Foundation footing design pdf

The choice of the Type Fund Choice appropriate type of foundation is governed by some important factors, such as the nature of the load structure rendered by the structure of the bowels characteristics Of the allotted value of the foundations therefore to decide on the type of foundation, subsoil exploration must be carried out. The characteristics of the soil in the affected area under the building should then be carefully assessed. You should then evaluate the permissible power carriers of the affected soil layers. After this study, it would be possible to decide whether to use small foundations or deep foundations. Small foundations, such as supports and rafts, are cheaper and easier to execute. They can be used if the following two conditions are met; The stress caused by the building (Dp) is within the acceptable bearings of different layers of soil, as shown in pic.1. This condition is met when, in Fig.1, less and less than that and less than that and so on. The building could withstand the expected settlement assessed for this type of foundation, if one or both of these two conditions cannot be met, the use of deep foundations should be considered. Deep foundations are used when the top layers of soil are soft and there is a good layer of bearing at a reasonable depth. The soil layers under the bearing layers should be strong enough to withstand the pressures (Dp) from the loads that are transmitted to the bearing layer, as shown in pic.2. Deep foundations are usually piles or piers that transfer the load of the building to a good layer bearing. They usually cost more and require well-trained engineers to perform. If the soil layers studied are soft to a considerable depth and there is no bearing layer at a reasonable depth, floating foundations can be used. For the construction of a floating foundation, the mass of the soil, roughly equal to the weight of the proposed building, must be removed and replaced by a building. In this case, the bearing load under the building will be equal to the weight of the removed land, which is smaller (ka DDD 2C) and Dp will be zero. This means that the bearing power under the building is less than (qa), and the expected settlement is theoretically zero. Finally, the engineer must prepare an estimate of the cost of the most promising type of foundation, which is the most acceptable trade-off between performance and cost. Small foundations Small foundations are foundations made near the surface of the earth or at shallow depths. As mentioned earlier in the previous chapter, shallow foundations are used when exploration proves that all layers of soil affected by the building can withstand the imposed loads (DP) without causing excessive settlements. foundations are either supports or rafts. The Footings Foundation is one of the oldest and most popular types of small foundations. The base is the expansion of the base of the column or wall in order to distribute the load on the supporting soil under pressure corresponding to its properties. Types of props there are different types of supports according to the nature of the structure. The basics can be classified into three main wall classes or strip supports it runs under the wall along the entire length, as shown in Fig.3. It is commonly used in supporting wall-type structures. The isolated base of the column serves as the basis for the column. It is commonly used for reinforced concrete Skelton-type buildings. It can take any shape, such as square, rectangular or circular, as shown in Pic.4. Fig.4 Typical Prop Distribution Combined Column Footing Is a combined base for the outer and inner column of the building, Fig.5. It is also used when the two neighboring columns of the building are close to each other, that their foundations overlap the distribution of stresses under the bases Of the voltage distribution under the foundation is considered linear, although this is not really the case, the error associated with this assumption is small and may be missed. The load of compilation loads affecting conventional types of buildings are: Dead Load (D.L) Live Load (L.L) Wind Load (W.L) Earthquake Load (E.L) Dead Load Full Dead Load, acting on the elements of the structures to be considered in the design. Live Load It is unlikely that the full intensity of the live load will operate simultaneously on all floors of the high-rise building. Consequently, codes of practice allow for a certain reduction in the intensity of live load. According to the Egyptian Code of Practice, the following reduction of live load is allowed: No. Floors Decrease live load % First floor zero % 1st floor zero % 2nd floor 10.0 % 3rd floor 20.0% 4th floor 30.0% 5th floor and 40.0% Should Not Reduce the Burden on Homes and Public Buildings such as Schools, Cinemas and Hospitals. Wind and earthquake loads When buildings are high and narrow wind pressure and earthquake loads should be taken into account. The assumption used in spread footings elasticity analysis suggests that the distribution of stress under bases that are symmetrically