pg no - 81 of 15:456) Fe 415 grade, fise = 230 (pg nor 82 of 15:456)



Ast = 3x ( 4 x 202) - 942. 47. 1. xm NI. R = bX = x (libc) x (d <  $\frac{7}{3}$ ) let Sin be the depth of ocutral cricis taking moment of transformed area about neutral onets CNADXX X = on Ast (d-x) =>230x x2 = 13.33 ×942.47 (560-2)  $\frac{115}{230} \times \frac{\pi^2}{2} = 12563.12 (560-2)$  $= \frac{115 \times 2}{115 \times 2} = \frac{12563 \cdot 12.560 \cdot 12}{12563 \cdot 12.560 \cdot 12}$ =  $\frac{115 \times 2}{115 \times 2} = \frac{7035347}{2} \cdot 2 - \frac{12563}{12 \times 2} = 0$ =  $\frac{115 \times 2}{115 \times 2} - \frac{7035347}{2} \cdot 2 + \frac{12563}{12 \times 2} = 0$ =  $\frac{115 \times 2}{115 \times 2} + \frac{12563}{12 \times 2} - \frac{7035347}{2} \cdot 2 = 0$ Moment of registance = Art rost (d- \*) depth of neutroy axis near = KXg 10 412 JP - 31. 201 Quite T

(11 x - ) xg - 12A K= 1+ OSt 1+ MX OCOC . OUR (まっち) ~x ( 243 ) x porting is ingets 2. 101,230 3.33 x 7 13. 33 X942 . 47 ( \$60 - X x-2020.29 (502.c) × X2 26al = KRg = 0.29 × 560 x cl. 60= 162. 4 mm. IF Xmaract 7 xbay IF 198.67 7 162.9 - Over beam  $M \cdot R = b \times x \times \left(\frac{\alpha_{cbc}}{2}\right) \times \left(\frac{d_1 - \frac{R}{3}}{3}\right)$ ( 2 230× 198 67 x ( 7) x (560 - 198.67) - 45694.1x 3.5x (560-66.22) = 15-9929.35 × 493.78 = 789693811. 35 depth of newth = 78.96 KN.mf 106

Dt & 13. 03.23 and chapter Dimit state Method Defination 410 the method of decign based on limit stare Concept the structure shall be desegned to to throughout on ets laffe. 4/1t shall also statesty the survectorility requirements such as limitation on deflection and creacking. The acceptable limit for Safety & Some of the acceptable limit for Safety & servecebility requirement beforce failure occurs és called lémét state. LyThe aim of design is to acceptable acceptable propability that the structure cost not become on whit for use. imét state of <u>collapse</u> OR <u>fimit</u> state of striength When it state of stength one those associated with failure under the action of propable & mast on unfavorable combination of load on the ctructure using appropriate parsial the cator factor which may emplanger. the safety of life & property. ythe lengt state of strain Encludes of limit Extess of equilibrium. Of the structure of a whole or any of the parts. (in coss of stabelity of the structure Encluding supports & foundations. repture of the structure.

eve Brittle Fraeture I Freacture due to fating faguting limit state of servecebelity To starting statisfy the limet store of services. -bility the deflection & cracking in the struct-6 ANDERESS INTO 180 ( POUR + 2 ) Deflection The deflection of a structure shall not The deflection of the effectioncy of the structure adverting of ore paretion. provers of Hards EPSICERStor boat Simess Cracking of concrete chould not adversity When with type of structure & environment. The surface wets of cracks should not Pg-67 whe term characteristic stringth means that value of stringth of the thousand below The term character of the material below value of stength of the than sole of the which was not more than sole of the test. Result are bacepted to fall. The characteristics strength "Fore connote characteritic concret shall be according to table no 22 (19 no de) . whe characteristic value chall be assume as mentionen yield stress act 0.2% proves The ctestign load, id to geven stants 700019 154 = 428

characterestic load pro-6.7 The tetos, at points to and puttount, 4 Charca cterestic load means the value of land which as 950/0 propability of non exceeded during the life of the structure Believe the out philling XXX Dead loads are given in is : 557 (parit 1) Emposed load leve (part -2) 10/7-10/ 21/1 The deficition of C. 278.21 Stor The Stank tostas Missuk. 000187 Wind load 15:875 (part-3) Sesmic load is:0001893 shall be assume as characteristic, load. pluces partha and 10 times Dt: 15.03.23 00 ch aust in as Design values Creek Chies 15 25525 Scott Harris 2 NT VI Materials The design strength of the materials, For is given by have deretics of f File term characteristic my in pt 000 90 125:0 Nr. the 0 0 where !!!! f = characteristic stringth of the material chares deschiere chrengts have consiste Ym = paritial safety factor appropriate to the booteneal & the comit state Whe charge charge considered. ar mentioner yeeld stress out and there. Loads design load, for is given toy? The design For = FXF FOOTS

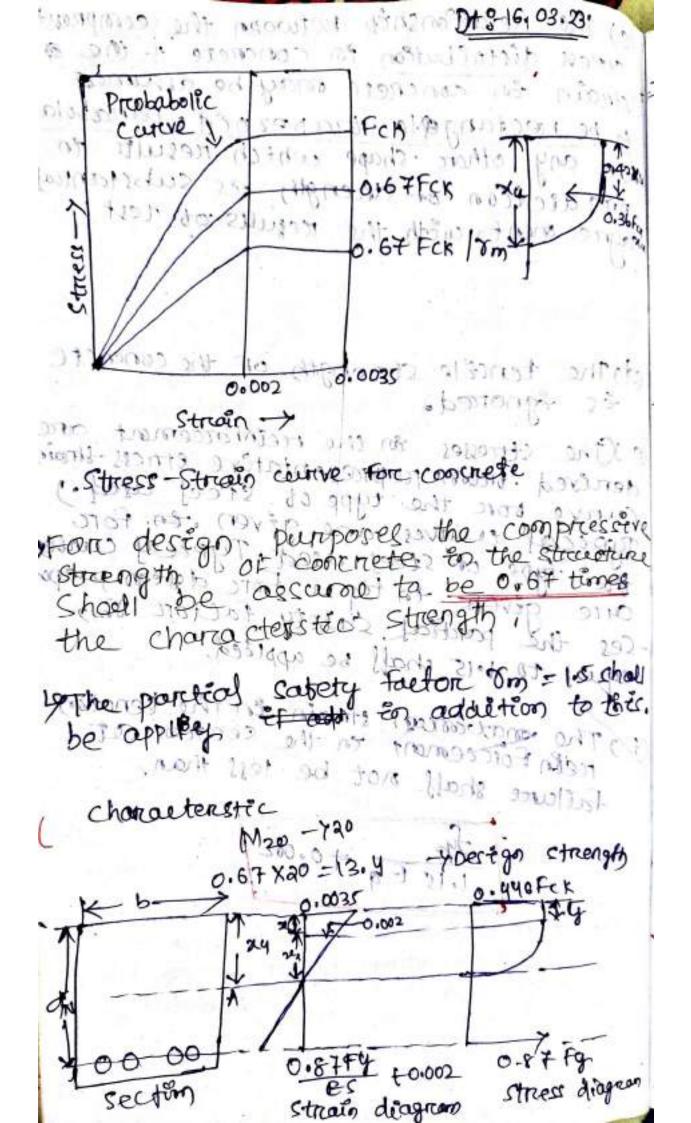
where a not me motored withdraw a F = characterentic load gand If. = paritial satisfy factor appropriate lænet state being considered of 00 Sires 21 Values of parctial Sabety Factor For Yf loads lamit state of Load Componation lamit state of servectal collapse -tletu internate is the dignosting of writing is a citation we (Uning to sould's des (1) (32 (42) (42) (6) (6) (7) about out ctoli mould be laken a ur 1.0900 15 1.0 DL+LL 1.5 1-5 orc DL +WL darte which and al 1.0 08 08 DL+IL+WL og M - mai 177 APR imit state USD Sh NO. / Land Combenation Ulternate limit DLTLL FICOLTU) DUTAL 0700 13.008 CC DL+WL (BDL contribute 0.90L+1.5WL) DLOWL 2 Into Aster to stabelity DLTWL disor assists 11.5(DLTWY) 1.2 COLTLITWY DL + 0.8 LL to.8 WL overcturen tong BUTH TWL (b) The marked was give 5 the an outteramost commension is taken as 0.0035 to bonding.

2. partial satety factor in for material. instractor's strength 1792 De La Horan re Noj Materia Ultimate limitstate Erwicebili 5101 Concrete Ec=5000 1.50 FERM Es=2x10 on pa Steel -1.15 11:12 15:005 to stule tracks material in Mimm = Jamp NPCG B appoilas when assessing the strength of a structure on structural, memberi for the limit. state of collapse the values of pation factore ishould be taken at 1.5 Sabety for steel. 11:10 JIO 2-1 2m At Q. Find the elastic modulus OF consince te Fore Mao greade . DC+IC+DDL FRONT VFCK. MPR perrore conte Ch No / Cand Company Ulterate = Storal ac DCTL 22360.67 onpa (Ani) ( 1d 0.901 + 1. EWI - DL + WI Stud 6 Prexidence of collaps init state applane sections obignap to the arts remin planet lettery panding. But mutano (b) The markenum strain En concrete at. the cutermost compression fibre is taken as 0.0035 in bonding.

(c) the relationship between the compressive stress dirtribution to concrete 4 the a strain on concrete may be assumed to be nectangelle strapezore i pariabola more any other shape which result to priedection of strength tis substantial agreement with the regults of test

d) The tensele streenigth of the concrete is ignored.

le l'The stresses on the reinforcement are derieved train representative etness-strain curve our the type of steel used.) Type caf curves are given . to for the type of steel used. Typical current the type of steel used. Typical current one given in fig 23. For darign purpo -see the portial cabety factor 8m? Lequal to 1.15 shall be applied. The matricement in the section of reen forcement in the section of failure shall not be less than, Charlos terist 10.002 chemast's (60) 1.15 E HAGICK 1.51 NE (00.0 + 23 C (mit )92 Starie diame 120 7 C 11 F.



Note 27101 W the above strices strain for the design block parameters are as follows. y Fors stress 4 Arrea OF parabolic portion =  $\frac{2!}{3} \times 0.446 \text{FcHx}(\frac{4}{5})(\text{xw}) = 0.17 \text{Fck}(\frac{4}{5})$ rectangular portion= yo Arrea 0.446 For ( 3) 20 5-2/-1=1-= 0.19 FCK X Xu WTotal area of trees block = 0. FF Fix xuto. 19 = 0.36 Fek 24 let q = be the distance of centroid of stress block from the arstreen extrem compression fibre y = 0.17 Feg, zee (x1+3 20) to-19Feg ilas 20100001 100000 (20) 0.360 Pagore wit in Substitution 21 = (-=) xu & xz = (+) xu : depth of Centre ] of sempressive force y 50.4200 totomer fibre in streeting From ender recentarcos coction.

where, Fick = characteristic compressive strength of a concrete & Luz (103) 107 Didepth Freutral and in threak o 2) X 6.446 F ctr (분) (xy) Fy /1-15 rectangulan 01935 2011.0 0.90\$ O.SF4 0.805 CHERCE ESTANTON NAME? Later 1 13. stress 10.03 in with sui 20012 20.001 1. 10.002 20.00 Star 1 2001 d 10.002 1 : 12 report a cold worked detormed to Types of Beam Section = P il section in which tension steel treaches gield steel as the concrete treaches the failure steel steel strain in bending are called balanced steel strain section. st & nr 5 Substitution of (i) section ien which tension steel reaches yield steel out loads lower than the yield at contrate reaches the load at contrate reaches the failure strain in bending are called failure strain in bending are called under mela forced cection.

(iii) Section the which tension steel reades 10ad at which concrete reache the failure strain in bending reaches are called over reprintanced beetin over recentanced 3rd chapter Analysis of single Reinforced en Anaty Rectongular bears. LOW UX -W 8 11 11 0.4465CB 0.0035 1842 xu c= 0.96fc ub 10,017 xu Flotal com Yzze А Total tension 0.875 trang T=0.57 58 Act Stress diagram. Section Strain dragram Total Arrea of stress block = [0.175ck aut DO. 19 Fek Zu =036fck 24 A singly reinformed rectangular beam section with strain d'agricon & striesdiagram are chown win above figure. Revetrage Mercesont att must Food 0 Total compression = Total tension => 0.36Fck. D. Re = 0.87 Fy AH Ru = 0.87 Fy Ast Pg-96 0.36 Fex.b

The Xu X Xu jonar -> then the section is posbred as ander thin forced 2 a > xundx -y the Moston over- reinforced Sind chapter VIF Xu = Xu max -> Bajonced & section · datest & 105.0 Lu maix / d) Grade of steel 0.53 Fearo. 0.98 5. 5 Fe gs +a. 24:0:0:00 Stues. Section ? Ferro Strato drag Total force of stress Noch = 0.131 ask 20.48 -0.48 dat Xuimae = 0. Ut Xa of charged including the production income section and the second and and To find lever Arcro mpst mondia - 0.422 62115 GP20. From the tress diagreem Z lotal compression that there there => 6.36708.b. xu = 0.87 Fy Pit NA 127 F8. 0 = wx x-912 BG -

To Find Moment of Resistance is For a balanced section, M.R = Total compression 12/01/100 Mu=0.36 Fck b Xu X (d-0-42 Xu) MR For a under reinforced sector M.R = Total tension & lever ann. 0.87 Fy Ast x (d-0.4200) pastion istory ster léméting values substitute. proper mar & Marin For My of assertance average to an Run Mon Mulem = 0.36 X Fer Ybx d' P. 11 617 to magnin is (ant so portation of a contation of sections) Ing Section Oluma anty x Mu, 100 = 0126, X ( 201 jonan STIS NO CON (pitrai) paralog & fer bd2 19-96 yu. Ma < Mu tim Mu=0.87 Fy Au of (1- Het. Fy) porteon

Type of problem Three different types of problem are considered tor congly trainformed rectangulare beam. - Ma = 0.96 Let box a & Col . 0 = 0 M Type-1 To find out the depth of neutral axFy. of type of the beam. 12.51 r retorn 1 letot - g.MA is fore a geven certeon equate total tension & totay compression & thed out the depth of resulting axise weing du = 0.36 Fight al Atso Fend out the limiting value of depon of neutral axis tumax cuting tumas Dur Mon XA (ing IF - Xu K Xumar - Then the section Er Hnown as under (com un ap. 0- preintoured section. IF sein du more of them the section IF xu = xu, max -> Balanced Section. x fer bd AN ST WAY WAY SWAM AT Type-2 To Find out the moment of neststance given sægtion why pit F800 - M of a

