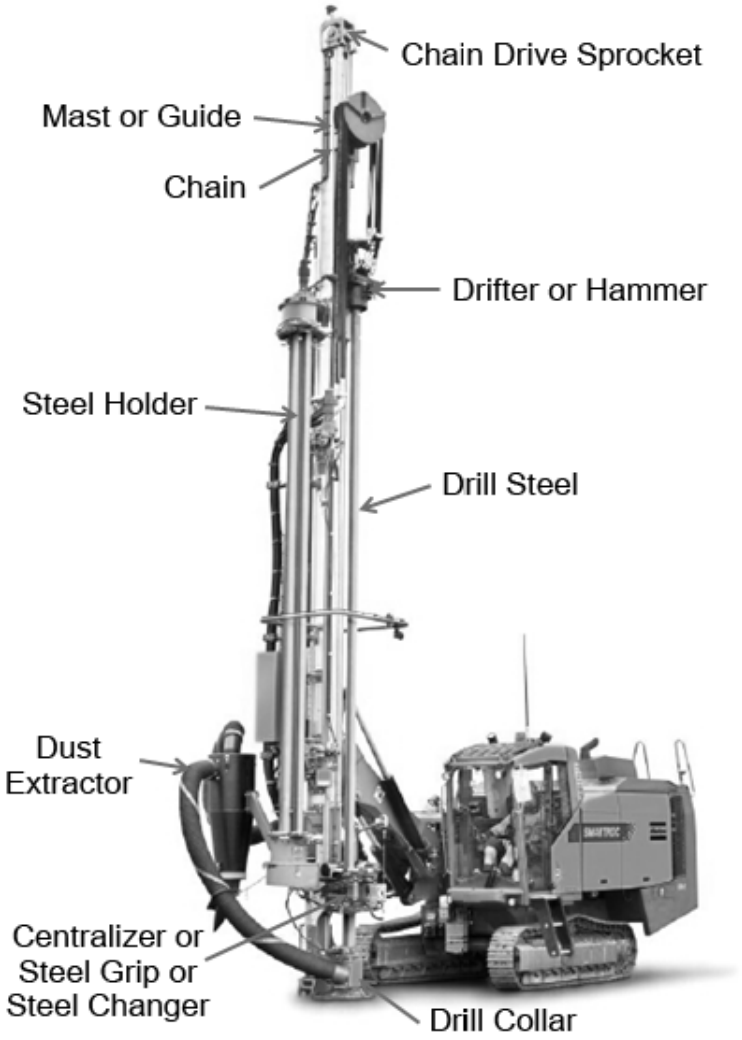
October 2014 BC-27

Drilling and Piling Terminology

Understanding basic drilling and piling terminology is an important step on being able to talk to prospective customers. Knowing basic terms and processes will allow you to engage in meaningful dialog quickly and to be able to position the Trimble DPS900 Drilling and Piling system correctly with the customer.

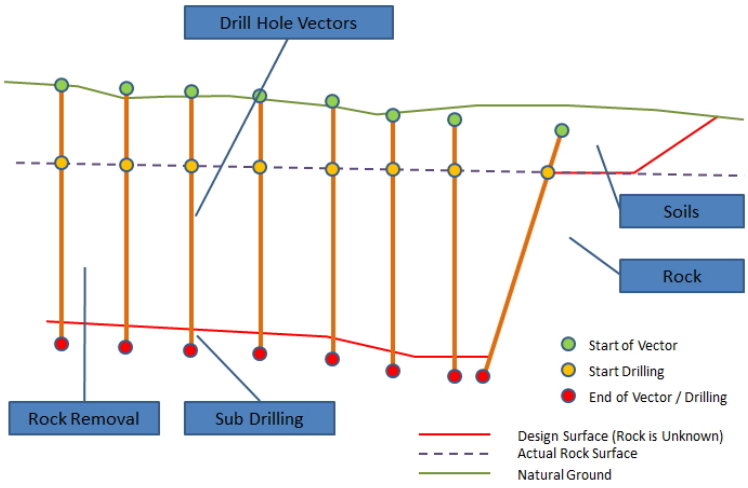
Drilling Machine Terminology

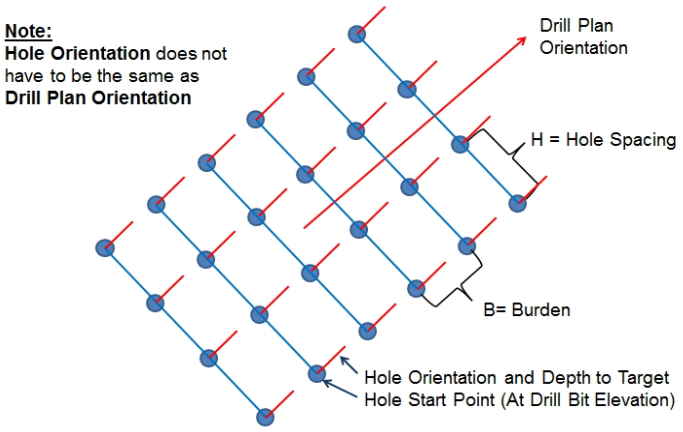


Trimble Heavy Civil Construction Division, 10368 Westmoor Drive, Westminster, CO 80021, USA