loaded is not homogeneous. The actual distribution of the voltage depends on the type of material under the foundation and the rigidity of the base. For reliance on loosely cohesion-less material, soil grains tend to push the lateral edges out of the load, while the center soil is relatively limited. This results in a pressure chart somewhat as indicated in Figure 6. For the common case of rigid fundamentals on cohesive and cohesive materials, Fig.6 points to a probable theoretical distribution of pressure. The high edge pressure can be explained, given that the edge of the shear must take place before a settlement can take place. Since the intensity of pressure under the foundation depends on the rigidity of the base, soil type and soil condition, the problem is usually uncertain. Typically, a linear distribution of pressure under the foundation is used, and this procedure will be observed in this text. In any case, a small difference in the design results with the help of linear pressure distribution Allowable bearing voltages under the supports Safety Ratio in the calculation of allowable carrier capacity under the foundation should not be less than 3, if the loads considered in the design equal to a dead load - a reduced live load. The safety factor should not be less than 2 when the most severe loading condition is taken into account, i.e. a dead load - a full live load, a wind load or a seismic load. The loads of the add-on are usually calculated at ground level. If a clean allowable bearing pressure is given, it should be reduced by the amount of concrete below the ground surface per unit of the base area multiplied by the difference between the specific weight of concrete and soil. Assuming equal to the medium density of soil and concrete Fig.7, then should be reduced structural structures to spread the foundation for distribution basis following the elements to be considered 1-Shear Shear stresses of spruce usually control the depth of the spread of the base. The critical section for the wide haircut beam is shown in Fig.8-a. It is located at a distance d from the column or the wall side. The value of haircut stress In Table 1. Critical section for punching haircuts (two-mountain diagonal sl.) is shown in Figure 8-b. It is d/2 away from the face of the column. This assumption is in accordance with the American Specific Institute (A.CI) Code. Table (1): Allowable voltages in concrete and reinforcement:- Types of voltages symbol Acceptable voltages in kg/cm2 Cube strength fcu 180 200 250 300 Axial comp. fco 45 50 60 70 Simple bend and eccentric forces with great eccentricity FC 70 80 95 105 Shear emphasizes slabs and supports without reinf. Other Members with reinforcement q1 q1 q2 7 5 15 8 6 17 9 19 9 7 21 Punching Shear qcp 7 8 9 10 Reinforcement Mild Steel 240/350 Steel 280/450 Steel 360/520 Steel 400/6 00 fs 1400 1600 2000 2200 1400 1600 2200 2200 1400 1600 2000 2200 1400 1600 2000 2200 Sheamar Punching, usually, control the depth of the base's spread. From the principles of Fig.8-b static, the force on the critical section for the haircut is equal to the force based on the section of the haircut caused by pure pressure of the soil fn. where qp - permissible shock stress haircut - 8 kg/cm2 (for the strength of cube No.160) fn - pure pressure of soil b - Side column d' depth of punchy haircut It can be assumed that the critical section for stamping haircut is on the face of the column, in which case the permissible shock stress of the haircut can be taken as much as 10.0 kg/cm2 (for the strength of the cube 160). The base is usually designed to ensure that the depth is large enough to withstand a piece of concrete from the web reinforcements.

2- Bond Bond stress is calculated as where the force of the haircuts is taken in the same critical section for bending the moment, or where changes in a specific cross-section or steel reinforcement occur. For the supports of the permanent section, the section for communication is on the side of the column or wall. Strengthening the bar should have enough length of DD, Fig.9 to avoid retractable (bonds of failure) or splitting concrete. The value of dd is calculated as follows: for the first calculations, take fs equal to acceptable work stress. If the calculated dd is more than the available DD, then recalculate the DD by taking fs equal to actual steel stress. The acceptable values of bond stress OF the BB are the following 3-Bending moment critical sections for bending Defined from Figure 10 as follows: For the concrete wall and column, this section is taken on the face of the wall or column Fig.10-a. To lay the wall, this section is made halfway between the middle and edge of the fig.10-b wall. For the steel column, this area is located halfway between the edge of the base plate and the face of the Fig column(10-c). The depth required to resist the moment of bending the 4- Bearing on the top of the base of the base When the reinforced concrete column transfers its load to the base, the steel column, which carries part of the load, cannot be stopped at the top of the