



Introduction

Dimensional Solutions is a Houston-based software company with focus on engineering principles by providing state-of-the-art software solutions for civil engineering design issues. **Dimensional Solutions integrated foundation design solutions offer complete design from initial to final construction.**



Foundation Design Solution features five distinct programs viz. **Foundation3D**, **Mat3D**, **Shaft3D**, **DSAnchor**, and **Combined3D** which can design many different types of foundations, provide Solutions for Power, Transportation, Utility and Building.

Each **Dimensional Solutions** software program can complete a foundation design that considers a variety of input conditions including materials, soil types, asymmetries and more. The design engine takes geometric and environmental inputs and develops construction drawings including sections, plans, with CAD.

Common Specifications for all programs.

- **International Design Codes:** Supports many international concrete design codes.
- **User Defined Parameters:** Provides many customizable design options such as concrete cover, pile arrangement and many others to help meet various types of project specifications
- **Load Cases and Combinations:** Generates commonly used load cases and combinations for equipment foundation design, thus significant design time saving.
- **Soil/Pile Supported Designs:** Completes both soil and pile supported foundation designs in an integrated environment, allowing to consider many “what-if” scenarios for an optimal solution.
- **Analysis/Design Modes:** Supports both analysis and design modes to complete grass-roots or revamp projects, reducing the total cost of ownership.
- **Multiple Foundation Components Design:** Completes design of various components of a foundation such as pedestals and footing, saving the cost of learning multiple software solutions.
- **Rebar Layouts:** Provides rebar layouts in pedestals and footings with customization options.
- **Material Quantities:** Generates material quantities, enables to provide accurate cost estimates every time, at every phase of the project.
- **Detailed Design Sketches:** Generates a detailed design sketch with foundation plan, elevation, and sections, allowing you to summarize the completed design effectively
- **2D Drawings:** Interfaces with popular CAD engines to generate 2D construction drawings,
- **Multiple Reporting Options:** Generates different kinds of customizable reports for internal or client needs.

Foundation 3D



Foundation3D is a spread and combined footing analysis / design tool that completes soil or pile supported horizontal exchanger's foundation with minimal input. This tool is perfect for designing foundations for industrial equipment such as and vessels, vertical vessels or towers, pipe racks, and other super structure supports.

In the plant design world, civil / structural engineers are the first ones required to produce final deliverables such as foundation design drawings. Therefore, automation in foundation design is a must in achieving an important milestone of a very compressed project schedule.

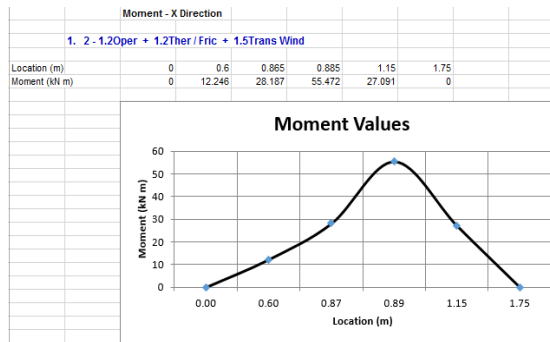
Fig. Exchanger Data and Geometry

Basis of foundation design

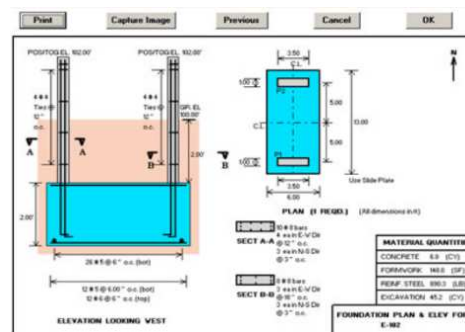
- The program designs a spread and combined (two-pier) foundation.
- Both pier and footing are assumed rigid with respect to load, soil bearing and pile load distribution purposes.
- All loads at the top of pier are assumed to act at the centroid of the pier.
- Reinforced concrete pier and footing design are based on ultimate strength design methods.

Equipment Geometry and Loads

Foundation3D completes the foundation design of a single or a stacked exchanger/vessel with minimum data input. **Foundation3D** can consistently be expected to meet or exceed the project schedule demands. From equipment specific automated load calculations to generating design sketches, **Foundation3D** will increase the productivity significantly at every stage of the project.



Foundation Plan with Reinforcement sketch



Moment diagram for selected load/Load combination

Choosing Analysis or Design

Foundation3D can analyze or design a foundation. Choosing between analysis and design of a foundation is a function of many factors such as pier dimensions, footing dimensions, warning messages at critical checkpoints, and time.