(i) for ting out depth of neutral type of beam. as dissuced type +1 arth (10) For over reinforced & balanced section then calculate moment of mesestance. by using following og? Rujonace Muslim = 0.36 X (201 more) X (1-0.42-0 X fcb, Xabd2 in For under reinforced section otten obtain moment of restance by using following eqn. NLu = 0.36 Facto Xu X ( od - 0. (QXu) iven data Act. Fy Mutim = 0.87 Fy Act. 9 OR Feg at 16 april atom ype-3 To Find out the a singly reet forced rectangular wedthing applied factored To design givan section. forc Cours PR. HOD : moment

is The width is decided by the following formula 1. d. A. A. JE. 0 4319 pl F 2.0 M its XOJKED Olim XO. 17 DE. 0 1= 12 K. = 0.36 x ( 2 monx) x (1-0.42 Olion where, 24,more) XFCK

(i) The steel arrea cap be cake wated by wing Following Foremula. C RECORDER OF louder empirient as mere - 0.87 Fy (0-02/2 20, mar) 11 Mar 1 (160) - 0 36 X ( 2011 10/1 A rectangulare bears 230 mm gwide of Sao mon effective depth is reinforced with four no.s of 16 mm diameter bare find with the depth of neutroel barrs find out the depth of neutroef. This axes & specify, the type of bears. This material are a Map grade concrete & fe usour grade & Fe usour grade steel. Ru = 0.36 Feeb Xu XI Given data q = 520 mm. Har to star F2.0 = mit why Anos. of 16mm dia T Ast = 4 x + x(16)2 proceeding and sold and Total compression introtal territory = 0.36 Fick . b. 24 = 0.87 Fy Auf on 10 0.87 Fy Auf . 0.87 Fy Auf . 0.87 Kuis x804 => xu = 0.87 Fy Art M 0.87 K415 X804 => xu = 0.36 Fck. 6 min 0.96 X 20X230 (1-0.4) (1-0.4) = 0.36 × (-30 100x) × (-0.4) J. a. www. Xtch

For Feyns, <u>xultion</u> = 0.48 at not
= 12 03 mar = 0.48 × 520
Juc zumar - yunder reinforroed soction
1982 A rectangular bean noomm wede &
use mon ettective depth is not diameter with city no.s of 20 mm. diameter bars. Find out the depth of neutral bars. Find out the depth of neutral anets &, Specity the type of beam of the material moment of registance of The material moment of registance of the material moment of registance of
The beam. The material are M30 the beam. The material are M30 grade concrete & Fe 200 grade steel.
Given data Given data
of = yramon ADD-S of 2810000. dipo: 201 - 5-
$\frac{\pi}{4} \times (av)^2$
= 1256.03 - Total teroi 09
$= 0.36 \text{ Fck} \cdot b \cdot 2 \alpha \qquad = 0.87 \text{ fg Att} = 0.87 \text{ fg Att} = 0.36 \text{ X 30 X 30}$
- (2000 02 - 000 -

For Fe are, summar = 0.53  
= 
$$\frac{1}{2} \times u_{1} max$$
 = 0.53 K 4100 m  
=  $\frac{1}{2} \times u_{2} max$  =  $\frac{1}{2} \times u_{2} \times u_{2}$   
 $\frac{1}{2} \times u_{2} max$  =  $\frac{1}{2} \times u_{2} \times u_{2}$   
 $\frac{1}{2} \times u_{2} + u_{2} \times u_{2} \times u_{2}$   
= 0.36 F cx b  $\times a (d - 0.42 \times u)$   
= 0.36 K 30 X 200 X 126.53 (uro - 0.42 MZ6.59)  
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$$F_{y} = 48 415 \text{ H/mm}^{2}$$

$$d = \sqrt{\frac{Mu}{Qlim Xb}}$$

$$Q_{lim} = 0.36 \text{ X} \left(\frac{2u \text{ max}}{d}\right) \frac{XH}{Qlim (1-0.42 \frac{2umm}}{d})$$

$$F_{0}r_{z} = 0.36 \text{ X} \left(\frac{2u \text{ max}}{d}\right) \frac{XH}{Qlim (1-0.42 \frac{2umm}}{d})$$

$$F_{0}r_{z} = 0.36 \text{ X} \left(\frac{2u \text{ max}}{d}\right) \frac{XH}{Qlim (1-0.42 \frac{2umm}}{d})$$

$$F_{0}r_{z} = 0.36 \text{ X} \left(\frac{2u \text{ max}}{d}\right) \frac{XH}{Qlim (1-0.42 \frac{2umm}}{d})$$

$$Q_{lim} = 0.36 \text{ X} \left(\frac{2u \text{ max}}{d}\right) \frac{XH}{Zu \text{ max} = 0.45 \text{ X} \frac{2umm}}{d}$$

$$Q_{lim} = 0.36 \text{ X} \left(\frac{2u \text{ max}}{d}\right) \frac{XH}{Zu \text{ max} = 0.45 \text{ X} \frac{2umm}}{d}$$

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$$Q_{lim} = 0.36 \text{ X} \left(\frac{2u \text{ max}}{d}\right) \frac{2umm}}{d} \frac{2umm}}{d}$$

$$Q_{lim} = 0.36 \text{ X} \left(\frac{2u \text{ max}}{d}\right) \frac{2umm}}{d}$$

$$= 2.75$$

$$A_{0} \text{ Y} \left(\frac{1-0.42 \text{ X} 0.48 \text{ Y}}{d}\right) \frac{2umm}}{d}$$

$$= 2.75$$

$$A_{0} \text{ Y} \left(\frac{1-0.42 \text{ X} 0.48 \text{ Y}}{d}\right) \frac{2umm}}{d}$$

$$= 2.75$$

$$= 2.75 \text{ mm}$$

$$A_{0} \text{ Mu}$$

$$A_{1} \text{ Mu}$$

$$A_{2} \text{ Mu}$$

$$A_{3} \text{ H} = \frac{120 \text{ mm}}{0.87 \text{ F} \text{ Y} (d-0.42 \text{ X} 0.93)}$$

$$= \frac{120 \text{ X} 10^{6}}{0.87 \text{ F} \text{ Y} (d-0.42 \text{ X} 0.93)}$$

$$= -9(57.81 \text{ mm}^{2} \text{ M} \text{ M}$$

2 18. 03.00

Doubry Reinforced Section If the applied moment & greater than the moment of recertance of a songly reinforced: Section then these can be three alternatives

() IF possible ; increase the dimension of the section, prefeble depth.

ils. Higher grade concrete can be used to increase the moment of resistance of the section.

the steel reinforcement may be added in complet -ssion zone to Encrease the moment of resistance of the section. This is known as doubly reinforced section.

Deravation of the Formula

Pes max

Adpopt aton min depth (

0.03 Daroad 0 ASC 5 + 20.00 (April) Cherles. 80 1-167 q 100.00 19:271 tres section resisting section menisting section Resisting 0.446 Fex 0.0035 d a Mile En mon 1.SODIS 100 60 91=0.87 Fy 0000 0.87 Fy 0.002 Astim babsvoste. 0150 = Ast ilim + Asta (Strain Dragram) (for ce Diagram) (Beam cross Section) Mu lim) ON CONTRACTOR NO 1 1196 at a dente 10365 P 20519 0000 not and novot the Fre -Fec) D -d') -tenetion Stee 539 Dealor1 T2=0.87 Fy Ast force bragram Ederang\_ C.008) P MC of beam of Musi) V-sc - fee it : Arres of additional tenergie reen Forceprent.

A gloubly reinforced beam subjected to a moment. Mu can be expressed as a rectanged are section with tension reinforcement Au can reinforced for balance condition giving moment of restistance Mulion + M section reinforced costs compression reinfor -cement and Asc & tension reinforcement Atta giving moment of resistance Mulion

4 Mu + Mulion + Muz for the Fore the moment Mulion that tension steel Aut, limit is find out as explained Aut, limit is find out as explained fore singly reinforced beam.

Y For the additional momint & Muz the additional tenseon steel & compression steel are provided such that they give a caleple of moment Muz.

Y let the compression reinforcement be proveded at a depth d' Fran the a proveded compression febre. Them streen compression for additional moment sever lever Arm for additional moment will be of (d-d').

4 Consedercing tension steel Anerebore Mug = 0.87xfy x Asta X(d-d')

4 Concedering compression steef Muz - Acc X(Fse - Fec) X(d-d') Coherce, Acc X(Fse - Fec) X(d-d') Coherce, As+ = Arrea of additional tensile rein Forcement.

Asc = Arcea of compression reinforce FSC = Stress En compression reinforcement FCC = compressive stress in concrete of The top love of compression reinfor--cement. approved to addit. balanced by additional compressive Force. 4 : Asc (Fsc - Fcc) = 0.87 FyAsta 4 Ast = Asic (Fic-Fic) Pg-96 Total Arica of rainforcement chall be obtained by As+ = As+, +Ast2 when, Ast, = Area of reinforcement forca Stagly reinforced section for Mulia. The value of fsc in N/mm<sup>2</sup> can be obtained from the following table for different value of d g grade of steel. A: mank boß Fy to N/mm? x1000 d/d' 1.13 0.20 0.1 0015 0.05 850 R17 217 217 a17. 250 342 329 353 BST d 240 395 0 370

500 424 412 345 370 550 458 441 419 380

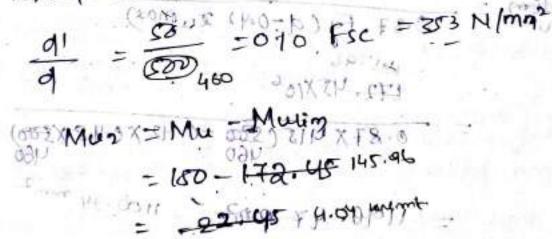
The value of fcc. Es very small so can be Fsc Sturge to 130 20 578 8 8 10 10 negelected It statistics in 120012 Bifficandinana The state of the second of the Daliyati (Claim) Type of problem Crease the addression resimbly and 1 prost-tobar pe. lo findaut moment of restistance of a even section. geven section Total compression = Total tension. CITCO = to 0.36 fex bxu. + Asc (Fsc - Fee)= 0.87 Fy Art entrons Asti - Area of regiologicant Find out " recei coston promotion istenson istenso The value of fee in N/mm2 can be awined Forg Xumar & type of beam, is suller Over neinforced xu 1 & 7 Ruimax section, then take xu=Kumax FIS ¥18 · Mu = 0.36 Fck · b xu (d-0.42 xu) + Map Asc Fse (di-d') 002 1-AA 850 08 419

UPe-2 To find out treinforcement to freetune flexance for a given section of factored moment Findout Multon greinforcement Artim for a given section by with following eg, Muy lim = 0.36 FCKbx 2la, max (d- 0.42 Xu, max) Ast, im = Mulim (of - 0.422 max) Obtain Muz = Mu- Mu, icm Find comprission deer from following Mug = - Asc XFSc (1-d) egg Marger Mura Asche Fsc (d-d') SORX I Corresponding tençãon stey con be -out toy tallowing formula. Aug Asc (Fsc = Fsc) 107 25.0 ALSINO XXAP f2=10-87 Fg. KOCR XOEX 3 8:0 081258 3 8= Athim + Astall 1220 Ast in 089531 966581 -9191 Mon PG. SII - LSK

Q. Find the factored moment of registance of a bears section 230 mon wilde & 460mm effective depth reconforced with a nos. or 16 mm. dia bary as compression reinfor -ement of an effective cover of yomm. and 4 nos of 20 mm dia barrs as tensition, reinforcement the material arre Mao grade concrete of Fe 250 grade steel. Xelat as a -Given data D=230mm, Fck = 2000 mm d = 460 mm , Fy = 250 mm d 1=40 mm Asc =  $a \chi \frac{\pi}{y} \chi (16)^2$ Ast = 402 mm<sup>2</sup>  $A_{st} = 4x + 7(a_0)^2 \qquad K = 290000 - 71.$   $A_{st} = 40 + 20008 = 0.1 \quad F_{sc} = 217 N / mm^2.$   $T_{st} = 460, \quad T_{st} = 0.01 \quad F_{sc} = 217 N / mm^2.$ Total compression = Total tension = 0.36 FCK bxa + Asc (FGC) = 0.87 Fg. Ast = 40.36 X 20X 230 Xut 1402 X 217 = 0, 87 X 250 X 1256 -y 165624 +872342= 6 273180\_ => 1656xu = 273180-87234  $= \frac{185946}{1656}$ · xer = 112.29 mon.