base, as it can overwork the concrete in the contact area of the column. Therefore, it is necessary to transfer part of the load, overflowing the steel columns at the expense of bonds, in support, or expanding the steel columns, or dowels. From fig.11: where fs actual steel force 5-plain concrete footing under R.C. Footing It is common practice to place a simple concrete layer under a reinforced concrete base. This layer is between 20 cm and 40 cm. Projection C of a simple concrete layer depends on its thickness t. Referring to Figure 12, the maximum moment of bending per unit length in the section a-a is given Where fn - pure pressure of the soil. Maximum stress at the bottom of section AA: DESIGN R.C. WALL FOOTING: The wall support strip of reinforced concrete is wider than the wall. Figure 13 shows different types of wall supports. The type shown in Fig.13-a is used to carry light loads and fit on a homogeneous soil with good payload capacity. The type shown in Fig.13-b is used when the soil under the foundation is not homogeneous and has different supporting capabilities. The type shown in Figs.13-c and 13-d is used for heavy loads. Design Procedure: Consider the length of the 1.0 meter wall. 1. Find a P at ground level. 2. Find, if given, it decreases or calculate PT . 3. Calculate the base area If the link stress is not safe, we either increase using steel rods with a smaller diameter, or increase the ∑ O depth d. Bending the steel rebar at the edges of the base helps in resisting the voltages of the connection. The diameter of the main steel rebar should not be less than 12 mm. To prevent cracking due to uneven settlement under the wall itself, additional reinforcement is used, as shown in pic.13-c and d. It is taken as 1.0% of concrete section under the wall and distributed equally from top to bottom. 19. Check the link attachment Design of the single Column Footing One pillar support, usually square in plan, rectangular bases are used if there is a restriction in one direction or if the supported columns have too elongated .rectangular cross section. In the simplest form they consist of one slab FIg.15-a. Fig.15-b shows the pedestal of the column, the pedestal provides depth for a more favorable load transfer and in many cases is required in order to provide the necessary length for dowels. Sloping supports such as those in Fig.15-c Design Procedure for Square Column Footing American Codes of Practice equals the moment about the critical section of u-y pure stress acting on hatched .area abcd rice. 16-a- In accordance with the Continental Codes of PracticeMmax. Equal to none of them; The moment of clean voltages, acting on the hatched area of abgh, is shown in Figure 16-b, about the critical section y-y or 0.85 moment of pure voltage, operating in the area abcd in Ris.16-a y-y. 8. Determine the depth needed to resist punching dp. 9. Calculate dm, depth to resist b q B, side of the base in accordance with the American codes of practice b (bc y 20) cm, where B.C. is the side of the column in accordance with the Continental Codes of Practice. It should be noted that the dm, calculated by the continental method, is larger than the computer on the American code. Greater depth will reduce the amount of steel rebar and usually satisfies the depth required for punching. The American code gives less DM with a higher cost of steel rebar, but with the help of high-stressed, steel, the area of steel fittings can be reduced. In this text, the bending moment will be calculated in accordance with the American Code, while b will be accepted either as equal to bc No. 20, when conventional steel is used, or is B when using high strenuous steel. The depth of the base d can be taken any value between the two values calculated by the two methods above. It should be noted that at the same time of bending, greater depth will require a smaller area of steel fittings that cannot meet the minimum percentage of steel . Also, a small depth will require a large area of steel, especially when using conventional soft steel. 10. Choose most of dm or dp 11. Check the DD, the depth of the dowel column. The procedure for designing a rectangular support procedure is the same as a square base. Depth is usually controlled Haircut, except If the ratio of length to width is large, a wide bun of haircut can control the depth. Critical sections for haircuts are at a distance d on both sides of the Fig.17-a column. The bend point is calculated for both directions, about 1-1 axis and near the b-b axis, as shown in Fig.17.b and c. Long-way strengthening (Side L) is calculated from the moment of bending and evenly distributed along the width of B. Strengthening in a short direction (Side B) is calculated from the moment of M11 bend. When placing the bars in a short direction, it should be taken into account that the support provided to the support by the column is concentrated near the middle, hence the area of support adjacent to the column is more effective in resisting the bend. For this reason, steel is adjusted in a short direction. This adjustment