

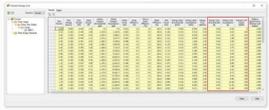
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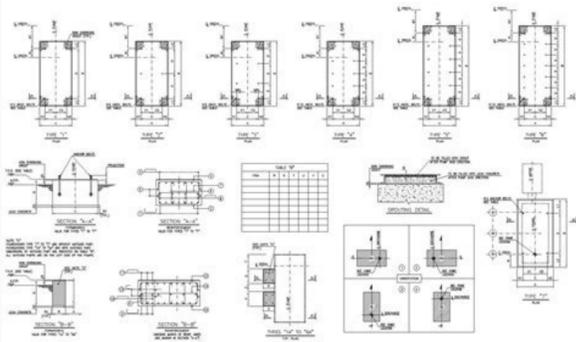
Pump foundation design spreadsheet

Pump foundation design example. Vertical pump foundation design example.

1 GENERAL DESIGN REQUIREMENTS 2 FOUNDATIONS AND STRUCTURES FOR VIBRATING MACHINERY 2.1 Scope 2.2 Definitions 2.3 Design criteria for all heavy machinery 2.4 Design criteria for reciprocating machinery 2.5 Design criteria for rotary machinery 2.6 Design criteria for light vibrating machinery 3 LOADING OF MACHINE FOUNDATIONS 3.1 Static loads 3.2 Rotating machine loads 3.3 Reciprocating machine loads 3.4 Impulsive machine loads 3.5 Loading conditions Calculation ReferenceDesign for Machine Vibration FOUNDATIONS AND STRUCTURES FOR VIBRATING MACHINERY Rotating machine loads Foundations and structures for vibrating machinery are designed to support heavy machinery that generates vibrations during operation. These vibrations can cause structural damage, negatively impact the performance of the machinery, and transmit vibrations to nearby structures or the surrounding environment. To minimize these issues, special considerations must be taken into account when designing foundations and structures for vibrating machinery. Some key aspects to consider when designing foundations and structures for vibrating machinery include: Isolation: The foundation should be designed to isolate the vibrating machinery from the rest of the structure or adjacent structures. This can be achieved using various techniques, such as using isolators or pads made from materials that absorb vibrations, creating gaps between the machinery foundation and the surrounding structure, or constructing the foundation on a separate, isolated slab. Mass: The mass of the foundation should be sufficiently large to ensure stability and minimize the transmission of vibrations. A general rule of thumb is that the mass of the foundation should be 3 to 5 times the mass of the supported machinery. However, this ratio may vary depending on the specific machinery, soil conditions, and other factors. Stiffness: The foundation should be designed to have a high stiffness to prevent excessive deformation and movement under the dynamic loads generated by the machinery. This can be achieved by using reinforced concrete or other rigid materials and designing the foundation with appropriate dimensions and reinforcement. Damping: Damping is the ability of the foundation to dissipate the energy of vibrations. The foundation should be designed to provide adequate damping, either through the use of materials with inherent damping properties or by incorporating external damping devices, such as dampers or tuned mass dampers. Natural frequency: The natural frequency of the foundation and the supported structure should be considered during design. Ideally, the natural frequency of the foundation should be different from the dominant frequencies of the vibrating machinery to avoid resonance, which can amplify vibrations and cause structural damage. Soil properties: The properties of the soil, such as its bearing capacity, shear strength, and stiffness, must be considered when designing the foundation. The soil should be capable of supporting the combined static and dynamic loads generated by the machinery and the foundation. A geotechnical investigation may be necessary to determine the soil properties and select the appropriate foundation type, such as shallow or deep foundations. Maintenance and monitoring: The foundation should be designed with maintenance and monitoring of the machinery, as well as the foundation itself. Vibration sensors and other monitoring equipment may be installed to assess the performance of the foundation and identify potential issues. Designing foundations and structures for vibrating machinery requires a thorough understanding of the dynamic behavior of the machinery, the foundation, and the supporting soil. Various standards and guidelines, such as the International Building Code (IBC) or the American Concrete Institute (ACI) 351, provide recommendations for designing foundations and structures for vibrating machinery.