Report Generation

After analyzed or designed a foundation using Foundation3D (or rest other foundation programs), echo of input and results can be generated in Summary, Detailed in Excel format, HTML format.

MAT 3D

Mat3D is a general purpose yet comprehensive, easy-to-learn and easy-to-use graphical interface with less learning curve for design of mat foundations for a precast concrete parking structure, equipment, or a building. It completes both soil and pile supported, multi-load point mat foundations quickly and accurately. It does design of pedestals, soil-supported mats or pile-supported pile caps in minutes.

Mat3D can significantly reduce the time and effort it takes to analyze/design a foundation and takes the complexity out of the process. Following are some of the reasons why it reduces time and effort while offering simplicity:

- For foundations with multiple piers, such as those for building columns and other structures, designing a foundation requires inputting minimal foundation design parameters and loads.
- Whether the mat is soil supported, or pile supported with any unsymmetrical pile pattern, Mat3D designs both the columns and the mat in a few easy steps.
- Can analyze a number of “what-if” scenarios. Mat3D’s messaging system such as failure in wide beam shear or punching shear reduces your guesswork in determining various foundation parameters.
- It generates design sketches such as foundation plan and elevation, and pile location plan. It also, allows you to take longitudinal or transverse sections through the mat along any selected piers.
- Mat3D interfaces with popular CAD engines such as AutoCAD, Microstation and SmartSketch. Therefore, you can produce construction drawings with the touch of a button.

User- Defined Options

Mat3D allows to specify many options required for foundation design such as:

- Material properties for concrete, reinforcing steel, and soil or piles
- Design parameters such as setting minimum and maximum rebar size, allowable increase in soil and pile stresses due to short term loads, and others
- Geometric parameters such as concrete cover over rebar, minimum and maximum pile spacing, pier and footing formwork dimensions, and others.

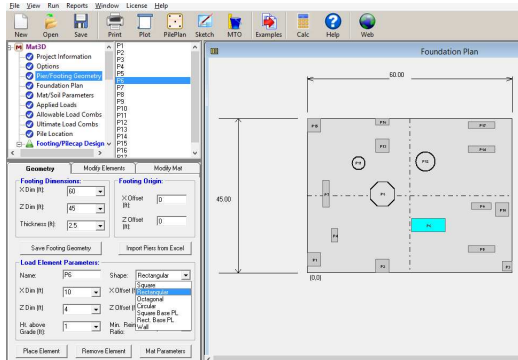
Load Case/Load Combinations

In Mat3D user can enter any load case, for e.g. Dead, Live, Wind, Earthquake, Crane load, Thermal load, Friction load, or any other and any allowable/ultimate strength load combination of the load cases in Mat3D. Additional loads can be add, modify or delete with a simple mouse right click. Load combination factors for allowable strength (used for determining bearing capacity of soil and pile capacities) and ultimate strength (used for reinforced concrete design). Also choice of using in built default factors based on code requirements gives flexibility to design foundations supporting structures in any kind of industry such as residential, commercial, industrial or petrochemical.

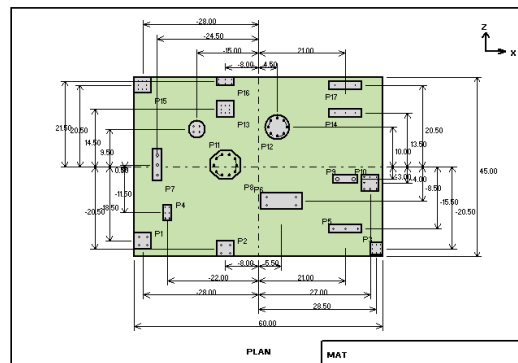
Foundation Plan Sketch

Based on the completed foundation analysis/design, MAT3D generates design sketches, showing the plan, elevation, material quantities and sections through the pier showing reinforcement details. The sketch displays anchor bolt layout on the pier(s), pier and footing dimensions, pier offsets from the centreline of the footing if any,

pier POS (point of support) elevation, pier longitudinal and transverse rebar information, footing rebar information, and material quantities of the foundation



Foundation Plan

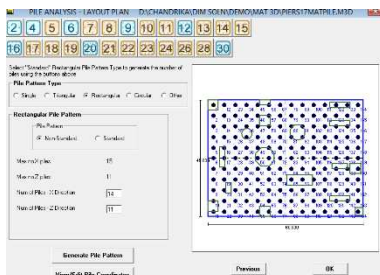


Foundation Plan with Pier spacing

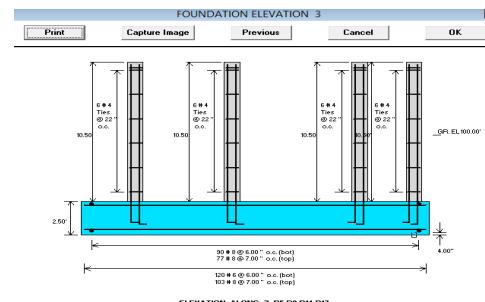
Pile Patterns

Mat3D supports many different pile patterns under square, rectangular and octagonal footings. They are:

- Single pile pattern
- Triangular pile pattern
- Square/rectangular pile pattern
- Circular (Ring) pile pattern
- Other pile pattern



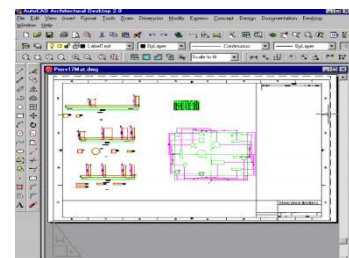
Pile Layout Pattern



Elevation sketch along Z direction along selected piers

Construction Drawing

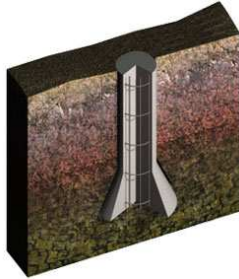
Plot of detailed construction drawing in the CAD software after completion of foundation analysis/design in MAT3D can be created in AutoCAD / MicroStation. Since a construction drawing is the final deliverable after any foundation analysis or design, Mat3D automates this process and completes the entire drawing in a few seconds.



Mat3D is an integrated and complete solution to foundation design thus increases the productivity significantly at every stage of the project.

SHAFT 3D

Shaft3D is pile design solution which is ideal for **drilled shafts or caisson type foundations** for **windmills, transmission lines, utility lines** or any other structure requiring drilled pier foundations, Completing shaft axial capacity analysis, lateral analysis and concrete design, all in one integrated environment.



Shaft3D is well suited for designing caisson foundations for windmills, transmission lines, utility lines or any other structure requiring drilled pier foundations. Shaft3D completes both **rigid and finite element analysis** in single environment in much lesser time.

Geo-Technical Data

In Shaft3D the total depth of the soil profile can be input ie., multiple soil layer data can be specified which can be equal to or greater than the shaft length. Shaft3D will use the appropriate depths of the individual soil layers to determine the lateral resistance. **Shaft3D** provides typical values of the soil properties such as angle of internal friction, soil cohesion, the soil unit weight and modulus of subgrade reaction.

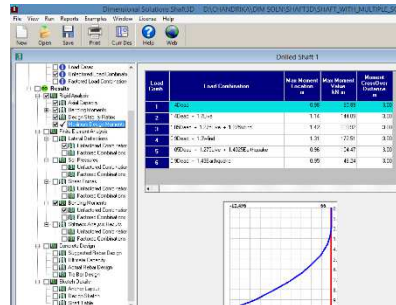


Rigid Analysis

The drilled shaft is treated as a rigid member. The program calculates Axial Capacity, Bending Moments, Design Stability Ratios.

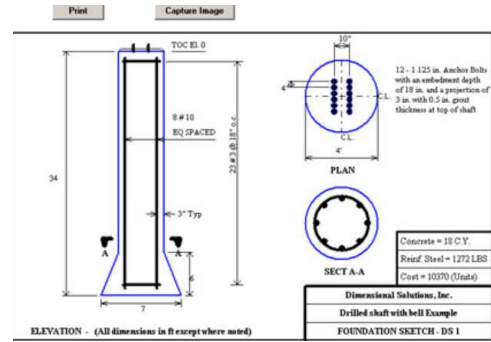
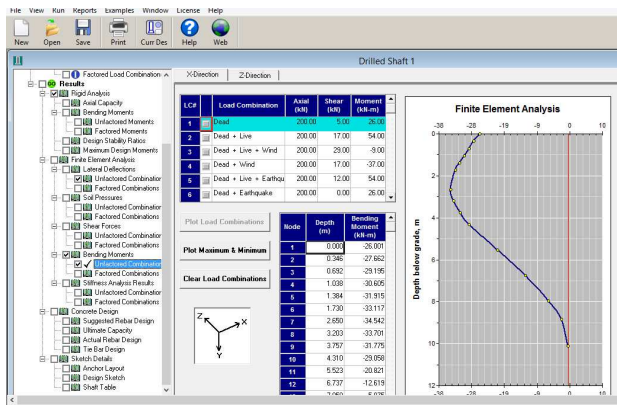
| Load Combination | Axial kN | Shear kN | Moment kNm | Shear kN |
|---------------------------|----------|----------|------------|----------|
| 1 Dead | 20.39 | 5.39 | 25.39 | 15 |
| 2 Dead + Live | 30.39 | 12.39 | 54.39 | 25 |
| 3 Dead + Live + Wind | 30.39 | 29.39 | 9.39 | 25 |
| 4 Dead + Wind | 20.39 | 12.39 | 54.39 | 25 |
| 5 Dead + Live + Longshore | 20.39 | 12.39 | 54.39 | 15 |
| 6 Dead + Live | 30.39 | 5.39 | 25.39 | 25 |