VA COPP (02-052)EZE ( 530-50) Calculate the area of steel of grade Fells requered for a section of width 200 mon & ovorall and depth sound ( the ctive depth 460 mm) En M20 25 the limet state moment to be carried by the bronean section is isoknim Given data 9 My = 150 KN.mp. 600 = 250 mm () Fy EZE 415 28 500 = ( pann, fck = 2021P X 48-0 For Feyis = 0.48 mars. 128 remax 241 max = 0.48×0 460 = 0.48 X 850 500 - 330' & mm'

$$Mullim = 0.36 Fer b X Xu, max (d - 0.42 k xum)= 0.36 X R 0 X 250 K 0.487 200 (540 - 0.42 k xum)= 0.36 X R 0 X 250 K 0.487 200 (540 - 0.42 k xum)Yes= 172 C S C 4400 K M. mt= 172 C K KN.mt= 172 C KN.mtMultim = 0.87 Fy(d - 0.42 k cmoz)= 172 C K KN.mtMultim = 0.87 Fy(d - 0.42 k cmoz)= 0.87 Fy(d - 0.42 k cmoz)= 1196.51 mm2for a Fetts = 253 N/ma2= 1196.51 mm2= 0.10 Fiel = 253 N/ma2$$



$$Mus_{1}^{(1)} = Mus_{1}^{(2)} + Mus_{1}^{(2)$$

Art. = Artim + Art. 40 2211 1100 + 27.28 - and have = H96-47 + (-1.37) + 1 + 1 + 1 + 1 pricibare no altain 1127.28 mm low out . parts institute it itasi i mm cony on you Repair contained frain Tigune at 1921 - aros Dt: 22.03.23 Specific atton for beam Effective span (3) the effective span of a simply supported beam shall be taken as clear span plusteble ctive depth of the beam on center to center distance between the supports which ever is less. taken as ets length to the fore of the support put plus half the effective depth expect where the forms the end of a continuous beam where the length to the centre of support shall be taken. \* Limiting stifners (25) 3 \* The steffness of beams is governed by the span to depth rate. \* A perc clause of 15 456:2000 pg nor,37) to effective depth testis chould not excee Types of support to dep the ratio Cantelevere ¥ sempty supported 20 Continuous 26

A For spans above tom the above values may be multiplied by 10/span in m. A Depending on the amount and type of Steep, the above values shall be modified by multiplying with the modification factors obtained from figure of 15 455 2000 . Minimum reinforcement A The ment should not be less than the tollowing (clause 26.5.1 Of 15 456 ? 2000) (PgND-46) anonal Activities for set of 28.00 contraction of the chall be taken as che<u>nne and</u> stand the dirture depth of the beam are chefter to ched of dirture between the supported wisch end to is tak. Maxtmum reinforcements was substitut A The maximum arreat of tension reinforcem ONTH crupse sectional area (clause 26.5.100 (Pg No - 42) contenuous beam IS 456 52050) centres of cupport S - 1 - 5 - 16 - 1 25.4 5 45 l'a konnavala 25 mond \* The statteress of Pt, max 40.84 80 stapp at 1.092 M ton per clause of 15 455: 2010 panding parks for Dil Bog Ross thepthit of the body of other at the logan . earby cobbacted 3.0 contenadores 36

spacing of barre ( The horizontal distance between two paral-es main reinforcing barrie shall usually be not less than the greater of \* D'éametere, of the barr, it the diameters and and ton and 2.5 one equalit A D'Eametere St the largest bare, it the bares are unequal. prophytical asi / & stann. more than the nominal marcinem size of the aggregate. found tore \* When there are two or more nows of bares, the barrs shall be vertically in line and the minimum vertical distance between the barrs chall be is minitud thirds of nonthal maximum size of aggregate ote the maximum size of meater. the bares, which evere is The maxemen cracing of barry intension for beams is taken from table is of on the amount of regently button m on the amount of redictuibution canning Horizontal distance

Concrete cover for reinforcement 4 Théckness ob concrete coverchorc reinforc Tement is assumed based on. Att each and ob treenforcement barr, the concrete cover sholled not less than 25 mm not less than twee the diametere, ob, fuch bar, 10000 A For long-trudency rein Forcing bare & beam the concrete covers should not less than as mon nore less than the diameters of such bar. Ede face herrforcements mail relate & seide of no face reinforcement chall be provided along the two faces, where the depth of the beam exceeds 750 A The total area of such reinforcement shall be not less than 0.1% of the beam area and shall be districtuted equality on two facer at a spacing not lex ceeding 300 mm on width O A singly reinforced utrelctongular been of width beam of width 230 mm & 460 mm. effective depth is reinforced with side 20 mo dia tar. Find out the tactories The material are Moo grade concrete 3 Hys themforcement of grade Fection. 4150 Fendout the factored moment 05 resistance to zt is reinforced with 5 no. 20 mm. dia. bar.

Given data 0= 230 mm. Tohnor. Nom DE SOC d = 460mm 3 no. c of 20mm dia (SF F.Y = # 415 8 XDEC (18 X J.S.O.  $Ast = \frac{3}{7} \times \frac{\pi}{7} \times (ao)^{2}$ = 942.47 mm<sup>2</sup> Total Compression = Tatal tension = 0.36FCK. b. Ru = 0.87 Fy Act 0.87 Fy Act = > xu = 0.361 Fch: b. 0.87 X 415 X 942.47 0.36 X 20 X 230 = 205. 48 mm 1 2 . HA For a FRAYS (atol Storman ) 2 0.48 Total compression = y xaymon = 0.48× 460. - 220.8 mm PF. OF21XZIAXES. O 0.36×80×230 11

$$Xa < Xa max \rightarrow ander retationed beam
Max = 0.36 Feb bx (d-0.42.2a)
= 0.36 X & 0 X 230 X & 0 5.48 (460-0.42 X
& 0 5.48 0 X 230 X & 0 5.48 (460-0.42 X
& 0 5.49)
=  $\frac{127160178 \cdot 2}{10^6}$  N. mm  
=  $\frac{127160178 \cdot 2}{10^6}$  N. mm  
=  $127160178 \cdot 2$   
=  $10^{27}$  N. mm  
=  $127160178 \cdot 2$   
=  $10^{27}$  (16 KN mt.  
=  $127160178 \cdot 2$   
=  $10^{27}$  (20)<sup>2</sup>  
S =  $500.5$  of 80 mm  
Aut = C X  $\frac{12}{4}$  X (20)<sup>2</sup>  
S =  $1570749$  mm  
Total compression = Total tention  
=  $0.877644$  Mat  
=  $0.87764$  Aut  
=  $0.877445 \times 1570.799$   
=  $0.36780 \times 230$$$

= 342.47 mm. fore, Fe 415 = xumax Xumax = 0.48×460 = 220.8 mm, ututo novijo que y du max - y over rosinforired beam. Mu, 12m = 0.36 X ( 20, more) x (1-0.42 Choo -1/ 10% Xamore xfck X bd2) 220.8 X (1-0,42× 460 220.8 = 0.36 X/ XAO X 230 X (460)2) and the total 1. 1. 1. 1. 1. 131 3688 - 637

D A singly theinforced nectangular beam job width 200 mm & 400 mm effective depth 25 melnforced with X 500, 20 mm dia bar en tension cree & rieinformed with compression steel of 2 no: 16 mm dia bare at d1 = 40 mm. Findout the factoring moment of relistance of the section (M20 græde & Ferro) 60 845128 10.10% FF-198 Given data b=200 mm 9 = 400 mm. 5 no. of 20 mm dia 2 no. of 16 mon dia d'= yomm. Fck = 20Fg = 500 Ase = 5 x 1 x (20)2 = 1570,79 mm2 = ax = x (16)2 Ast = 402.12mm2  $=\frac{40}{400}$  = 001 FSC = 412 M/mm<sup>2</sup>

Total compression = Total Pension 0.36 FCK ( bxut Arc (fsc) = 0.87 fg. Art = 0.36×20× 20 ×2/4 + 1570.79(412)=0.87× Ob- CON Jella K HAD - do  $= \int | 440 \times 4 + 647 | 65.48 = 174922.2$ =  $\int | 440 \times 4 = 174922 - 697 + 65.48$ =  $\int | 440 \times 4 = 174922 - 697 + 65.48$ -4722 43.28 = 1440 24 = -64 7165.48 + 174922.2 ->> 1440 xu = 472743.28 => 2 a = 472243.28; (204) 1940 48 88.325 -7 20 = 327.94 dus site an For Fess, recenser = 0.46 × 400 = 184 mm. ru y Rumax yover reinforced. atob porta p= 220 mm 1 d= crommen. - m 1-12 08 - 12 AM Sec 14 12.5 34.0 -FCK=20 = > × vimos = 0 48X S ty = 415 .

HA Mu = 0.36 FCK Xb XXu ( $(q-0.42 \times u)$ ) + Atc CFSC) C  $(q^{-2}-q^{-1})$  × 1 = 8.0 XF20-((1)) PF. 0-21 = 0.36 × 20 × 200 × 327.94 ( $(400 - 20.42 \times 327.04)$ + 1570.79 × 412 C 400 - 40) + 1570.79 × 412 C 400 - 40) = 0.56 8 30012.49 N.mm. 2000 × 20 × 20 × 20 × 200 × 300 × 327.04

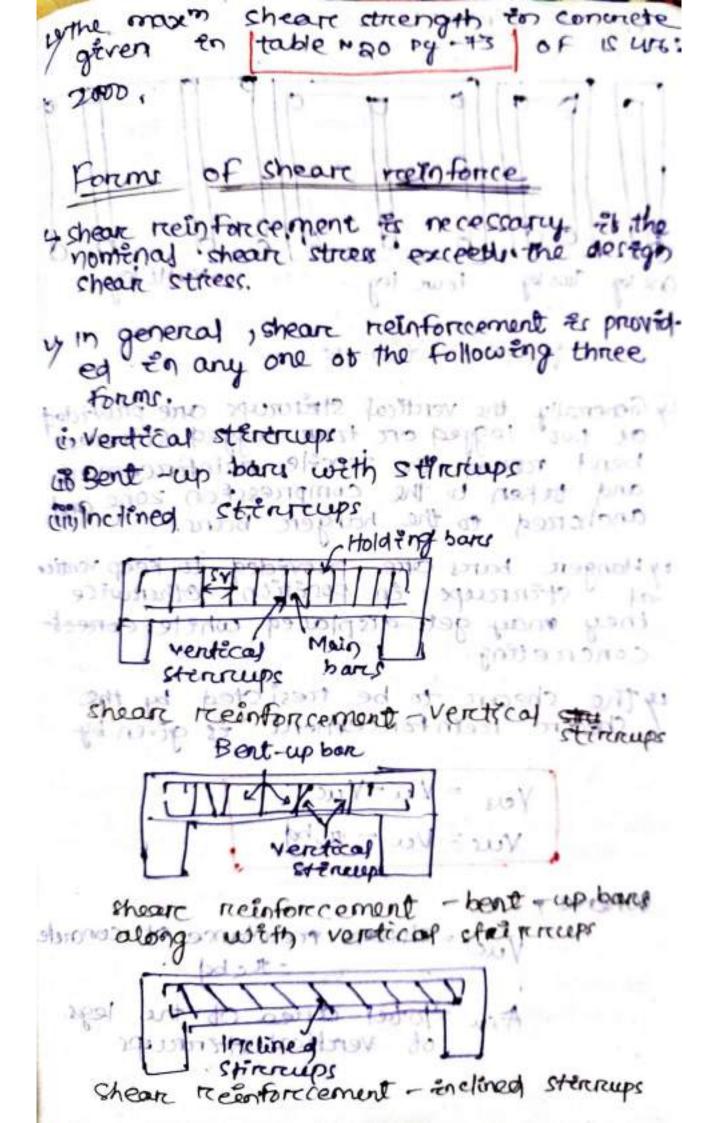
Q. A rectangular canté levere beam of sèze 230 mm wêdth XSOD mm ettective depth és cubjected to a bending moment, Of eakin/m. at working loade. Find the steel area required internation once M20 grade concrete & Hypo reinfor -cement ob grade feuis.

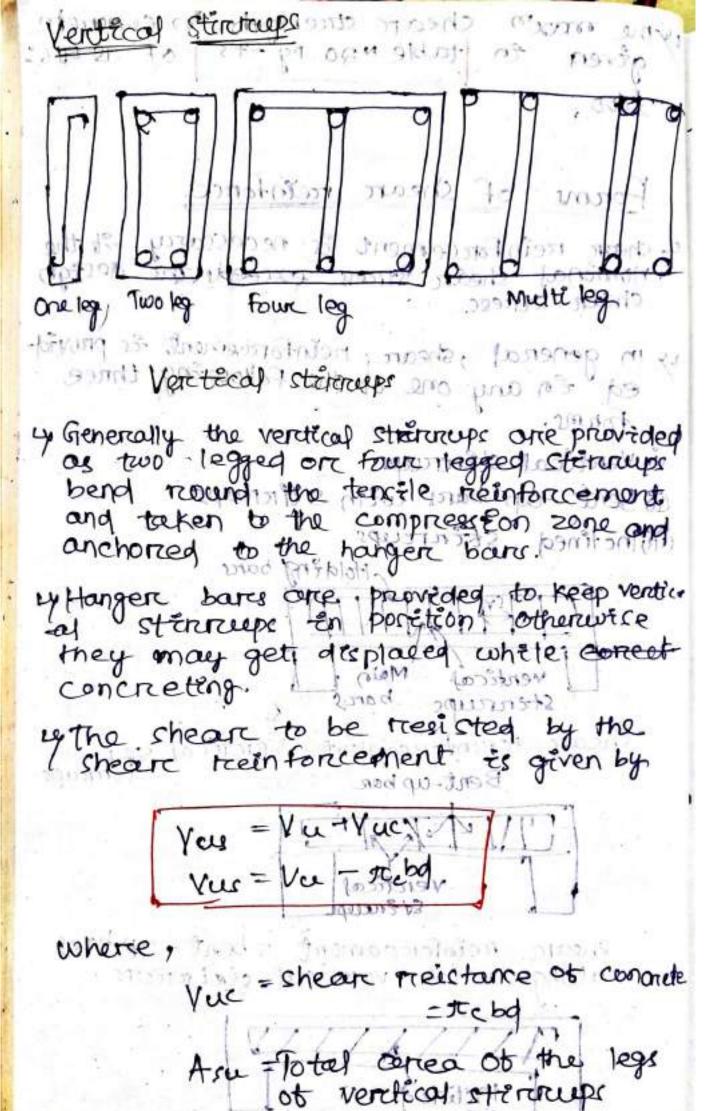
the constant the Difference of the Different of 28 of its 21000 1000 Development length shear Bond Diagnonal shear (4 Flexinge crock (0) Shear & Stoppy relatorced bears an anoral more porcers out manager Shalower 23 (2003 200 100 - 31 oluportition) is, Bendling of singly reinforced been to usually accompand by shear (i) The combenation of shear of bending stresses produces the prenciple. to the beam, chear strep to bear tomogeneous beam at service? 931 Zmar 64.03 A's' , 003 bornis B. . B. sugar a ad at ant ud NOW !! betech 1599 20000000 1.3512 reatingular Imax n force g far 000 noszi-rignos, got onto to anonest e rreachenz montaine value at the neutral Their out pas trion neutral are i cap to the Centre of gravity of street

Bin the case of homogeneous beam that i, e a concrete bean without reinton. - Cement, the shear stress at any point is given by the elastic theory (ii) The distribution of chear stress acercors the homogeneous bean of rectanguar & section is perabolic not naturce for plants to postandi (iii) It is zerio at the top & bottom f is maximum at the neutral anes. (v) The maximum chare stress =1.5.X. mosd with corres Tmax = 1.5 K F mood break beam Reinforced Concrete beam y'n reinforced concrete bears, the concrete below the neutral enter to neglected being in tension. y the shear & assumed to be needed by the bond between concrete y Hence, the shear stress En reinforced concrete beam varies parabolically with serio at the top, comp ression face, reaching movimum value at the neutral axes and constant trons neutral ares up to the centre of gravety of steep bary.