Engineers should also consult the manufacturer's recommendations and consider any site-specific conditions when designing the foundation. This document is exclusively the property of IO T D ES IGN & E NG INE ER ING Limited. It is to be used only for the purpose for which it is lent and must not be copied or used in any way detrimental to the interest of this company and subject to return on demand. 3.0 SCOPE 1.1 GENERAL DESCRIPTION The foundation has been checked for bearing pressure, buoyancy & soil pressure. 2.0 BASIC INFORMATION 2.1 MATERIAL USED PCC M20 Thickness 75 mm Concrete Concrete grade shall be M30 with fck (characteristic strength, 28 days). = 30 Unit Weight of Concrete 2.5 Reinforcement Steel. As per IS:1786, Grade Fe 415 with fy = 415 Bar diameters used (mm) : 8, 10, 12, 16 2.2 SOIL PARAMETERS Assumed net SBC @Depth 1.5m for 2m x 2m foundation 3.5 Net bearing pressure (for seismic case) 4.375 Gross Bearing Pressure 9.109 Gross Bearing Pressure for seismic case 9.984 Unit Weight of Soil 1.8 2.3 CODES & STANDARDS PDRP-8310-DI-000-0001 - Civil/ Structural Design Basis IS 456-2000 - Plane and Reinforced Concrete IS 2974-Part 4-1987 - Design Loads for Buildings and Structures IS 1893 (Part-1)-2002 - Criteria For Earthquake Resistant Design Of Structures SP-16 - Design Aids for Reinforced Concrete to IS:456 2.4 INPUT DATA Foundation Data Width of pedestal, w 1.650 m Depth of pedestal, Hp 0.800 m Length of raft, L 2.000 m Breadth of raft, B 2.000 m Depth of Raft, Hr 0.300 m Dia of shaft, D 0.995 m Depth of Shaft, Hs 3.616 m Thickness of shaft wall, t 0.200 m Clear Cover of Footing 50 mm Refer. 26.4.2.2 IS 456-2000, 6.2 SP 34-1987 Clear Cover of Wall 45 mm Refer. Design Basis Clear Cover of Slab 25 mm Refer. Design Basis Elevations Finished Ground Level, FGL EL. 99.850 Top Of Grout, TOG EL. 100.450 Finished Floor Level, FFL EL. 100.300 Equipment Data Weight of Motor, Wm 1800 Kg Weight of Pump+barrel+sole plate, Wp 4700 Kg Total Weight of Pump system 6.50 T Frequency of Pump 1493 Rpm Time period 0.040 sec Bar dia used 16 The scope of the present report is to analyse and design of pump foundation for vertical crude pump 205-P-027A/B/C at Paradip, Orissa N/mm2 gc T/m3 N/mm2 T/m2 T/m2 gs T/m3 This document is exclusively the property of IO T D ES IGN & E NG INE ER ING Limited. It is to be used only for the purpose for which it is lent and must not be copied or used in any way detrimental to the interest of this company and subject to return on demand. 1.650m 0.80 0m EL.100.450 TOG 1.200m EL.100.300 0.150m EL.99.650 FGL 0.200m 2.81 6m 0.995m Dia. 1.395m Dia. EL.96.834 0.300m Cross-Sectional Elevation 2.000m 2.00 0m (sq.



11. 650m PLAN This document is exclusively the property of IO T D ES IGN & E NG INE ER ING Limited. It is to be used only for the purpose for which it is lent and must not be copied or used in any way detrimental to the interest of this company and subject to return on demand. 