will place the steel percentage in a zone centered on a column with a width equal to the length of the short base. The rest of the reinforcement is distributed evenly in the two final zones, Figure 18. According to the American Institute of Concrete, the percentage of steel in the central zone is given: where the S and the ratio of the long side to the short side, L/B . Single SEMELLES supports must be bound by beams known as semelles, as shown in Pic.19.a. Their function is to move the walls of the first floor and transfer their loads to the supports. Semelles can prevent a relative settlement if they have a very tight section and are heavily reinforced. Semelle is designed as a continuous reinforced rectangular beam bearing the weight of the wall. The width of the semel is equal to the width of the wall plus 5 cm and should not be less than 25 cm. It must withstand the forces of the haircut and the curves of the moments to which it is exposed, semelles must be strengthened from above and below to counteract differential settlements. Equal Reinforcement As. The upper level of the semelle should be 20 cm below the level of the platform surrounding the building. If the ground floor level is higher than that of the platform, the level of the inner semmelle can be taken 20 cm below the level of the first floor Footings is exposed to Moment Introduction Many basics resist, in addition to the concentric vertical load, a moment near one or both axis of the base. The moment may arise as a result of the load applied from the center of the base. Examples of foundations that must resist the moment are those for retaining walls, primacy, bridge piers, and columns of foundations of high-rise buildings where pressure causes noticeable moments of bending at the base of the columns. It is assumed that the pressure of the soil, formed under an eccentricly loaded support, coincides with the axis of the P load, but not with the base centroid, which leads to a linear non-homogeneous distribution of pressure. Maximum pressure should not exceed the maximum allowable pressure on the soil. It is possible to tilt the base due to the higher intensity of soil pressure on the leg. This can be reduced by a large safety factor in calculating the allowable soil pressure. Chapter 1, section of the Basics with eccentric or sloping loads provide for a reduction in allowable soil pressure for eccentricly loaded supports. Basics with moments or eccentricity about one axis, where P - vertical load or associated force e - the eccentricity of vertical load or, as a result, the force q - the intensity of soil pressure (I) and should not be more than the allowable pressure of the soil qa c-The Load P is beyond average when the load of P is outside the middle third, that is e zgt; L/6, Eq.7 indicates that the voltage will occur under the feet. However, no tension can develop between soil and support, so stress is ignored, and the area of support, which is in tension, is not considered effective in carrying the cargo. Therefore the pressure figure on the soil should always be in grip as shown in Fig.21-.c. For the eccentricity of e zgt; L/6 only in relation to one axis, you can control equations for maximum soil pressure q1 by finding a pressure compression chart, the result of which should be equal on the same P load line. This diagram will take the form of a triangle whose side is q1 and base - Basics with moments or eccentricity about both axis for ground with moments or eccentricity about both axis OfLy 22, the pressure can be calculated by the following equation a- Neutral axis outside the base : If the neutral axis is out of base, then all pressure q is in compression and equation (9) is valid. The location of maximum and minimum pressure on the soil can be determined by observing the directions of the moments. The maximum q1 pressure is at (1) Fig.22-a and the minimum q2 pressure is at point (3). The pressure of q1 and q2 is determined by Eq. (9). b- Neutral axis cuts the base If the neutral axis cuts the base, a particular base area is subject to the strain of pic.22. Since the soil is unlikely to capture the support to keep it in place, so the chart shown in Fig.22-b and Eq. (9), cannot be used. Calculation pressure on the soil should be based on the area actually pressed in compression. The compression of the chart can be found in such a way that its result should be equal and on the same P power line. (9). 2- Determine the position of the neutral N-A axis (zero pressure line). This is not a straight line, but for the problem is assumed. Therefore, you need to find only two points, one on each side of the support. 3- Choose another neutral axis (N'-A') in parallel (N-A), but slightly closer to the location as a result of the P load operating on the basis. 