1-1-1 14. 16 20 Xu 10.1 00. Reinforced (onmete section) Pastast .... Dts 29.03.13 shear stress 4 The max form DXZ Linon F he becam E lever Ann E sheart fortce N = sheart fortce N = 2000 Code por shear stress to balled on Owarage sheart stress accords (20) Section Presveded for Arg: shear strees / Nomenal shear Stigess · Zvini, Vie - Pano-72 where Nu = shear force due to destign nosito porte a Bracadto of the memberi Force flanged section ette shall be taken as breadth of the web.

q= effective depth. beams of of variaging depth (72) case n Nomenal sheare stress Zv = Vut (Mu Xtanks 1.60 Recolatered Contracte. Eacter where 3rd Mu = Bendenig moment at the section = Angle bet? top & bottom ciges of the bears (75) shear etnength & concrete Destign chare force to some nextend. when shear needstance value depends mainly on grade of concrete & one of steel provided for negisting of steel bendeng moment. The decign shear striength of concrete to Hable - 19 pg No - 73 SF ts goven 15,456:2000 (73) sub Maximum shear striength on concrete section in shear the nominal shear Section, strick should not exceed the maxim. shear stries to en concrete taken a





A Chemina

d = EFFEctive depth of the section. For vertical stronges Vue = 0.87 ty Aard 01123125.50 (0) 211 teen terror Fore Encloned stinnaps quant? lett Ficking 1057000 mitor 87 Fy Aavo · (cind + cord) (2) Viar = 0 3- State Cart For single bar on single group of parcalles bars. Vas = 0.87FgAs SEnd Maxtonum shearc reinfaccement; The mentionum quantity of shear trainforcement should be provided for all beams which is poven 15 456 :2000 Close no 20.5. 1.6.) (.pg no.48) the equation By 0.9. 0.8. Hy ASV Z where , cross-sectional area of stim-AN = Total up lege effective in shear. Sy = Stercraep spacing along the length b = Breadth of the beam on breadth of the web, of flanged, beam, and (0)

Fy = characteristic strength of the stirming reinforcemente En M/mm2 which shall not be taken greater than 415 N/mg here veretical communes Maximum spacing of shear Reinforcement The maximum spacing of shear reinforcom-ent measured along the axes of the members hall not exceed 0.750 for vertical starrup and D for inclined starchep at 45°, where D is the effective depth of the section . Under considercation. In no case shall the spacing exceed soom. to quart signers are stand of SI4135 [al] winnt gspod . Section for shear Crutica and the test of the second sec of State put neuro Lam matri , SUBDON 110 11 20 5) 030 83 324 21 0(1 adjeups d X Mill -mits to trans with 202 - 2203 effective in choose. error and proto page densisher and 6 = Breadth of the beam or breadth of the way to flonged beam RAD

Lite

ufor beams generally Subjected to UDL of where the principal load in lateray load is located further then apform the face of the support where of the critical section depend on the the critical section depend on the condition of supports as given is Fegurie 115 A, B, C plant

y when the nearting in the direction of the applied shear. En traduces of the applied shear in the end negros compression Ents the end negros of the member section located of the distances than d from the face of the support may be design for shear (fig Age)

O A T Beam Section having 2300m width of rive and 400 mm effective depth is neinforced with 5 nor of 160000 dea bare Given data

 $d = 460 \text{ mm}^{10} \times 100 \text{ mm}^{10}$ 

mad Willeria: Shyamir. PIG . V2

Stal past all 5+ = 5 X Ty X ((6) = 1005. 51 mm

st wild of all or and prevent of the te a condi bastin fotosat 25. ant orrentat 24.00 and ant 105215 ×103 and 10 230 × 460 = 0.496 N/mm 100 Ast 100 × 1005. 31 -0.95 Pd NO-73 -0.95 Pg NO-73 -0.95 at a distances . than it from the salutes and so as shear (ray as a) = 0.56 to:048 = 0:608 N/mm Zc = 0.50 ; -Here, ZV ZZ : shear reinforcement is required select Grown dia mild steel bar for stirrup.  $A_{TV} = 2\chi \cdot \frac{\pi}{4} \chi(6)^2$  (Assume 2 leg)  $z = 56 \text{mm}^2$ For menemum sheat relative mont  $\frac{A_{5V}}{b_{5V}} \ge \frac{0.4}{0.87} F_{2} = 0.75$ ATO \$\$60 . . 56 7/ 0.4 = 345mm. 230x5v 7/ 0.87 X415 (6)300mm. SV < 219.77mm, Provide 6mm dea two legged

spacing shall not exceed Dt- 4/4/23 O.A. T beam section having 230 mm. Width and 460 mm obtective depth is neinforced with 5 Nos. of 16mm. the section is subjected to a bactor sheare of 90 KN. check the shear. striess, and design the shear reenforce -emert. The materies are Moo grade of concrete and @ Feys grade steel for stirring mild steel bar may be used. given data mon 2 - "Cash - x& = with b = 230 mm 2587 + 200 d = 460 mm 2587 + 200 Vu = 90KN  $\sqrt{2}$  = 2.87210(= Ast = 5 x 1 x (6)2 = 1005. 31 mm2? Space on shall one tone superior. 230x 460 = 0.85 N/mm2 90 100 Act 100 x 1005 31 puniers pt = = = 1 site nors 230 x 460 ant Rassing Brdz ware e. from table nor 19 15 456 (2000) ZC = 0.608 N/mm2 Zv>Zc

. Sheart reinforcement shall be provided.

Yues = Vue - Ze bd

14.000.00

132 2

11:

= (90× 103) -0.608 X230×460

= 27673, 6N = 25.67KN

Useng 6mm. déa two legged meld steel bars for sterreup

 $A_{SV} = 2x \frac{\pi}{4} x(16)^2 = 56 \text{ mm}^{2106} \frac{1000}{100}$   $= 125673.6 = \frac{0.87 \times 250 \times 567460}{5V} + 1000 = 0.0000$ 

Spectory shall not exceed.

(c) 6, 300, man . 28.0 = 031 8025

jnovite conon déa to leggéd stimup ja 21800 pacing c/c

(0001 : lable non 19 10 426 (2000)

- man 14 202.0 - 5%

XXX

J. A.T. bearn section having, 230000. depth of new and 460 mm effective depth to river Forced with ship of 16 mm dia barrs as tencion reen for cement, and out which 2 NOS bare are bentup at 400. The section is subjected to a factor shear OF 120 MN. check the shear stress and design the choan meinfon--cement. The material are M20 grade concrete and Feyls grade steef for stirrup mild steep bar may be used. Given data b = 230 mm. bentup. ban = d = 4600002 Vu = 120 KM : Nomenail shear strees , ZV = to 22.8-120 8103 = 230 × 460 = 1.13 N/mm2 2 borrs are benfrepard prite . : Asy = 2x + x ((5)2 = 402 mm2 Asv = 0.87 Fy Asv seng. = 0.87 X415 X402 X sin 450 = 102 630.9 N = 1.02. 63.KM For remaining 3 bar Act = 3x 16)2 = 603 mm2 Pt = 100 krt = 100 ×603 = 0.57

Table no -19 (page no-73) Z =0.50 N/mm? Yuy = Vu-Zebd -70.48 0.56 -0.75 -70.56 = (120 × 103) - (0.50 × 230) 0.25-70.08 × 460) don't in of Stephen on deal 0.08 X0.08 = 67100 N. 0.07-7 = 67.1KN. = 0.02 ocki sha lai C122 1 10 1 P IIIS MADE 131.12 0.57 70.488+0.02 Usua blirin gunna 02.0= 100 6122 110 apple movin . . shear resistance provided by bentiep bar = <u>67.1</u> = 33.55KN Vas or I = wV . Shearc resistance provided by vertical storrup=67.01-33.55 2000/12113 = = 33.52: . Using 6mm dea 210ggod n mild steel bare fore stercreep. Vus = 9:87 fy Arvid Pg NO-73 530 1572 X 401 X 401 45-3-13 -As  $y' = 2x \frac{\pi}{y_{10}} x (6)^{2} = 56 mm^{2} - 51$ 51 55 > 167 mm 33.55 ton late 25 . 0. - 09hx 026 179 ba

spacing shall not exceed. (1) Oots Xd = Oits X 460 = 345 mm. (1) 300 mm. · spacing = 187 mm. · provid e 6 mm dia two legged

stirrup at 167 mm spacing c/c (centre to centre)

O A rece beam of span (m. Es 20 mm. wide and soomon deep ceffective it has y barrs of 22 mm tensile neinforcement the beam carries a load OF 30 KN 1/m. Enclude relfweight. Des Egn the beam for shear use M20 grade concrete and Fe 415 grade steel.

Given data  $b = 200 \text{ mm} \cdot 1 \text{ W} = 30 \text{ KN/m}.$  q = 500 mm.L = 500 mm.

maximum shear force (Vi) =  $\frac{Wy}{z}$ 

= 30% =75 KN .

Nominal shear strees  $Z_{V} = \frac{V_{u}}{Eq} = \frac{75 \times 10^{3}}{250 \times 500} = 0.60$   $N/mm^{2}$ Ast = 4x  $\frac{\pi}{V} \times (22)^{2} = 1520$  mm<sup>2</sup>

Bond And Bond Strees. 21: 10/04 The plaine section beforce bending memains withe design has to take care of the Following two cases of bond failure i) Anquechorcage bond. bom W. Flexercal Flexencel Bond araces which ufferenced bond is one the change to tensile force carne the barc along its length due the barc along its length due from bending moment ed by the barc もの change to the length of the cratical at points along y Flexental bonds & to morre i o i where the sheare "This occurs at a particular cector flexard There force bond as bocal Streeg. S. J. S. Known ? OUS! obry os (Solo appes. 9.9.15107 (Ontino) of paura bong bt Two types of bond

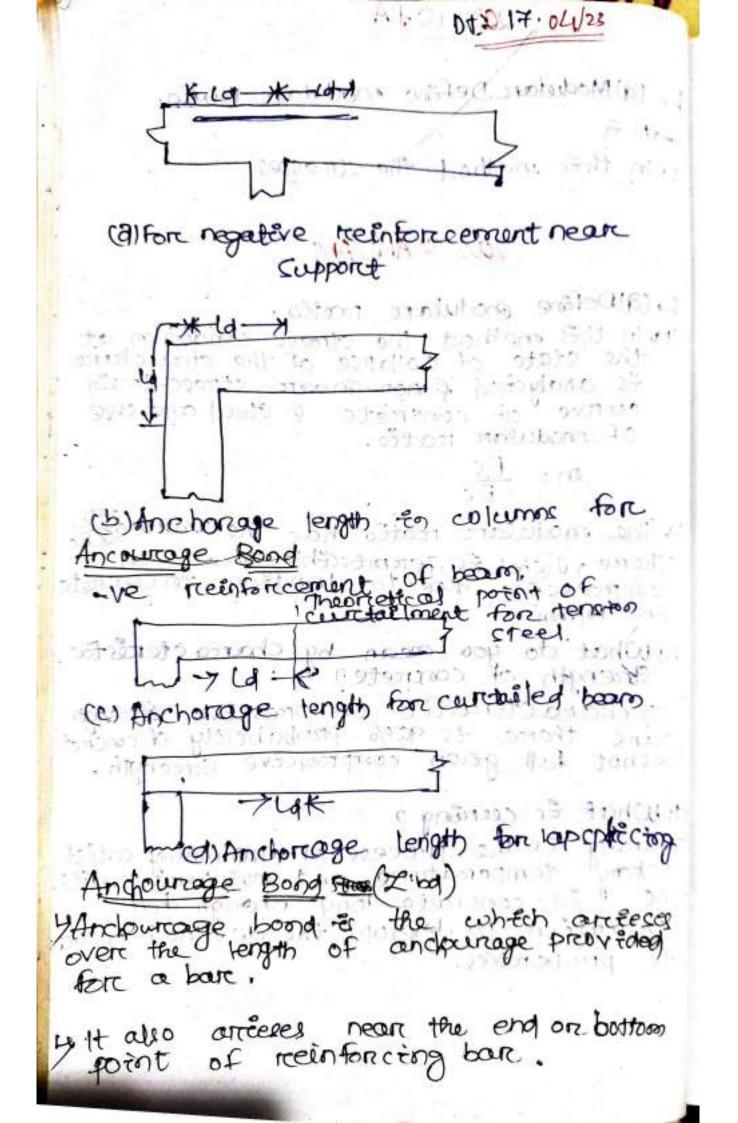
Calculate the spacing of 2 legged Ø. reenforced for beam 400 mm. wide \$600 mm. ovarcal depth of Feyls. alt, we issist used 152500 152550 at called chickacede levery y'he ichoto of the bare la marchined to thenesters. Its force to the bare promostion concrete through Given data world wat house in brook arth at b= 400000. menton scheare. receiption.coment Arv > 0.4 Cpg no-40 bsv > 0.87 Fg ind = 600 mon in had As Y = 2X = x (10)2 157.07 > 0.24 4 00 XSV > 0.87 X415 a managen par Sv = 354.43000. Spaceong Shall not exceed (i) O. 75 XO Secoper. Previded 2 legged worm dia straup @ cwith respectito) straup charing =0.75×600 20012 1100012 1.02800 30 C/c spaceno-0-0-0-0-0-0-0-

Dt= 11/04/23 Bond Inchorcage "The men anchorage length required a regist design force in the ban is called anchorcage length. Ø The length of the bare is trequered to transfer the force in the bar to the surrounding concrete through to the surrounding concrete through bond is called development length. is The design bood strees, of in limit The desegn method for playing plain state method for given bars in tension is given P9-42 942 OF 15 456 : 2000 A songly reinforced rectangular beam 300 ×600 mm carries a uniformily distributed load so knifert Encluding Self weight over a simply upported bears of span Gont. Encluding weath share of a soon dia of which weath share of a soon dia of which are creanked up near the are creanked up near the are creanked up near the delego, choose reinforcement & Support Nomeral shear stress ENat NW force - Chieora (over Figure disc ) H av 0-0-0000

Given date  
L=6 ont.  

$$W = 50 \text{ KN} / \text{kmt}$$
  
 $f_{g} = 415$   
 $f_{G} = 2.0$   
 $\frac{W1}{2} = V_{0} = \frac{50 \times 6}{2} = 150 \text{ KeV}^{-1.5}$   
 $\frac{W1}{2} = V_{0} = \frac{50 \times 6}{2} = 150 \text{ KeV}^{-1.5}$   
 $\frac{W1}{2} = V_{0} = \frac{50 \times 6}{2} = 150 \text{ KeV}^{-1.5}$   
 $\frac{W1}{2} = V_{0} = \frac{50 \times 6}{2} = 150 \text{ KeV}^{-1.5}$   
 $\frac{W1}{2} = V_{0} = \frac{50 \times 6}{2} = 150 \text{ KeV}^{-1.5}$   
 $\frac{W1}{2} = V_{0} = \frac{50 \times 6}{200 \times 600} = 0.83 \text{ N} / \text{mm}^{2}$   
 $UDL = 80 \text{ KN} / \text{mt}$   
 $\frac{75}{100 \times 600}$   
 $\frac{75}{100 \times$ 