3.0 DESIGN OF FOUNDATION 3.1 Calculation of Vertical Dead Loads Pedestal Area, Ap 1.94 Volume, Vp 1.56 Weight, Wp 3.89 T Shaft Area, As 0.75 Sectional modulus of shaft, Zs 0.17 Volume, Vs 2.11 Weight, Ws 5.29 T Raft Area, Ar 4.00 Volume, Vr 1.20 Weight, Wr 3.00 T Soil 12.53 T 3.2 Calculation of Seismic Forces CG of motor = 1012.50 mmm CG of pump+barrel+sole plate = 2460.00 mmm CG of Pump System w.r.t to bottom of base plate = -139.00 mm = Z I Sa/2 R g = 0.067 I = 1.75 As per table 6 of IS 1893-2002 Sa/g*Z/2 = 0.12 0 sec. time period considered as per Spec.SP001 Rev. A2, Pg.13 Cl.5.3.1 R = 3.0 (Table 16-O, UBC-1993) Horizontal seismic force = 0.44 T Bending moment at shaft base = 1.52 T-m Factored Bending moment (Mu) = 2.28 T-m 3.3 Check for Base Pressure Static Load on soil 31.20 T Contact area 4.00 Seismic moment 1.65 T-m Max. Pressure on soil 9.037 Min. Pressure on soil 6.565 Bearing Pressure is < gross bearing pressure of 9.9838 T/m2, Safe 3.4 Check for Buoyancy Uplift Total effective downward force 22.23 T Uplift buoyant force on foundation 5.50 T Downward force is < buoyancy uplift force. Safe m2 m3 m2 m3 m2 m3 Weight of soil, Wsoil CG considered at mid height of each component Design Horizontal seismic coefficient Ah m2 T/m2 T/m2 T/78 Manual Entries in calculation of distance of cg from ref point. This document is exclusively the property of IO T D ES IGN & E NG INE ER ING Limited. It is to be used only for the purpose for which it is lent and must not be copied or used in any way detrimental to the interest of this company and subject to return on demand. 3.5 Design of the Circular Shaft Total weight coming on the shaft 15.68 T Factored load (Pu) 23.51 T = 230669.2572 + 22327651.1750840.6442 169806028 Max. Min. 0.439 0.176 Without considering the contribution of reinforcement in the axial compression, = 918.46 T Safe 3.6 Design of the R.C.C. raft Length of cantilever = 1.43 m (Ref. Sketch-1) Bearing pressure per meter width = 9.04 T/m Soil pressure per meter width = 5.07 T/m Effective Uplift force = 3.97 T/m Sagging moment at the face of the shaft = 4.08 T-m Mu = 6.12 T-m Percentage reinf. Pt 0.319 % (Ref: Table 4, Flexure, SP-16) = 957 No. of bars = 5 Provide 16 dia. bar spaced at 200mm c/c 2.000m Critical Length 2.000m 1.3950m Sketch - 1 P/A + M/Z N/mm2 N/mm2 Permissible axial compression, Pc = 0.4*fck*Ac Mu/bd2 Ast required in per meter run mm2 PMC-INSTALLATION, OPERATION AND MAINTENANCE OF CRUDE AND FINISHED PRODUCTS TANKAGES FACILITY AT PARADIP REFINERY PROJECT, PARADIP ON BUILD-OWN-OPERATE-TRANSFER (BOOT) BASIS OWNER : Sheet 5 of 7 . TABLE 4, FLEXURE, SP-16, Rebar :- Dia, Area & Ut. Wt. Pt for Fe415D Area, Ut. Wt. 0.30 0.084 8 50.26548 3945840.35 0.098 10 78.53982 6165380.40 0.113 12 113.0973 8878140.45 0.127 16 201.0619 15783360.50 0.141 18 254.469 19975820.55 0.156 20 314.1593 24661500.60 0.170 22 380.1327 2984042.65 0.185 25 490.8739 38533600.70 0.200 75 0.2140 80 0.2290 85 0.2440 90 0.2590 95 0.2741 00 0.2891 05 0.3041 10 0.3191 15 0.3341 20 0.351 25 0.3651 30 0.381 35 0.3951 40 0.4111 45 0.4271 50 0.4431 55 0.4591 60 0.4751 65 0.4911 70 0.5071 75 0.5231 80 0.5391 85 0.5561 90 0.5721 95 0.5892 00 0.6052 05 0.6222 10 0.6392 15 0.6562 20 0.6732 25 0.692 30 0.7072 35 0.7242 40 0.7422 45 0.7892 50 0.7772 55 0.7942 60 0.8122 65 0.832 70 0.8482 75 0.8662 80 0.8852 85 0.9032 90 0.9222 95 0.943 00 0.9593 05 0.9783 10 0.9973 15 1.0173 20 1.036 Mu/ bd2 PMC-INSTALLATION, OPERATION AND MAINTENANCE OF CRUDE AND FINISHED PRODUCTS TANKAGES FACILITY AT PARADIP REFINERY PROJECT, PARADIP ON BUILD-OWN-OPERATE-TRANSFER (BOOT) BASIS OWNER : Sheet 6 of 7 . 