4- Calculate the moment of inertia of the area in compression in relation to N'-A' . The simplest procedure is to draw the basis for scaling and divide the area into rectangles and triangles 4.4 STRUCTURAL DESIGN OF FOOTINGS SUBJECT TO MOMENT The main problem in designing eccentricly loaded supports is to determine the distribution of pressure under the foundation. Once they have been determined, the design procedure will be similar to concentrically loaded supports, critical sections selected and voltage calculations due to the moment and haircuts are done. Where the moments of bending on the column come from any direction, for example, from wind loads, square support-; preferably if space constraints do not dictate the choice of a rectangular base. If the bending points always work in the same direction as in the columns supporting rigid frame structures, the support can be extended in the direction of eccentricity The size of the base B and L is proportional in such a way that the maximum pressure on the foot does not exceed the allowable pressure of the soil. If the column carries a permanent bend, such as a bracket carrying a steady load, it may be an advantage to place the column from the center on the support, so that the eccentricity of the received load is zero In this case, the distribution of pressure on the base will be homogeneous. The long section of the foot base should be designed as a cantilever about the section across the face of the column, the calculation of depth to resist the punching haircut and a wide bun of haircuts just as in the supports supporting concentric loads Since the moment of bending at the base of the column is likely to be large for this type of support, the strengthening of the column should be properly tied to the support., Details of reinforcements for this type of props are shown in Fig.24 Square support is usually most convenient to keep the bar diameter and intervals the same in both directions in order to avoid confusion in steel fixing. The Combined Basics Introduction Previous section presented elements of the design spread and wall foundations. This section addresses some of the most complex problems of the small foundation. Among them are supports supporting more than one column in the line (combined supports), which can be rectangular or trapezoidal in shape, or two pads connected by a beam, as for a support belt. Eccentricly loaded supports and non-symmetrical supports will also be considered. Rectangular combined supports When property lines, equipment layout, column intervals or other considerations limit the base gap in the column locations, a possible solution is to use a rectangular base shape. This type of support can support two columns, as shown in Figure 25 and 26, or more than two columns with a slight change in the design procedure. These supports are usually designed by making a linear distribution of voltage at the bottom of the base, and if the result of soil pressure coincides with the result of loads (and the center of gravity of the base), soil pressure is assumed to be evenly distributed, linear distribution of pressure implies a rigid basis on homogeneous soil. The actual basis is generally not rigid, nor is the pressure even under it, but it has been found that the solutions that use this concept are adequate. This concept also leads to a fairly conservative design. The design of a rigid rectangular support is to determine the location of the center of gravity (cg) loads of the column and to use the size of the length and width so that the centroid base and the center of gravity loads of the column coincide. With the established base sizes, you can prepare a haircut diagram and the moment, the depth chosen for the haircut (again, usually makes the depth adequate for the haircut without the use of reinforcement to meet the rigidity requirements implicitly), and the strengthening of steel selected for the requirements of bending. Critical sections for haircuts, both diagonal and wide-beam, should be taken as indicated in the previous section. The most positive and negative aspects are used to design reinforced steel and will result in steel at the bottom and top of the beam. In a short direction, obviously the entire length will not be effective in resisting the bend. The area closest to the column will be most effective for bending, and this approach is recommended. This is basically what the ACI code defines in Article 15.4.4 for rectangular supports If accepted that zone that includes columns is the most effective, what will this width zone be? Of course it has to be more than the width of the column. It should probably be no larger than the width of the column plus d to 1.5d, depending on the location of the column based on the author's analysis, the lack of a Code Guide, and the recognition that additional steel will freeze in the zone and increase the moments in that zone and reduce the moment out of the zone. Effective width using this method is illustrated in Figure 27 For the remainder of the base in a short direction, the ACI Code requirement for steel with a minimum percentage (v. 10.5 or 7.13) should be used. When choosing sizes for a combined base, length measurement is somewhat important if it is desirable that diagrams with shear and moment are mathematically close as a bug test. This means that if the length is not exactly a calculated value from the location of the cg columns, the eccentricity will be put into the base, resulting in a nonlineaine earth pressure chart. The actual length built, however, should be rounded to a practical length of, say, the nearest 0.25 or 0.5 feet (7.5 to 15 cm). Column loads can be taken as concentrated loads for computation with shear and charting of the moment. To design, use a haircut and a .values moment on the edge of the (face) column. The resulting error using this approach is negligible.Fig.