 $p_t = \frac{100 \text{ Ast}}{60}$ atob north 3.095 (1) - 1 200 68 62 · 10 1.10-27 100 × 1472 300 ×600 101 50.816 % Manu Flucatton Table -19 (Pg+73) Zc = 0.58 N/mm2 10011 100011 CONCEPT CONCEPT Marsh Marsh  $Z_V = \frac{v_0}{14}$  : Zv 7 Lc John as Fullat :. sheare reinforce · · V 496 = 0.87 Fy Asv Sind - 450 (2506 41M) Arx = 2x = x(20)2 10-1-00 = - A&1. 7477 hd Vus = Vu - Zc bg. 225 K103 = 75 - 0.58 x 300 7600 = 120600N Pd -104175 2014 200 Real F 25.1 -120 600M 1 2 vov 6 1 Vusb = 0.87 For Asv Sind = 0.87 MUNEX 981.7477 (-20 400 = 250 600 (N. .. SFI) -



1) The andowrage bond meetst the pulling out of the bare of it is tencion or pushing in of the bare of it is in compression. Andourcage bond strees is develope over To Specified length I Ld : y Anopurage tor Lunch so that to steel is not ended tencion load con be neached & popout will not y Anciourcalog of relatoricing ban the necessary when the development so necessary when the development length of the meinterment is largen than the structure. Dt? 19/04/23 1020 9 1 ... MT (0) with require longth necessary to develop pull restiting for case of called anchownage longth on case of axial tension on compression for development longth is denoted by tension of flow of flooring 4 Destern bond stress for deformed bar to tenston tes as perc 15 1786 & there values shall be increased by 60% 4 Destan bond stress for bars on by Compression shall be increased by 85% as - Company to bond stress 85%. to tension = 1.2 for Fe250 (1) Note Q. Zbd (Design bond street) in four brude (B) (For tension)

(i) Zod for tension for deformed bon? (ii) I by for compression for deformed ban? 13/0 947 DONES KING (i) 200 = 1.2×1.6 = 1.92 =1.2 × 1.6 × 1.25 = 2.4 is Zbg . trans Donanti v Sko tension For Compression for fezro (1) Ibg For tension For deformed bar, (1) Ibd Fort Compression for Fesso? tei)Zbq = 1.2 X Post 1.25 miles hourage lenging ne (1031 windert Development OTTO: Ben (007 11 13.) 20x0x MDESEW, provd chesser -25° (1052) 90 od llado 00 /5 たりれついや For meldisteel? (651,1957)(135) 02.951 12(137 (00) 木 1.2 fere (KH) (P ) (g)standard hooking tradi (nonine) non

For Fe 415 & Fe soostee) at 239 KTC 4 est to present of late κP CONTRACTOR DISTANCE 100cl 02/02/2 » (KA DOK. 01.37 (b)standarig berg. the bars of . (879) ASI anchourage times standard bart tione types times star is To prove bend borre provided into many standard bare? antitute Dar . . averalent, development length egho 29 bends may Standard hook & taken as per pgno-43 forc taken, neloien 15:12 bei to 2 mosors of Bend & hook & Bends and hooks shall confirm 15:2502 - The anchorcage value of bend shall be taken as 41 teores the deameter of the bar the quanture the bend subject to a maximiter town population the dameter Hooks: The enchange value of a Standard utype hook chart be equal to 16 times the centre décharcemetéries épices é Nof the bari. 1 not less than 1.3 fearss the lop

Note yAncharteng value is as per 43 OF 15 45 y Lapping of bar is as per by Noi-15 Lapping of bars when reinforcement bare are placed the length of single reinforcement may not sufficient to stop in such cases the required design length is anchived by over lapping of 2 points bars is called lipping of transfer of loads friom one bar to Stantard arother bar. men vo This lap length is necessary for neinforced the transfer of both to allow the transfer of both tensile & comprissive loads from one reinforced bares to another by means of skin fruiction. 2400H brie length Determination Rules Force lap pgno-List (3) Lap oplices chall not be used for bang largen than semon; for largere diameter, bars may be welded, (see 12.4); for cases where welding is not practice -able lapping of barris langer than somm may be permitted in where case addition the power should be provided around CUD the kepped bans. 5 The 243 22,005 (b) usp : Gpec splices shall be concedered as staggened its the centre to g centre distance. Of the splices & not less than 1.3 times the lap

rength calculated as denceded only 100 2000

() cap length force band in there value tens dos chall be la cree 26.2.1) tens con chall be ly (see 26.2.1) on 300 whichevers & greater and for direct tension chall be 2 ly on 300 whichever is greater. The straight length of the hap shall not be less than the loop shall not be less than 15 0 or 200 mon. The bollowing provision shall also apply.

where lap accurs for a teneton bar located at !

notop of section as cast and the mon over is less than twice the deameter over lapped bar the lap length of the lapped bar of the lap length shall be encreased by a tactor or ly.

2) Conneri of a section and the minimum cover to either face is less than covert to cometer of the lapped by twice the deameter of the lapped by or covere the clear distance between adjacent laps is less than to monion oftenes the deameter of lapped ben, othere the deameter of lapped ben, control the lap length which ever is preater, the lap length

Where both condition (1) \$12 ) apply the applength should be increased by a lap length should be increased by a factore of 2.0 Notes Spleces in tension members chall Notes Spleces in tension made of barre not be enclored in Spirals made of barre not less less than 6 mm diameter with pits hot more than 100 mm. (d) the lap length on compression chall be equal to the development length of compression, calculated as described to 26.2.1 but not less than 240.

(e) when bares of two different dea are to be spliced, the lap length shall be calculated on the basis of diameter of the sossall'ere bare. CULMINS! (f) when splicing of welded where fabric is to be cannied out, lap cplices of where shall be made so that overlap measured between the extreme indig weres shall be not less than the spacing of cruoss, weres plus loo mon. (g) in case of build bars, lapped cplices of builded borrs shall be made by splicing one borr at a time, such Finderedual spleces within a fundle shall be En Bearn, cotourn & slabstggord ap tength 19-48 section as casts 50% 2NT According to is 456 :2000 lap rength of NO LOJEN Using coloumns 1 can be colculated Uhon D following formula. Cap length of coloumne yoard d= déametere of bar the clearc where wit 22:31 to us 456 ; 2000 the lap leg According to 10 4 6 related wings Following formula. 2d plum Lapplength of clab = 60xd . 12.1 10 ing to 12 456 \$2000 the lap length can be calculated using of beams Following formula. 18 30 Tap length of a = 60x01 11-011- 2016 in the lop length in compression check be equal to d'the development length to compression, calculated as described all but not les than 2410

Opension & compression, orage length in is single mild steel barr of drameter 20 - in concrete of grade M20. in (i) A hyse bar of grade to us of grade deaneter 16mm in an concrete of grade M20 . () M.s bære 10 (Fe20) 125 761 Deston stress for mis bar 0.87 fy= 0.87 x20 GS= 0;87 fy= 0.87 x20 F.IXD = 217.5N/mm<sup>2</sup> Tens ton Anchorage longth / Detelopment longth  $4g = \frac{O}{42} \frac{1}{12} \frac{1}{12} \frac{1}{12}$ D P pd S F Deetgn bond stries Ibd = 101.2 N/mm<sup>2</sup>  $U_1 = \frac{QV_1}{1709} = \frac{Q0X_{2175}}{4X_{1.2}}$ = 906.25 269 = 1.2 × 000×1.25 = 1.5 N/mm2 Compress ton  $Lq = \frac{\Phi G}{Y E q} = \frac{20 \times 2175}{4 \times 1.5}$ = 725

(ii) Desegn bond stries Log= 1.2 × 1.6 ×1212 92N/m and look black signat Tension = 0.87 Fy S.S. = 361.05 N/mm2 STRUCT N 10x 361-0500 - 601-75, 12 (WS-DOD) 16 x 36 00 = 7520 8 (6) 230 CONTRACT 16 × 361.05 Sound Arzar 1= 4×1.92 Andhoroge. longth / hole benerit longt Cs = 0.84 X 415 = 2351.05.  $\frac{1}{2} = \frac{0}{42} \frac{1}{2} \frac$ N- 893 = 601. H (0) = Perfor bond striess , Ind : Birs prod up 5220 SEIR X OS 20 S.IX.P. BORTP = P) 26:35 (compacts 501) Lega = 1.2 × 0001.25 1.25 Nones 2718705 200 LIQ 1 = 61 - IVII

13 most Settle 200 alt of Dr.= 2404 checking Davelopment length of Tenston Bart 10 0200 whe stress on reinforce tog bare at every cross-section must be developed of both side of the section. 4 This is done by proprieting development t length by to both side of the Section such as development length to usually available at med spon where positive bending moment where e. to materily such a development beam. Startlarily such a development lent to usually available at the entermedeate support of a continue bean coherce negative bendeng moment ic maxemum special checking for development length & ascential at following water. B At semple support (i) At contelevor supporting : ) (ii) At point of contrafference in the potent of par subott Requercement of Development length The is use code saying that at semple support the positive manne to a diameter cruch that 4</milty 1 S( WI + Lo Wheree, Palmonguo Plinpg 44 4 = Developmente length. Mi=Moment of reeistance of the cement at the section to be streeled to fa;

0.87 fy on the case of Konet state dosegt and the permicrible strees Tat gteld worching stross design, CERTIC GARDING STREET at do V = shear force at the sect due to destan. 100, de. In an polovak . o = sum of the all anchorage begand the equivalent ach: on mechanical anchorage at semple supports and at to the effective depth of the members on 129 whichever & great and Juckton aller 2 allow \$ = deameter of bar in th non of carticatterau The velue of Mi/v en the above expression may be encreased by 30% when the ends of the reinforcement expression treaction by a compressione Support the 204 (00) prices = 00) 12 (1.03) 8 (M) + LO Enternay O.A. Pistemply supported beam two ascon. and the bares going toto the support tes I man the chear the centre OF support -SKST ( working 1120 shepting 118 Seconts ad ~

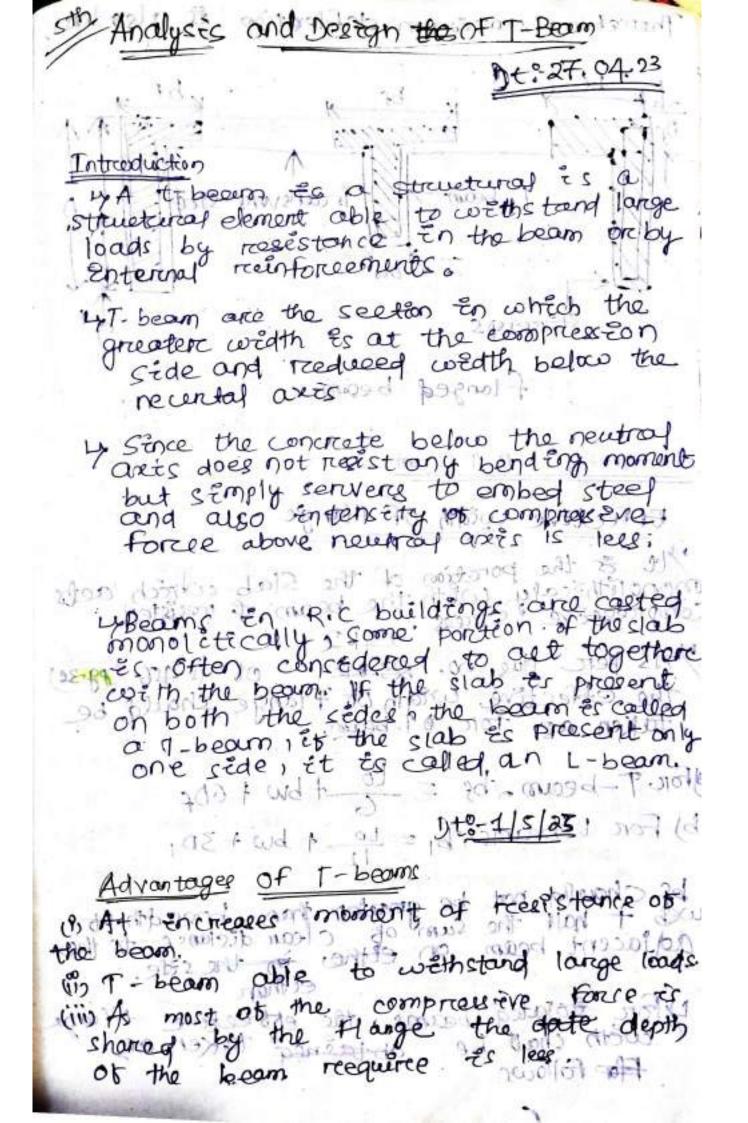
load. Determine the anchorrage Solo + Factored sheare forece = 1.5 × 110 - 165 KM suce < runtar ( and the rejution and ( contras? Ast = 2X JE X (20)2 (20, X 4 )= 628 mm2 1 1 5 4.07. 1M clease correct Bearing 25mm < 2050 Jotes-Colourn 4003. 20 Dr Footeng - 75 mm Assuming as mon cleave cover to the longe redenal bare tongth E St c. m x cocn. - Etgectère = 500 411002 Ebtective length =500 -25- 20  $M_{1} = 0.87 \text{ Fy & Act Cd - 0.42 xu}$   $M_{1} = 0.87 \text{ Fy & Act Cd - 0.42 xu}$   $M_{1} = 0.87 \text{ Ay Act}$   $M_{1} = 0.87 \text{ Ay Act}$  0.87 Ay Act 0.86 Fex, BJac S S

Quemax, =0.480 (pg no-70) 011 X = 0-48 X 465 MAS 223.2 months basiste seci < xumar ( under reinforced M1 = 0.87 Fy Ast eq - 8.92 Xu) = 0.87 X415 × 628 (465 - 0.42× 126) = 9 \$ 43 4771-95 N/mm 2 945-4771-95 = 93.43 Hos Kolent Anchorage length; lg = 0.87 XFg AC Ascument as anno clean count of the the Lq = 4×1.92 ( LX 5 9. 40 . 2 50) off the bar & geven at 90°. Not centre of support thereby etter anchorcogy value 10=8 go beng =8 80 mon. mm. 2 c1 :

of 1.3 ( ML + Lo) Theoking ton f length] State Grante 93.43 78100 +160 101890 1.3 -+160 -165 × 103 1.0000000 AFT NITTOP gener. 20:08 mm. service and a dor Since actuals bare dia Bot 20mm, is that 20 mon. therebore there es for crease the anchorage 10 i.e 240 mm, neeged no 120 10 length 0 2012 HOVEN CONF Chine -- Departure Contraction (11) C. 3 ( 2.43 ×100 1.3(10000 the stand Internal Quertion -11 (B) (B) (B) (5x2=10m. 14121 1.5 Answere all Questions 2) A cantelevere supported beam is so conxiso cm. and has 5-1600m Hysin bars going to into the supports . IF the shear at the is 150 KN factories 10ad Determi. anchorcage length cuse M30 mEx Support the. -ne and Fe soo grade steel). reenforced rectangular beam to tay depth convices a point for KNP Encluding over a simply stagly US X750 mg KN supported beam of span ( Font. and reinforced with 4 no. of 20 mm.