| Soil Strength | 1 | 2 | 3 | 4 | 5 | 6 |
|---|--------|--------|--------|--------|--------|--------|
| Apparent Unit Weight (kN/m ³) | 20.39 | 20.39 | 20.39 | 20.39 | 20.39 | 20.39 |
| Adhesion (kPa) | 152.11 | 152.11 | 152.11 | 152.11 | 152.11 | 152.11 |
| Internal Friction (kPa) | 2.39 | 2.39 | 2.39 | 2.39 | 2.39 | 2.39 |
| Modulus (kPa) | 3.96 | 3.96 | 3.96 | 3.96 | 3.96 | 3.96 |
| Modulus of Subgrade Reaction (kN/m ³) | 148.39 | 148.39 | 148.39 | 148.39 | 148.39 | 148.39 |
| Unit Weight (kN/m ³) | 192.39 | 192.39 | 192.39 | 192.39 | 192.39 | 192.39 |
| Overturning Moment (kNm) | 192.39 | 275.39 | 438.39 | 438.39 | 275.39 | 275.39 |



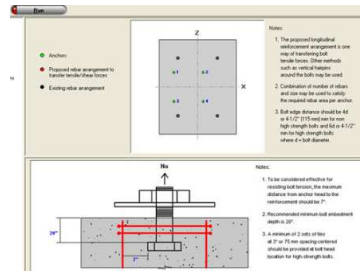
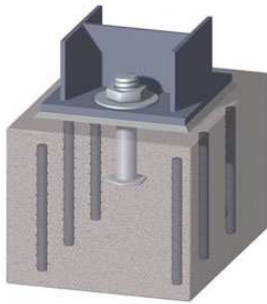
Finite Element Analysis

Shaft3D performs linear finite element analysis using the stiffness method. Deflections and forces are calculated at each nodal location.



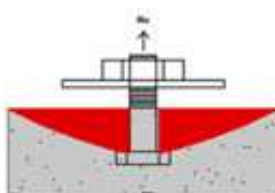
DSAnchor

With **DSAnchor**, designing anchors for concrete foundations is no longer tedious or time-consuming. Our software allows you to quickly and accurately design safe anchorage in a few short steps. The intuitive graphical interface provides an easy way to determine safe anchorage of equipment and structures

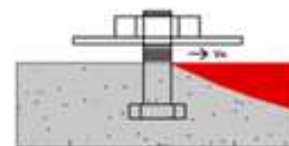


Design and Analysis features:

- Rectangular and circular anchor patterns, symmetrical and asymmetrical anchor layouts.
- Display of individual anchor and anchor group capacity calculations.
- Axial loads and biaxial bending.
- Availability of anchor tables to select anchors.
- Flexibility in choosing the anchors in tension and shear
- Specify various user parameters such as tension and shear edge distances, group areas, interaction ratio, and bolt bearing area.
- Verifies rebar and anchor bolt placement conflict, Graphical display of the governing modes of failure.
- Display of governing tension and shear control parameters.



Governing Failure Mode:
Capacity Breakout
Governing Equation: 2.4 or 2.5



Governing Failure Mode:
Capacity Shear
Governing Equation: 3.23 or 3.27

TECHNICAL SPECIFICATIONS ALL FOUNDATION SOLUTIONS

| | |
|------------------------------|---|
| Units | English, Metric and SI compatible |
| Building Codes | American Code ACI 318 2011, Australian Code AS 3600 2009, British Code BSI 8110 1997, Canadian Code CSA A23.3 04, International Building Code IBC 2006, Euro Code EN 1992-1-1 2004, Indian Code IS 456 2000, Singapore Code CP 65 1999, Wind Code ASCE 2011 |
| Rebar Tables | Customizable English and Metric Rebar tables |
| 2D CAD Interface | Autodesk AutoCAD, Bentley Microstation, Intergraph SmartSketch |
| 3D Modeling Interface | Autodesk AutoCAD, Aveva PDMS, Intergraph PDS |
| Other Interfaces | Intergraph PV Elite, Intergraph GT Strudl |
| | |

Interface with other Applications

Dimensional Solution Foundation application having common interface sharing with most common applications as shown below