(28) If the base is loaded with more than two columns, the problem is still statically defined; known reactions (column loads) as well as distributed load, i.e. soil pressure. The design procedure for a rectangular combined support: - Referring to Figure 29, the steps of the design can be summarized as follows: 1- Find the application line as a result of R. This is a L/2 fix, as y is known and limited. It should be noted that if the L length is not a precisely calculated value, the eccentricity will be introduced into the base, leading to a non-linear soil pressure chart. The actual length built, however, should be rounded to a practical length of, say, the nearest 5 cm or 10 cm maximum point at point K, where the strength of the haircut No. 6- Determine the depth for the haircut. It is customable to make the depth adequate for a haircut without the use of haircut reinforcement. The critical section for haircuts is at a distance d from the face of the column having the maximum tie, Fig.30 7- Determine the depth for stamping the haircut for both columns. According to the ACI critical section it on d/2 from the side of the column. Figure.30. 9-d selected the largest of t q d q q 5 to 8 cm. 11- Check the voltage of the bond and the length of the fastening d. 12- Short direction : Loads of columns distributed cross beams (hidden), one under each column. The length of the beams is equal to the width of the base B. The effective width of the cross beam can be taken the least of the following: the width of the column 2 g or the width of the column a d - the projection of the base beyond the column y, fig.31. b- The base width of the base should be noted that the ACI code considers that the effective cross beam width equal to the width of the column a d or the width of the d/2 column, and the cross-sectional point of the MT1 bend in the column (1) is equal to the cross amplification, which should be distributed over the effective width of the cross beam. A minimum percentage of steel should be used for the remainder of the foundation. The link emphasizes and anchor the length of the DD, to be tested. Combined trapezoidal support: A combined trapezoidal support for the two columns used in the column carries a large load near the property line, where the projection is limited or when there is a limit to the overall length of the base. Referring to Figure 32, the position of the column results downloads R finds the position of the trapezoid centroid. The length of L is determined and the A area is calculated from: The design procedure is the same as the rectangular combined base, except that the chart with the shear will curve the second degree and the moment of bend is the third degree curve. The design of the strap or Cantilever Footings A strap can be used where the distance between the columns is so great that the combined or trapezoidal support becomes quite narrow, resulting in high bending points, or where, as in the previous section. The sturdy support of the strap consists of two pillars of the column, connected by a member, which is called a strap, beam or cantilever, which transmits the moment from the outer support. Figure 33 illustrates the basis of the belt. Since the strap is designed for a moment, either it must be formed from contact with the soil or the soil should be loosened by a few inches under the strap, so that the strap has no soil pressure acting on it. For the simplicity of the analysis, if the belt. Not very long, the weight of the belt can be neglected. When designing a support belt, first of all you need the proportion of the base. This is done by making a uniform pressure of the soil under the foundation; that is, R1 and R2 (Figure 33) act on centroid supports. The strap must be a massive member for this solution to be valid. The development of Eq.1 implies a rigid rotation of the body; so if the strap fails to convey the eccentric moment from Column 1 without spinning, the solution is not To avoid the rotation of the external support is recommended to be . Istrap/Ifooting zgt; 2 Preferably proportions of both supports so that B and q are as equal as possible to control differential calculations. The Strap Footing reaction design procedure under the inner support will be reduced to the same value, referring to Figure 33 1- The design begins with a trial cost e 6- Check that the centroids of the areas of the two supports match the result of the column load. 7- Calculate the moments and haircuts in different parts of the strap-based. The strap strap is a single-panel beam loaded up by loads, transmitted to it by two supports and supported by a downward reaction on the central lines of the two columns. Thus, the upward load along the length of L is R1/L t/m'. The location of the maximum moment is obtained by equating the force of the haircut to zero. The moment decreases towards the inner column and is zero in the central line of this column. Thus, half of the reinforcement strap is terminated where no longer required, and the other half continues through the inner column. Check the stresses of haircuts and use stirrups, and curved bars if necessary. 