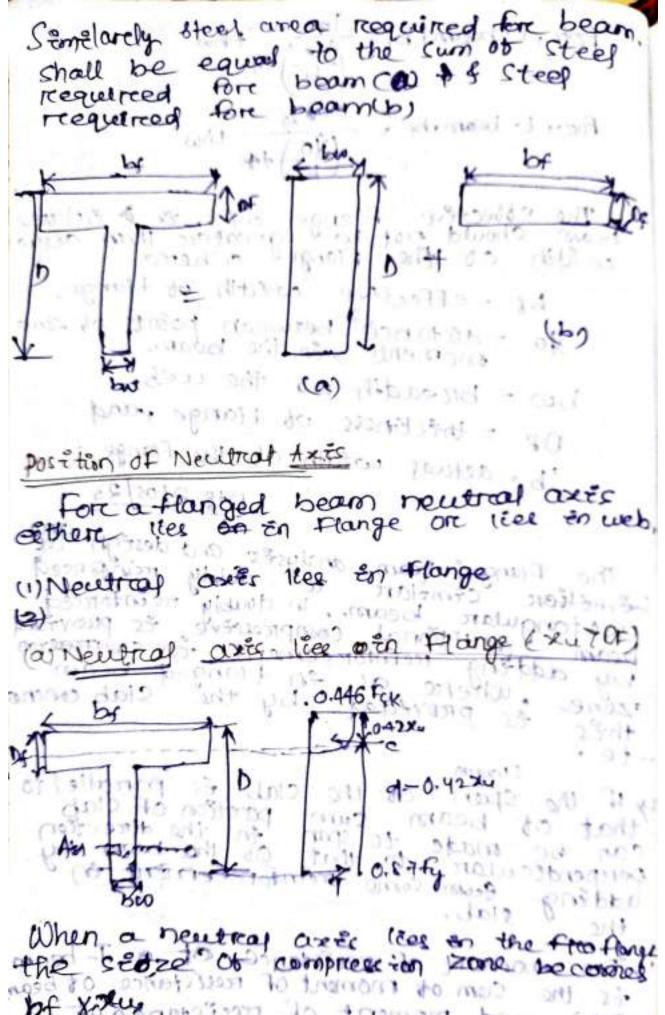
Shear Resistance & here cap bar 
$$\frac{9}{2} \frac{91224}{12}$$
  
Vusb = 0.87 Fy Asv. Store  
Asv =  $\frac{62 \times \frac{1}{24} \times (25)^2}{= 981.74} \frac{1}{12} \times (25)^2}$   
 $= 981.74 \text{ mon}^2$   
 $\therefore$  Kub = 0.87 ×415 ×981.741×5511450  
 $= 250639.10$   
 $= 250639.10$   
 $= 250640. \text{N}$   
Shear maistance  
Destan of vertical Statute of  
 $(Vus_1)$ .  $\frac{Vus}{2} = \frac{120600}{2}$   
 $(Vus_1)$ .  $\frac{Vus}{2} = \frac{120600}{2}$   
 $Vus_2 = \frac{0.87}{5} \frac{\text{fy}}{3} \frac{\text{fy}}{3} \frac{1}{2} \times \frac{1}{2} \times \frac{2}{602}$   
 $= 60300 \text{ N}$   
 $Vus_2 = \frac{0.87}{5} \frac{\text{fy}}{3} \frac{\text{fy}}{3} \frac{1}{2} \times \frac{1}{2} \times \frac{2}{602}$   
 $= 60300 \text{ N}$   
 $Vus_2 = \frac{0.87}{5} \frac{\text{fy}}{3} \frac{\text{fy}}{3} \frac{1}{2} \times \frac{1}{2} \times \frac{2}{602}$   
 $= 50300 \text{ N}$   
 $Vus_3 = \frac{0.87}{5} \frac{\text{fy}}{3} \frac{\text{fy}}{3} \frac{1}{2} \times \frac{1}{2} \times \frac{2}{602}$   
 $= \frac{50300}{5} \text{ N}$   
 $= \frac{319014007.8}{60300} = 31901-44007.8}$   
 $= \frac{79-48}{60900}$   
 $= \frac{6290.44}{2} \times 160.070 \text{ com}$ 

sheare recentor comment Minm ASV 7 0.81 Fy (Pg NO-48) bsy TX 寺 K(10)<sup>2</sup> アノ 0.4 310 KSV アノ 0.87×415 =  $3x \frac{1}{4} x(10)^2 \times 0.87 x415 = 0.4 \times 300 \times 57$ = 7 = 5 85070.40 = 12057=> SV = 708.92 => 708.92 7, SV Motor Spacing - 100.75 X d= 0.75 X GOD = 4700000 പ്പ് ദുതത്തി. · Spacing = 200 mm (Au 81 168 - 5 - C OOS 96-11- cepaz Passing sources and the state of the state 84-695 Enter Still all & the



Thereforce mozimum deffection & also les bf bf 1 T-beam Transvery sted -147 Stat Stéroraep S states a 71.12.511 aclad likes hearthant bour abl longed beam. Since the contrate below the neutroit Simenston of T-beam st stanply souver Effective wedth of flange Mt & the porction of the Slab which acts monolithecally with the beam of relater. The effective with ob Flange charled be taken as for of the base. Si stis sno AFOR T-bears by = lo the +60f b) For 1-beams,  $b_1 = \frac{10}{12} + bw + 30$ be chould not be gradter than breadth at web I half the sum of clean distance to the adjacent, beam, on either the site. either site. ettective floog totated beams, the ettertive fla beth chall be obtained taken as re Follows.

Forz, T-beam, bi = lo +bw part 2 + 6 000 (10)+4 +600 NO WO SHOE 1-2 HTAP Concerned in and position For 1 - beam bf = tbw Ro 1 The ettective flange with in it isolated beam should not be greater than actual with ot the flange where bs = effective with ot flange. No = dictance between points of zero bw = breadth of the web, Of = theckness of flange, and = actual width of the flange. 21x12 Lord 1911 ( 100001 10 Dtg. 2105/23 The flanged beam analysés and destigh of concernation compressive reinforced rectangular beam. In doubly reinforced rectangular beam. In doubly reinforced beam additional compressive is provided beam adding reinforcement in compression by adding reinforcement in compression by adding reinforcement is compression by adding reinforcement in compression by adding reinforcement is compression by a dding reinforcement is compre dour of 1821 US Senut 1 no 100 4. If the span of the clab is parcalled to that of beam cun porction of slap can be made to span in the direction perpendicular to that of the beam by adding sum some meinforcement of adding slab. y The moment of reservance of a T-beam is the sum of moment of resistance of bean A) and moment of receistance of beam (b).



bf Xora and inomiant to tramony but CA.

beam (b).

As concrete doesn't reasist any tension the with of tension zone has no ebbeet on the moment of registance of the section. Therebored this beam, can be analysted as a rectangular beam of demension (bf xon of the formula derived for relatingular beam; shall be apply. Forca sengly reinforced rectangular bean equating total compression is total tension . Xu = 0.36 Fulbe yere 2 block in concrete 21 To findout type of begins surport shall CIPTO S/ TXU Fondout & compared with actual, lue of neutral aris i.e tu be IF Xu 2 su max in Under reinforced beau IF Xu Y xumant Overland 23,15 m IF xu = thange of Balanced Massing Fore under reinforced boam, Mu = 0.36 Fek by Xu (0-0.42 zu) A ansant of anothing in the store of the second 1015

Fore over reenforced beam, Mulim = 0036 Fex bf 201, max (d-0.42 Mulim = 0036 Fex bf 201, 291, max

Dt 3-4/05/23 receist and american the 4. data 00 201 Malie TRADO Neutral areas cueb 0.446 fek 0.446fck AG. (NO 721131 d d= 0.4220 MEDIA 20 1104 . Di 324 0.07 100000 0.01 1.18 811 610 CHE ad Sta U.C. 1 bw. That stress to block to concrete show Es uneform upto 3/724 that the strees of them parabolic. Case-1 In this case Fother Streeces are uniform En Flange pornby = 0.87 fg Apt. tension Total Total compression = 0.36 Fex bus Xuit , 0.496 Fux Cof-bud X . Xu (ch-0:42 . Df Moment of registance, Mre = 0.36 FCR, bu Xue (d-0047714)+ 0+446 Fels(bf-bw)XDF (1- F) (DF 17 3 724) The recelengulare sfreez flock case. is assume to be great to 'yf'.

Total tension = 0.87 fy AFt · Total compression = 0.36 Fer bus see to. 446 FCK (bf - bw) XDf Moment of resistance, Me = 0.36 Fek bw xu (1-0.42 xu) +0.448 Fex (bf - bw) X &f (d - 4) where s off = 0:15 Xi + 0.65 DF 13 251 these Tositudes assured to . 111111 2004 Diff of bu 406 Det. latel . lo the 3 of -2 1-beam equations total compraction it have to read y C. Scick Spixe = OKII AN -DODIX STRANS -OS -NXXORAX 08X.08.0 SOSOIPOI DE LOS OPOZAN Q' AF T-bean of effective flange with 1200 -mmg theckness of slag 1000m. width of rais - Jun mm. gettective depth 560 mm 20 (web) reenforced with the 4 nos - ot 25 mm dea - barre . Calculate factoried moment of receptance. The matericale are Mab grade concrete prifegis grode steel. - 368 · 8 mm

Sol Given data of the bit IX (mai 4 fa 201 bf = 1200mm. 5600 OF. = 100 mm. 1 2000 tot 200 bw = 300000, - p) we we to but Art = 4 X U X(25) = 1964 M02 Art = 4 X U X(25) L = 1964 M02 Hange . Arsume neutral axts lies in flange (xu< Df) - ". Total tension = 0.87 Fy Ast · Total compression=0.36 Fex of the Quating total compression = Total teneros y 0.36 Fek bf Xu = 0.87 Fy AFt 1 0.36. X20 X1200 X 24 = 0.87 XAIS X 1964 => 8640 xu = 070910202 = y xu = 709102,2 8640 = 82.07 mm, LIUDMM COF) (OK) Neutral are s fres to flange only For fe all new, max = 0.48 mg = 0.48× 560 = 268.8 mm

der 2 deu maa Cundere reen forced Mu = 0.36 Fck by Xu (d-0.4220) =0.36 Yao X 1200 X 82.07 C 560 -0.42 (82.07) = 378645 760.4 Kittmt. N.m. M. = 378.64 X106 KN. mt (AR) A T-beam of effective flange with 800 monon, thickness of slab 70mm. wedth of rock 19150mm. & esteetive depth of 400 mm. Es reinforced with 5005.05 25 mon déa bares. colculate the factored to moment of resistance. The material are M30 grade connete & Fesso grade steel)

Dt: 9/05/23 Design of T-beam Stop-1 Depth of the beam 4 Select the depth(d) to range of \$12 to \$15 based on stiffness. yovercall depth of beam & taken as ditso, Step-2 95elt weight of slab. y Live load acting on beam. in Total load on clab=self weight of shabt live load. y load from the slab per metere reen of the been = load on slab perc m2xc/cdestance ifself with of the been, is Total load on beam = load thoms lag tSelf weight of beam, Up facetored locad=15x Total load on beam. Step-3 Factored bending moment. Mu = - 2 <u>Step-4</u> Effective wighth of flange 4 Cafculate abbeetive wedth weig The below torroula P7-37  $bf = \frac{10}{6} + bw + 6Df$ 

step-5 Assundag. The & coefficient the flange 4 Equate compressive force in concrete to terrile force in steel.

0.36 Fex by 
$$\chi_u = 0.87 \text{ fy} \text{ Ast}$$
  
 $y_{ee} = \frac{0.87 \text{ fy} \text{ Ast}}{0.36 \text{ fex bf}}$ 

Step-6 Reinforcement

onoment of receivence formula.

Me = 0.36 Fck bf 20 ( 9-0.42 20)

. .

1993 B. 1. 1. 1. 1. 1. 1.

 $A_{51,0020} = \frac{0.85 \text{ bud}}{F_{4}}$ 

Actiments should be less than Act, provide Step-7 Max® area of tension steep

My Calculate the reconforcement by using

Ast, max = 0.04 bwD.

Att, more chould be greatere than Asts proveded voltence deteremente on ot bares and deameter of the barg. Step-& Using SP16 4 Determine Mu 512

y Refere, Table 2 of sp 16 and road out the the value of percentage of reinforce-ment corresponding to ty and fix. Act = P+Xbd > Hence determine the no ot bars and diameters of barrs. 8-160 Peinforcement details Q. A T-bein Floore' conserts of iso mon theck R.C.C Slab Monolithic with 300 mm wide. beams. The beams are spaced at 3.5 m. Centre and their ettective span ES \$ 6 m. P. if the super imposed load on the slab is sim long indesign while an Entermediate F-beam, Use Mao mix and FEALS & grade sted. 11 Given data Effective span (3) = 6m. = 60000mm. DF = 150 mm; Sec. 11. 1 bw = 300 mm.