3.25 1.0553 30 1.0753 35 1.0953 40 1.1153 45 1.1353 50 1.1553 55 1.1753 60 1.1953 65 1.2153 70 1.2353 75 1.2553 80 1.2813 85 1.3033 90 1.3253 95 1.3474 00 1.3694 05 1.3914 10 1.4144 15 1.444 20 1.474 25 1.504 30 1.534 35 1.564 40 1.594 45 1.624 50 1.654 55 1.684 60 1.714 65 1.744 70 1.774 75 1.804 80 1.834 85 1.864 90 1.894 95 1.924 00 1.954 05 1.984 10 2.014 15 2.044 20 2.074 25 2.104 30 2.134 35 2.164 40 2.194 45 2.224 50 2.254 55 2.284 60 2.314 65 2.344 70 2.374 75 2.404 80 2.434 85 2.464 90 2.494 95 2.524 00 2.554 05 2.584 10 2.614 15 2.644 20 2.674 25 2.704 30 2.734 35 2.764 40 2.794 45 2.824 50 2.854 55 2.884 60 2.914 65 2.944 70 2.974 75 3.004 80 3.034 85 3.064 90 3.094 95 3.124 00 3.154 05 3.184 10 3.214 15 3.244 20 3.274 25 3.304 30 3.334 35 3.364 40 3.394 45 3.424 50 3.454 55 3.484 60 3.514 65 3.544 70 3.574 75 3.604 80 3.634 85 3.664 90 3.694 95 3.724 00 3.754 05 3.784 10 3.814 15 3.844 20 3.874 25 3.904 30 3.934 35 3.964 40 3.994 45 4.024 50 4.054 55 4.084 60 4.114 65 4.144 70 4.174 75 4.204 80 4.234 85 4.264 90 4.294 95 4.324 00 4.354 05 4.384 10 4.414 15 4.444 20 4.474 25 4.504 30 4.534 35 4.564 40 4.594 45 4.624 50 4.654 55 4.684 60 4.714 65 4.744 70 4.774 75 4.804 80 4.834 85 4.864 90 4.894 95 4.924 00 4.954 05 4.984 10 5.014 15 5.044 20 5.074 25 5.104 30 5.134 35 5.164 40 5.194 45 5.224 50 5.254 55 5.284 60 5.314 65 5.344 70 5.374 75 5.404 80 5.434 85 5.464 90 5.494 95 5.524 00 5.554 05 5.584 10 5.614 15 5.644 20 5.674 25 5.704 30 5.734 35 5.764 40 5.794 45 5.824 50 5.854 55 5.884 60 5.914 65 5.944 70 5.974 75 6.004 80 6.034 85 6.064 90 6.094 95 6.124 00 6.154 05 6.184 10 6.214 15 6.244 20 6.274 25 6.304 30 6.334 35 6.364 40 6.394 45 6.424 50 6.454 55 6.484 60 6.514 65 6.544 70 6.574 75 6.604 80 6.634 85 6.664 90 6.694 95 6.724 00 6.754 05 6.784 10 6.814 15 6.844 20 6.874 25 6.904 30 6.934 35 6.964 40 6.994 45 7.024 50 7.054 55 7.084 60 7.114 65 7.144 70 7.174 75 7.204 80 7.234 85 7.264 90 7.294 95 7.324 00 7.354 05 7.384 10 7.414 15 7.444 20 7.474 25 7.504 30 7.534 35 7.564 40 7.594 45 7.624 50 7.654 55 7.684 60 7.714 65 7.744 70 7.774 75 7.804 80 7.834 85 7.864 90 7.894 95 7.924 00 7.954 05 7.984 10 8.014 15 8.044 20 8.074 25 8.104 30 8.134 35 8.164 40 8.194 45 8.224 50 8.254 55 8.284 60 8.314 65 8.344 70 8.374 75 8.404 80 8.434 85 8.464 90 8.494 95 8.524 00 8.554 05 8.584 10 8.614 15 8.644 20 8.674 25 8.704 30 8.734 35 8.764 40 8.794 45 8.824 50 8.854 55 8.884 60 8.914 65 8.944 70 8.974 75 9.004 80 9.034 85 9.064 90 9.094 95 9.124 00 9.154 05 9.184 10 9.214 15 9.244 20 9.274 25 9.304 30 9.334 35 9.364 40 9.394 45 9.424 50 9.454 55 9.484 60 9.514 65 9.544 70 9.574 75 9.604 80 9.634 85 9.664 90 9.694 95 9.724 00 9.754 05 9.784 10 9.814 15 9.844 20 9.874 25 9.904 30 9.934 35 9.964 40 9.994 45 10.024 50 10.054 55 10.084 60 10.114 65 10.144 70 10.174 75 10.204 80 10.234 85 10.264 90 10.294 95 10.324 00 10.354 05 10.384 10 10.414 15 10.444 20 10.474 25 10.504 30 10.534 35 10.564 40 10.594 45 10.624 50 10.654 55 10.684 60 10.714 65 10.744 70 10.774 75 10.804 80 10.834 85 10.864 90 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