9- The design of the external support External support acts just as the base wall is equal to L. Despite the fact that the column is located on the edge of balancing the action of the belt, such as to convey the R1 reaction evenly along the length of the L1, which leads to the desired uniform pressure of the soil. The design is designed in the same way as for the wall support. 10- The design of the inner support support can be designed as a simple single-column-based. The main difference is that the punchy haircut should be checked around the perimeter of fghj, fig.33. FOUNDATION RAFTS Introduction raft foundation is a continuous foundation that covers the entire area under the structure and supports all walls and columns. The term mate is also used to base this type. It is usually used on the basis of low bearing capacity and where the area covered with a distributed support is more than half the area covered by the structure. The raft foundation is also used where the mass of the soil contains compressed lenses or the soil is unstable enough that differential settlement will be difficult to control. The raft tends to bridge over unstable deposits and reduces differential settlement. Bearing the capacity of the rafts on the sand Beating the capacity of the foundations on the sand increases as the width increases. Due to the large width of the raft compared to the width of a conventional support, the allowable bearing under the raft will be much larger than at the base. In practice, it has been observed that the use of acceptable bearings under the raft is twice the allowable bearing determined for a normal basis. rest on the same sand will give a reasonable and acceptable amount of settlement. If the water table is at a depth equal to or more B, the width of the raft, the allowable bearing determined for the dry state, should not be reduced. If there is a possibility that the water table rises until it floods the site, the allowable bearing capacity should be reduced by 50%. If the water table is at an intermediate depth between the B and the base of the raft, a corresponding reduction between zero and 50% is necessary. Bearing the capacity of the rafts on the clay. In clays, the bearing capacity is not affected with the width of the foundation therefore, the bearing capacity under the raft will be the same as under the conventional basis. If the calculated differential settlement under the raft is more than tolerable, or if the weight of the building divided by area gives a bearing load greater than the allowable bearing, you should consider creating a floating or partially floating foundation. To perform a floating foundation, excavations must be carried out to the depths of D reached, where the weight of the excavated soil equals the weight of the structure, figure 2. In this case, the excess of the applied voltage at the foundation level is zero and, therefore, the building will not suffer from resettlement. If the full weight of the building and the weight of the soil are removed Ws and excess load at the level of the foundation of the ze In the case of a floating foundation; The issue of Ws and therefore ze zero In the case of a partially floating foundation, the se has a certain value, which when divided by the area of the foundation gives a permissible bearing capacity of the soil; Design of Raft Funds; Rafts can be designed as rigid structures (so-called conventional analysis), according to which the pressure of the soil acting against the raft slab is assumed to be evenly distributed and equal to the total weight of the building divided into the area of the raft. This is correct if the columns are more or less equally loaded and equally separated, but in practice it is difficult to meet this requirement, so it is allowed that the loads and intervals of the column will vary within 20%. However, if the downward loads in some areas are much heavier than others, it is advisable to divide the raft into different areas and design each area at the corresponding average pressure. The continuity of the slab between such areas is usually ensured, although for areas with large differences in pressure it is advisable to build a vertical construction joint across the stove and add-on to provide a differential settlement. In a flexible raft foundation, the design cannot be based only on strength requirements, but it must be subjected due to a projected settlement. Thickness and number of reinforcements must be selected in such a way as to prevent the development of cracks