C/C Spacetong of beams = 3, Som · Live load = 5 KN/m2 Fck=20, Fy=415 Step-1 Depth of the beam . Assume, q = f to fo  $= \frac{6000}{15} = 400 \text{mm}.$ . Overall depth D = 0 +50 = 400+50 = 4500mm. DI: 12/05/23 Self wt. of concrete step-2 Loads = 2402 - 2500 ty /13 : Dead load of slab = 0.15 X25 = 3.75 KN/20 . Love load of slab = 5 ml/m2 . Total load = 3.75+5 = 8.75 MN/m2-: load from the slab per mt. of the beam = load on slob per m2 kc/c déstance bent? ben = 8.7.5× 85 = 30.63 KN/Mt. · Self wt of beam. = 0.3 × 0.3× 25 ×1 = 2.25 Hn/mt. ". Factoreed load = 10 2. 1.5x32.08 = 49. 32

Step-3 Factoried band in g moment.  

$$Mu = \frac{Wu}{e} = \frac{49.32 \times 6 \times 6}{8} = 281.944$$

$$\frac{Step-4}{Effective} \quad wtath of flange, T-beam i b_{f} = \frac{20}{6} + 5.00 + 605$$

$$= \frac{6000}{6} + 3.00 + 6 \times 150$$

$$= 22000 \text{ orm},$$

$$\frac{Step-5}{6} \quad Assuming \quad Xu \quad is \quad within finite flange, Xu = \frac{0.87474164}{0.3647656}$$

$$= \frac{0.8747415 \times 4145}{0.3667656}$$

$$= 0.0228 \text{ Ast}$$

$$\frac{Gtep-6}{Mu} = 0.36 \text{ Fex } b_{f} \times u(4-0.49 \times u)$$

$$= 7281.945 \times 10^{6} = 361.153 \text{ Art}, -37415$$

= 221.94 × 100 = 361.152 Act × 400 -361.152 Art 89.576 2003AR = 221.94×16 = 144460.8 Art-3.458737 -> 3, 458. Arta - 14 4460 Art taal-94×10=0 Ast = 221940000 : Xu =0.0228 × 221940000 = 5060232 m 0.30 0.84 Min = 0.057 Fy Ast (d- 0.42% 12) OP -2221-94×100 = 0.87×20×2200 ×0.42 =>221.94×106 = 0087 × 415× Ast (400-0.42 x 00 0228 April) =>221.94×106 = 361.05Ast (400-00429.576) 2/221.94 × 100 = 361.05 Ast × 400 - 361.05 Ast × 9.576×10 3Ast =)281.94×106 = 144420 Ast - 3.4574148 Ast2 > 3.4574 148 Ast? - 1444ao Ast + 221.94X10 => Art = 221940000 mm2 . Xu = 0.0228 X22194 0000 = 5-06 0 232 mm.

40178 · 16

Step-7 New water in the second Montenum area of a tensele steep, ment Ast min \_ Cossiburd fy. 0.85 000 × 30 × 400 415 · av filts e = 245.78 mm < Ast proveday step-s " Max" Arrea of tension steel, Ast, max = 0.04 X hwD = 0.04 × 300 ×450 = 5400 mm2 : provéde snos of 16 mm & borc Ast = 8 X - 4 162. Mart Colo - 100-1608.49mm<sup>2</sup> CONTRACT OF A SATE OF A SATE A REAL A REAL Commente Secondatoria de la seco 4000年1月1月1日(1月1日))(1月1日))(1月1日)(1月1日)(1月1日)(1月1日)(1月1日))(1月 

D+1- 16/05/23

Design of beams Basecs Rules for desego in Effective span C pg no-34 22.2) Semply supported becom ore slab The effective span of a member that Es not built entegrally with Ets supports shall be taken as cleare span plus the etsective depth of slab ore beam ore centre to centre of supports, whichever the following the second second second Estales and the sector Control of deflection. (pg no- 3+) (a) Basic values of span to ettective depth reation for spans up to 10 m. Cantellevere 20 Semply supported 26 Contenuous. (b) Forci spans : above 10 m. the values. 8) i) May be multepleed by 101span Enimeters except fore continever En cohech case detlection calculations should be. made. Reinforcement to beam (Pgno-46) Tenston Reinforcements (a) Min meinforcement - The min area of tension reinforcement shall be not less than that

given by the following.  $\frac{f_{4}}{bq} = \frac{0.85}{f_{4}}$ where = M2000 area of tencion reinforce Act = mont. b = Breadth of bears or the bread of the web of T-bears, d= essective depth, and fy = characterestec strength of relation. (b) Maxemun rainforcement - The maximum area of tension reinforcement 'shall not exceed 0.04 bD. Compression, reinforcement The maxim area of comprisesson righter -comment shall not exceed 0.04 bD. Comp--resser reinforcement in beam shall be enclosed by stirreeps, tor effective

lateral mestraint. The arrangetateral mente of sterraps shall be as specified mont of sterany. En 26.503.2.

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all the second second second State and the series . beat inc and spectral and to reach 1. 1918 mailing that winds in Autom and the prophics and the a file of the Ballmood of a . That she man in the anti- in thest is rectaration is rearrant to the in the one terms to bring trans stands all as the sheat is not evenered by sele and tercia For development length Cruteria

The is code saying that at the simple support the positive moment. tension rela forcement shall be remitted to a deameter such that Lg 3 (ML) + Lo

where,

## ig = Dep velopment length

Mi = Moment ob realistance of the section accuming all reinforcement at the section to be structed to for.

For = 0.87 fy in the case of limet state design and the permissi--ble stress design,

V = Sheare force at the section due to destign loads. Lo = Sum of the anchorage beyond the Centre of the supporce and the equival ent anchorcage value of any hour on mechantical anchorcage at simple

Support, and at a point of in fleet. -ion, lo is limited to the effective depth of the members on 120; whichevere is greater g

Q = Déameter of bar.

The value of M1/V on the above expression may be encreased by 20% when the ends of the recentorcement are confirmed by a compressive reaction. Compression < (1.3)X(Mi)tLo

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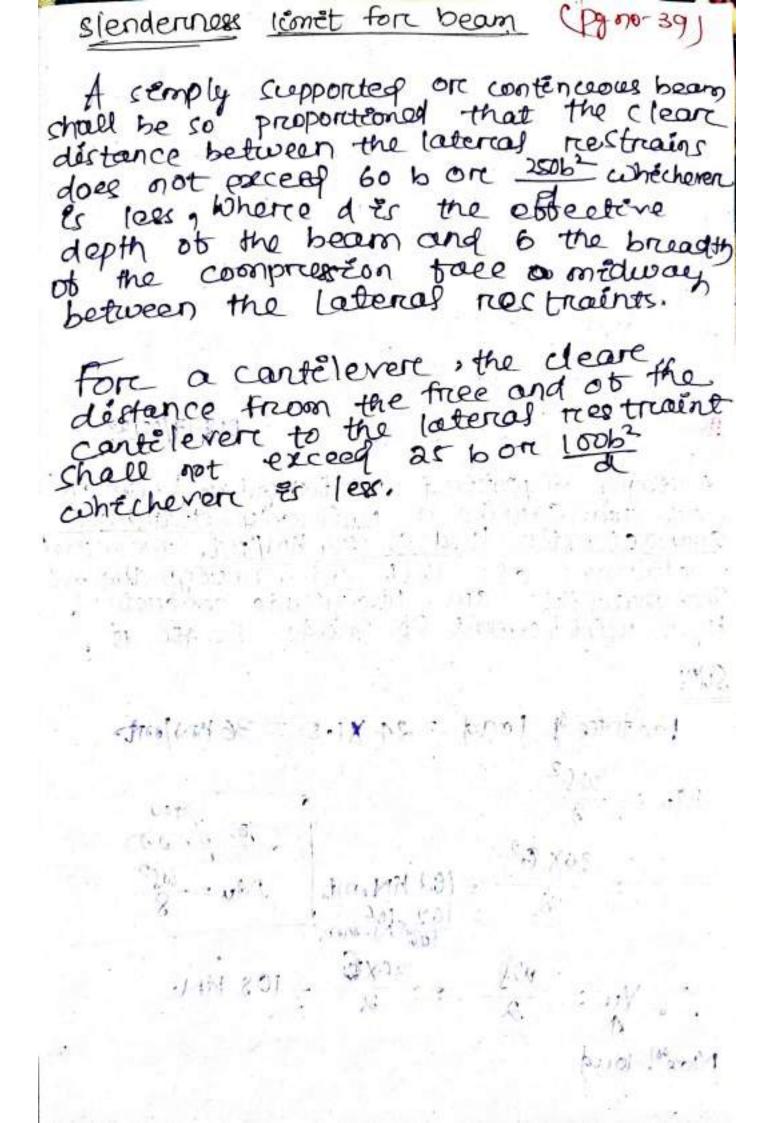
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ATTE FRANCE

1. 21 -

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A semply supported nectiongular beam of 6 mt spon. Carries a uniformly distributed <u>Charcaeterester load of 24 MN/mt. Enclusion</u> Encluding of self wt. Desegn the bas The materials are Mao grade concrute & Hyro reinforcement of grade Fe 450 415. Solo-

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1575 (552) TH

Factorized load = 24 × 1.5 = 36 HN/mt.  $Mu = \frac{w g^2}{8}$   $= \frac{36 \times 8^2}{8} = 162 \text{ KN.mt.}$   $Mu = \frac{w g^2}{8}$   $= \frac{162 \times 10^5 \text{ mm.}}{1000}$   $Mu = \frac{w g^2}{8}$   $= \frac{36 \times 6}{2} = 108 \text{ MN.}$  Modern 1000

Step-1 Depth of the beam.  
Assume, wedth of the beam.  
Assume, wedth of the beam, b= 20000m.  
(depth required)  

$$=\sqrt{\frac{162 \times 10^{6}}{2.75 \times 200}} = 443 \cdot 12 \text{ mm.}$$

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$$=\sqrt{\frac{162 \times 10^{6}}{2.75 \times 200}} = 443 \cdot 12 \text{ mm.}$$

$$=0.36 \times 0.48 \times (1-0.42 \times 0.48) \times 20$$

$$= 2.75.$$
Provede elbective depth  $d = 500 \text{ mm.}$ 

$$= 2.75.$$
Provede elbective depth  $d = 500 \text{ mm.}$ 

$$= 3.75.$$
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$$= 3.75.$$
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$$= 3.75.$$
Provede elbective depth  $d = 500 \text{ mm.}$ 

$$= 3.75.$$

$$= 500 + 30 + \frac{20}{2}$$

$$= 570 + 30 + \frac{20}{2}$$

Step-2 111 11 1 10 Steel area, Mu require 0.87 Fy (d-0.4220, mare) 162 X105 0.87 X415 (500-0.42 X0-48× 500) = 1123.97 mm2 . Provede :400.00 2000m. dia barc giving, Ast = 4X 75 x(20)2 1256.630002. Step-3 check for development length Step-4 cheek for shear. Step-5 cheek For destection: Span ore  $\frac{9}{9} = \frac{6000}{500} = 12$ depth. ore  $\frac{9}{9} = \frac{500}{100} = 12$ Actual upto loont. Compley superited spo Countileven >7 Actual Sport can thoug = 26

Basic gepth = 20 Serevies stress = 0.58 x fyx 0008 0.58 X415 × 1256.63 = 215.2800 N/mm2. pt. = bd 100× 1256.63 1001 - 300 × 500 E 0.84 Modifie dation Factore = 1.5 pormesseble (pan = 20x 1.5 Actual depth = 12 (0K) Cabo Sketch Detailing of a beam. the chall was protocolarly and all 2 .

6mmp@ 190 mn c/c 2-10# -675 2-20# 1-20# Longited inal section

Analysia & dorego OF Stonply Supporded 5 lap

AST Keb

Slab

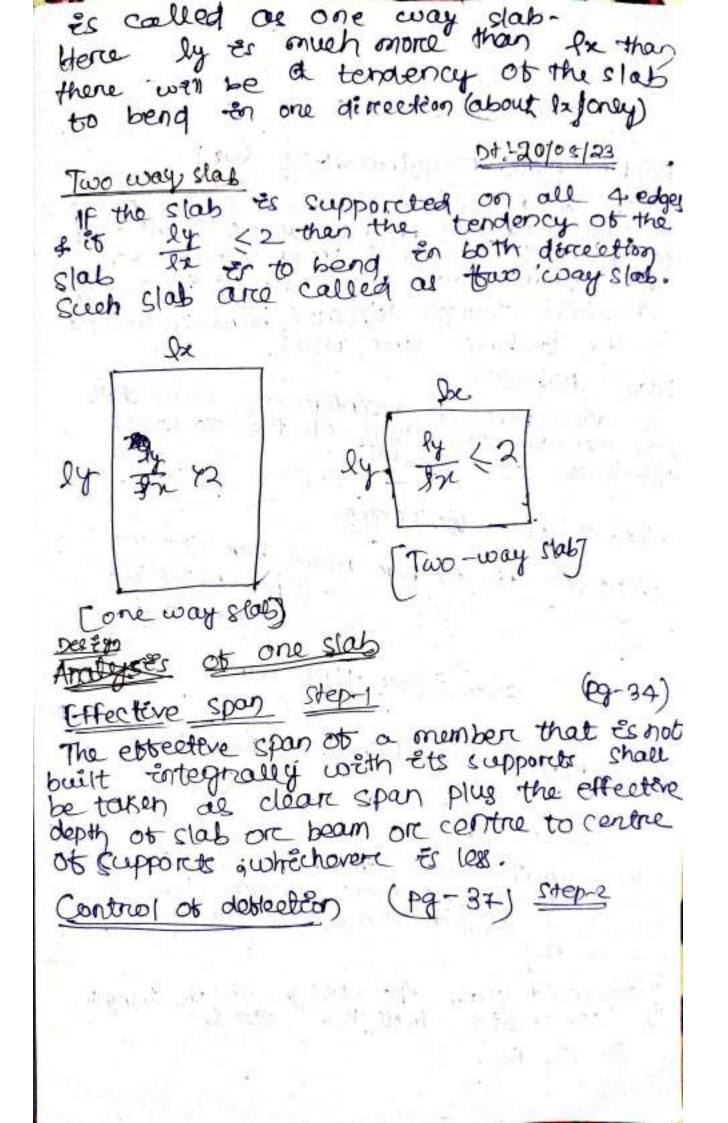
Slabs are plate clonents having the depth of is much smallere than its span & weight. They usually canning a uniformily distributed load at a form the blow out floor on most of the building. They are generally of the building. They are generally of two types

(2) Two way 11

One way slab

edges but supported on all four

8 pr 72



## <u>Step-3</u> Reinforcements requirements (4)

1. 1. S.

the mild steep reinforcement on either dipos total cross-sectional area . However, this value can be reduced to 0.12% when high strongth detormed bars or welded when high strongth detormed bars or welded when diameter

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sense in the proceed the set from

when and in lord -

The deameters of reinforcing bars shall not exceed one-eight of the cototal thickness of the slab.