in the stove. Since the differential settlement is not considered in the design, it is customary to strengthen the raft twice its theoretical amount of rebar. The amount of steel can be taken as much as 1% of the cross sectional area separated from above and below. The thickness of the slab should not be more than 0.01 curvature radius. The thickness can be increased near the columns to prevent the haircut from crashing. There are two types of raft base: a 1-flat raft cooker that is an inverted flat slab of Fig.34-a. If the thickness of the slab is not enough to withstand punching the haircut under the columns, the pedestals can be .used above the plate Fig.34-.b or, below .slab, by thickening the flat slab under the columns, as shown in Figure 34-c. 2- Plate and beam raft, which, is. The inverted floor of the R.C., consisting of slabs and beams stretching along the column, rows in both directions, Fig.34-d, it is also called a ribbed mat. If a continuous floor is desirable in the basement, the ribs (beams) can be placed under the stove, figure 34-e. The design of the flat raft slab, which has a homogeneous thickness, is divided into column strips and middle stripes, as shown in Figure.35-a. The width of the column strip is b q 2d, where side b and column. The depth of the D raft can take approximately equal to 1/10 clear span between columns. In addition, the width of the column strip can be taken at 3 b. Column strips are designed as continuous beams loaded with triangular loads, as shown in pic.35-b. The net intensity of the fn's uniform upward pressure in any area, such as the DEFG area, can be assumed to be one-quarter of the total load on the columns on D,E, F and G divided by DEFG area. The total loads that apply to the BDEES column strip, Figure 35, are considered triangular loading charts shown in figure.35-b. The total load on the DE part, PDE, is assumed to be pure pressure in the DHEJ area. The design of the hard raft (usual method) is the raft measurement established and the resultant of all loads is found and the soil pressure is calculated at various positions under the base from Eq. The raft is divided into a series of continuous bands (rays) focused on the pillar rows, as shown in pic.37. Haircut and moment diagrams can be set using either a combined base analysis or a moment factor beam Odds of Moment. The PI2/10 beam moment factor for long directions and PI2/8 for short directions can be accepted. Negative and positive aspects will be accepted as equals. Depth is chosen to meet the requirements of the haircut without the use of stirrups and strenuous reinforcement selected. The depth is usually constant, but the requirements for steel can vary from lane to lane. Perpendicular direction is analyzed in a similar way Plate design Girder Raft (Ribbed Mat) If the loads and intervals of the column are equal or vary within 20%, the pure upward pressure of the fn, acting against the raft, is considered homogeneous and equal to q/A., where the weight of the building is at ground level, and the area of the raft (along the outer part of the outer columns). If this pressure exceeds the net allowable pressure of the soil, the area of the raft should be increased to an area large enough to reduce the even pressure to net allowable values. This can be achieved by projecting the slab over the outside side of the outer columns. Referring to rice. 38 , various elements of the raft can be designed as follows: Plate design: 1-Design transverse beams B1 and B2 evenly distributed load/m' on Let R1 and R2 will be the central reaction of the B1 and B2 beams on the central main beam B3 respectively. The B1 end beams carry only a fraction of the load carried by the B2 beam and therefore the central reaction of R1 is considered to be equal to KR2, where K is a factor based on the comparative area, it is also assumed that the amount of central reactions from the B1 and B2 rays is equal to the total load from the central columns, thus 2R1-8R2 No2P1 and 2 P2 (2) Eqs Solution. (1) and (2), R1 and R2 can be determined. The moment of bending and diagrams of the strength of the haircut can be drawn, as shown in figure.39. Reactions R1 and R2 can be determined by equating the amount of vertical forces to zero. The central part of the beams at the moment of positive bend can be designed as a T-ray, as the plate is on the compression side. The beams below the B3 central beam should be designed as a rectangular section. 2- The design of the central main beam B3 Loading, the force of the haircut and the curve moment diagram are shown in Figure 40-a. The section can be designed as a T-ray. 3- The design of the central main beam B4 loading, the force of the haircut and the curve moment diagrams shown in the Fig.40-b section can be designed as a T-ray foundation footing design for steel buildings. foundation footing design calculation. foundation footing design example. foundation footing design pdf. risa foundation footing design. slab foundation footing design. strap footing foundation design example. staad foundation isolated footing design