(1) Maxin dia - 50 50 mon. (3) Min dia - 7 For moin bar -710 mon (3) Min dia -7 For moin bar -710 mon Cfor plain bari Fe 250)

8 mm (For Heyed bar)

For distriction bar, 6mm (for plain)

In normal cases the cheare on slab & not criticial howevere shear shall be checked as per plus 10,40.2 Ot is 456 (Pgno-72)

Fore solid slab the dosign chear strongth to concrete shall be to by Step-5 Creacking

To ensurce, that cracking of the slap is not excessive, spacing of the reinforcement shall be limited to following.

greater than) 3 of ore of 300mmon A (not

Fore déstribution bar spacing find ore \$ 450 mm.

where d= Etsectère depth of slab

57ep-6

Covor méld exposence clear cover éc For méld exposence duce by somm, 20 mm. thes can be reduce by somm, des or where republic comment of 20mm des or where is use.

E DOR

<u>Development</u> length

Of semply supported A semply supported one way slab of cleare spon -3mt. is supported on masonarcy well of thickness 300 mm Slab is used for residencial load. Design the slab. The materials are Mao grade of Hysto reinforcement of grade Fe415. Live load shall be 2 KNI/mt2 . 6 12 (22) ¥ 00. P (19) Sol?'-Assume invercal depth of slab (D) = 130 mm. =0013mt Step-1 was calculation. L: L = 2KM /mt2 · Dead tood = 0.13 Xas 53.25 KM/m2 (Assume) . Floore Ferich = 1.00 km/m2 . Total long = 6.25 KN/m2 . factored load = 6.25 XI.S =9.47 KN/m2 2mt. . Effective span = 30007110 = 3110 mm, ( dprovide)

$$\frac{1}{2}$$

$$3000+30=320 \text{ mm}.$$

$$\frac{1}{310-to 330}$$

$$\frac{1}{3}$$

$$\frac{1}{310-to 330}$$

$$\frac{1}{3}$$

$$\frac{1}{$$

\_\_\_\_

d require = 
$$\sqrt{\frac{11+36\times106}{2.76\times1000}}$$
  
= 64.15 mm.  
Ster 4 Calculateon for steel area.  
Ast =  $\frac{Mu}{10.36\times10^6}$   
 $\frac{1.36\times10^6}{0.87\times445(100-0.42\times0.46\times100)}$   
 $\frac{1.36\times10^6}{0.87\times445(100-0.42\times0.46\times100)}$   
 $\leq 358 \text{ som }^2$ .  
Spaceong =  $\frac{Arcea ob}{Requireed area to more percent.}$   
Provede 80000. dea barc  
 $\frac{11}{9}\times10^{3}\times1000$   
 $\frac{14}{9}\times1000$   
 $\frac{14}{9}\times1000$   
 $\frac{14}{9}\times1000$   
 $\frac{14}{9}\times1000$ 

Postfelbution bare Area = 0.15 % bD  
= 
$$0\frac{0.15}{100}$$
 × 1000 × 130  
= 103mm<sup>2</sup>  
A  
Spacetag of distribution bare =  
Area of one bare × 1000  
Recquired area to mm<sup>2</sup> port mt  
The x (6)<sup>2</sup> × 1000  
1.95  
= 100 × 100  
Neinbare  
det 10 mm.  
(Pt.) =  $\frac{1000 \text{ Aut}}{1000}$  = 0.32  
Tabl-19  
Tabl-19  
Tabl-19  
To 20 × 0.12  
0.42 N/mit 0.25 - 0.36  
0.50 - 7 0.42  
1.95

$$\begin{array}{c} 0.13 \neq \frac{0.12}{0.25} \times 0.13 \\ \vdots 0.0629 \\ (Table - 19, 19, 10, 72) \\ \vdots 0.32 = 0.36 + 0.062 \\ = 0.42 \\ \vdots 0.32 = 0.36 + 0.062 \\ = 0.42 \\ \vdots 0.32 = 0.546 \\ N/mm^2 \\ = 1.30 \times 0.42 = 0.546 \\ N/mm^2 \\ = 1.30 \times 0.42 = 0.546 \\ N/mm^2 \\ = 0.13 \\ N/mm^2 \\ (Sabe) \\ (Table - 19, 19, 10, 73) \\ \vdots K = 1.30 \\ (Table - 19, 19, 10, 73) \\ \vdots K = 1.30 \\ (Table - 19, 19, 10, 73) \\ \vdots K = 1.30 \\ (Table - 19, 19, 10, 73) \\ \vdots K = 1.30 \\ (Table - 19, 19, 10, 73) \\ \vdots K = 1.30 \\ (Table - 19, 19, 10, 73) \\ \vdots K = 1.30 \\ (Table - 19, 19, 10, 73) \\ \vdots K = 1.30 \\ (Table - 19, 19, 10, 73) \\ \vdots K = 1.30 \\ (Table - 19, 19, 10, 73) \\ \vdots K = 20, 39 \\ (Table - 19, 19, 10, 73) \\ \vdots K = 20, 39 \\ (Table - 19, 19, 10, 73) \\ \vdots K = 20, 39 \\ (Table - 19, 19, 10, 73) \\ \vdots K = 20, 39 \\ \vdots K = 20, 33.6 \\ 0.32 - 10.033.6 \\ 0.3$$

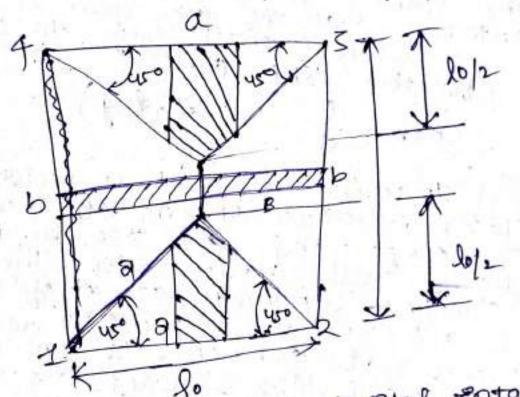
1 10 1.0322 111 A.S. 1921-1. 10 31 10140 24 11. 1100 THE PLESSING SHE Step-6 check fore development length step-7 Deflection Q, 000 Gomm & @140c/c som # @ 190 mon cic Spacetory. K310 K310 3350 0/0 D +3 14" 12 FILLION Stan O At Bas 8 1 "TEMM 1. 2. 5. 1 and an and the states S. 1. 7 . 0. (19. p. ) - 28. p. 1 the transfer with difficulty on a Pupping and a second of the second of the

W : Stated design load to

Two eway slab Y Generally when a two way slab is up compared to one glab the deflections bending of slab are reduced. LyIn this type of glad the bending monoil is distributed in both the diril This results increase in load carry, ing capacity of the section. Dt? 22/05/23 way. Analyses of semply supported two slab in Computation of bending moment when stoppy supported slab do not have advected adequate provesson to resist torseon at corner end and to prevent the mart moment per unit at are given by following eq. Mx = dx WRz My = dy Wily2 Where Mz & My = Moment on strips of whit width spanning 1 x & fy respective value. dr sidy = Coefficient given in table lx \$ gy = lengths of the shorter span & longer span respectively W = Total deségn load perc whit area.

As per 15 456 at least soop of the tension reconforcement provided at mig span should extend to the supports. The remaining so % should extend to 0.1 fx or 0.1 by of the support rate appropriate. [pg no-al]

Computation of shear force shear force are computed followeng the procedure started below with the procedure started below with difference to the tigure given jobs



The two way slab & derided ento the trapizedia zone tringular & the from each color by drawing an angle of 45°. The corner at angular segement a will loads of triangular segement a will be transfer to beams 1 \$2 and the loads of trianien to beam

213 .

The shear torce in both strips arre equal & we can write Vu  $w_{\chi}\left(\frac{\varrho_{\chi}}{2}\right)$ · Zy = Vu Check for deflection be checked as per one way slab show slabs spaning on two direction the shorter. of the two span showed be use fore calculating the span to effective depth reater. spian = f (Jrinkly) Q. A grawing room of a relidentia building measures 4.3 mt X6.55 m. It is supported on 350 mm. thick walls on all four sides. The slay Es simply. Supported at a gedges with a provision to relist tone torsion at corners. Design the slab wing M20 concrete & Hyep reenforcement of greade Fears. Solut Consédere ant-wide strip. . Assume . 180 mm. thech clab with 160mm effective depth. 160 1

$$b_{x} = 4.3 \text{ m}, \pm 0.160 \text{ m}, \pm 4.46 \approx 4.5 \text{ m}, \\ b_{y} = 6.55 \pm 0.160 \text{ m}, \pm 6.741 \approx 6.75 \text{ m}, \\ \hline Step 1 \\ \hline \text{load calculation} \\ \text{dead load} = 0.180 \text{ Ka} \cdot 5 = 4.5 \text{ KN } \text{ m}_{2} \\ \hline \text{floore load} = 1.0 \text{ KN } \text{ m}^{2} \text{ (Assume)} \\ \hline \frac{1000}{1000} = 100 \text{ KN } \text{ m}^{2} \text{ (Assume)} \\ \hline \frac{1000}{1000} = 1.0 \text{ KN } \text{ m}^{2} \text{ (Assume)} \\ \hline \frac{1000}{1000} = 3.0 \text{ KN } \text{ m}^{2} \text{ (Assume)} \\ \hline \text{forel} (0 \text{ ad} = 7.5 \text{ KN } \text{ m}^{2} \text{ m} \text{ foreloned} \\ \hline \text{forel} (0 \text{ ad} = 1.5 \text{ X } \text{ Fs} \\ = 11.25 \text{ KN } \text{ m}^{2} \text{ m} \text{ foreloned} \\ = 11.25 \text{ KN } \text{ m}^{2} \text{ m} \text{ m}^{2} \text{ m}^{2$$

$$\frac{94}{82} = \frac{6.75}{4.5} = 1.57 (Two wayslow)$$

$$\frac{94}{82} = \frac{6.75}{4.5} = 1.57 (Two wayslow)$$

$$M_{N} = 6.04 \times 11.25 \times (4.5)^{2}$$

$$= 0.104 \times 11.25 \times (4.5)^{2}$$

$$= 33.7 \text{KN} \cdot \text{mt}$$

$$M_{N} = 6.94 \text{ Wayz}$$

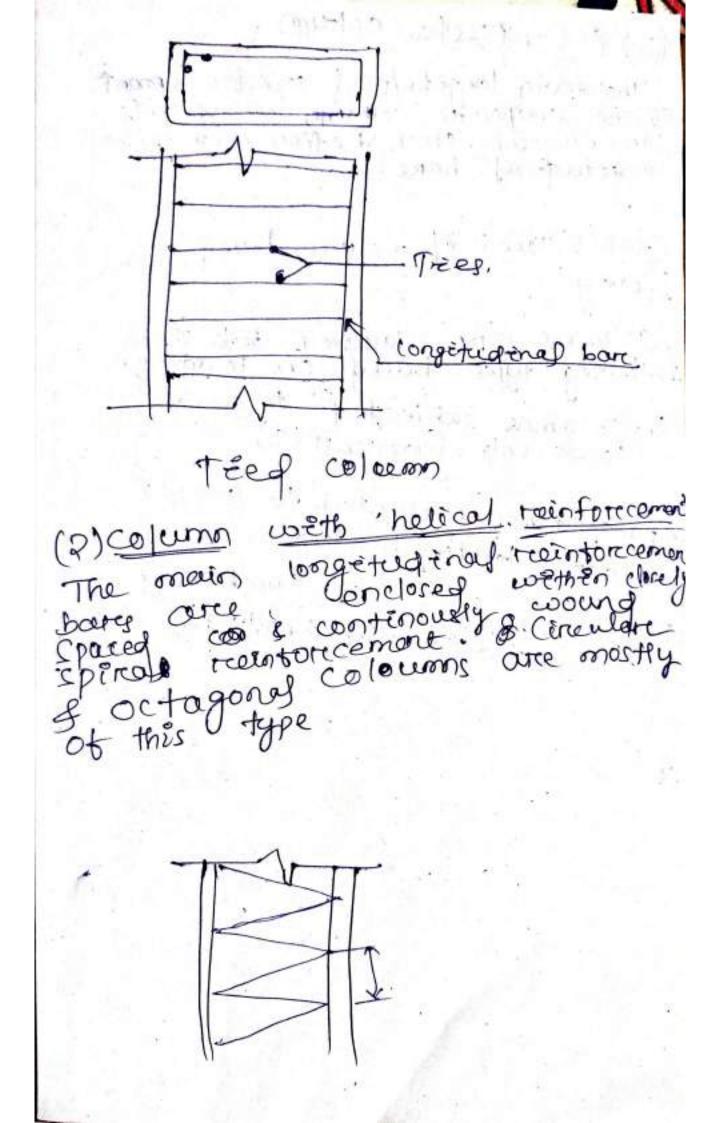
$$= 0.046 \times 11.25 \times (4.5)^{2}$$

$$= 0.046 \times 11.25 \times (4.5)^{2}$$

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7

Olumo Dto£23/08/23 4 A compression member whose effective length exceeds three times its least later dimension is turned as coloumn. 4 Lectus Jeft Perr · 28 P P/2 Z y If the ettective length is lose than the 3 types times its least latercas 3 types times =ts gimeneton és known as pedestad. I The shape of colourn may be square, rectangular, circular depending upo reguirement. Mclassification of coloum based on reinforcement The recentorced concrete column are classified into three group. (1) Tred colourn (3) Column with helical reintarcement (3) Composète column. the main longetudinal reintorcement bare are enclosed within closely spaced lateral tree.



(3) @ Composite column of the composite colourny consist of streetural steel section without classification of column based on loading Columns are classified into three following types basied on locating. CITCO lamos subjected to andas loads only. (concentric) (2) coloumns subjected to arrived & uniareas toading bending. 11, 11. Combine q (3) (1 Axial & BE-ooilas bending. 643213 Ø

Q.A shored RCC colours to to carrier a bictored load of 1900, i it the column is to be a squar then design the column assume Emin < 0.05 D . The materials on Assume Mao grade concrete & mild Steep (Fead) Solui Minon percentage of steel = 0.8% of gross sectional and . Arcea of longitudinal reinforcements the = 0.008 Ag Area of concrete, Ac= Ag - Ase = Ag - 0.008 Ag = (tg (1 - 0.008) Ac = 0.992 Ag GONAGTH colum fier real leftsl Ase = 0.008 Ag T