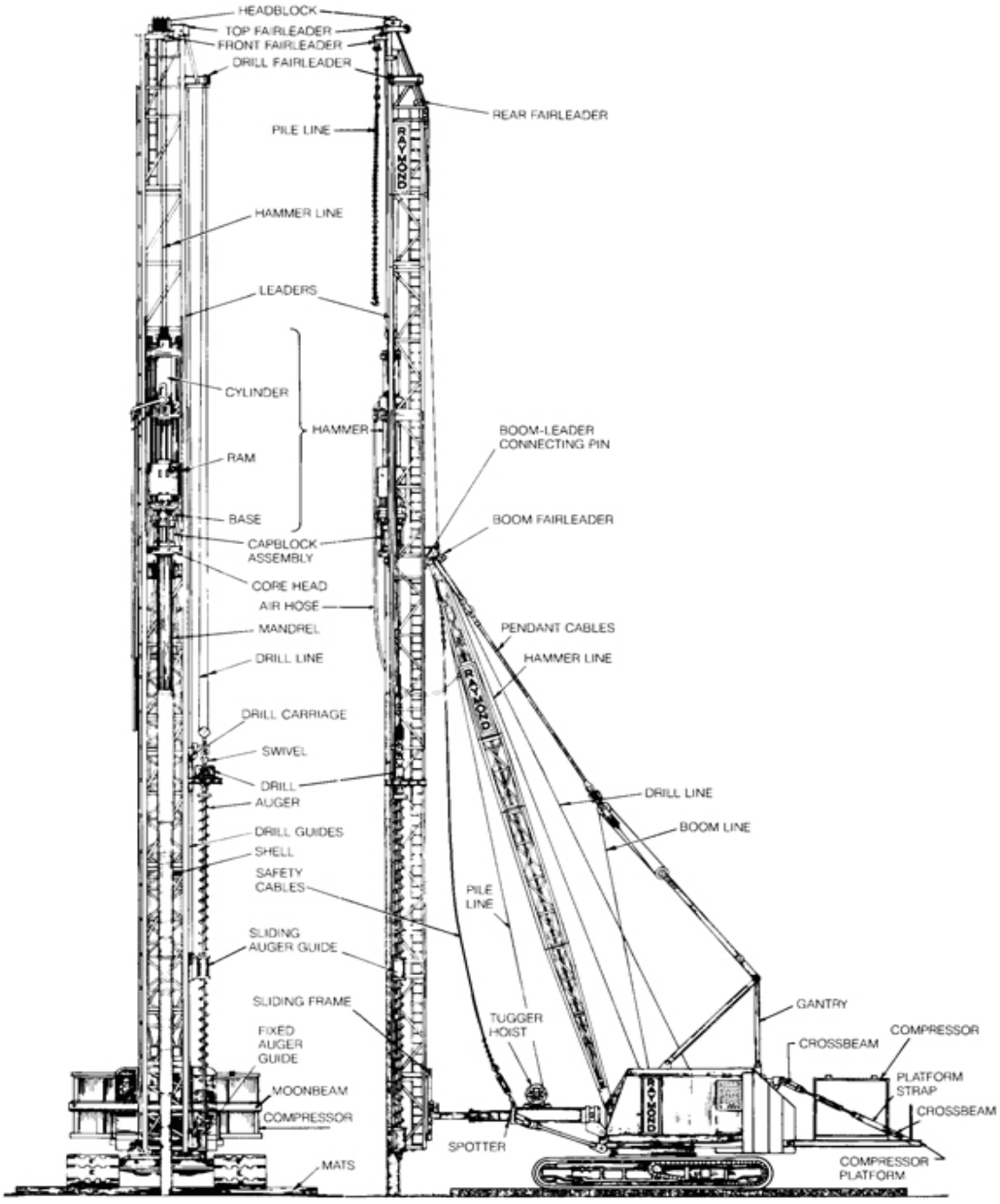
Key Terms in Drill Planning

- Burden (row spacing): Station spacing in corridors
- Spacing: Hole spacing along a row
- Sub drilling: Deliberate over drilling
- Inclination angle: Hole slope
- Hole orientation: Blasting direction for inclined holes
- Split / presplit holes:
    - Placed along the line at which you want to split the rock away from existing ground
    - Tend to be closer together (e.g. 2’ or 0.7m)
    - Tend to be smaller diameter (3”)
    - Smaller charge placed in hole (Designed to cleanly split not fragment the rock)
    - Designed to split not fragment the rock
- Blast holes:
    - Placed on a grid pattern within the split line
    - Row spacing and hole spacing are not necessarily the same
    - Tend to be larger diameter (4”)
    - Tend to be further apart (10’ - 12’ or 3 - 4m)
    - Larger charge placed in hole (designed to fragment the rock)
    - Designed to fragment the rock for haulage and removal





Piling Machine Terminology



Key Terms in Pile Planning

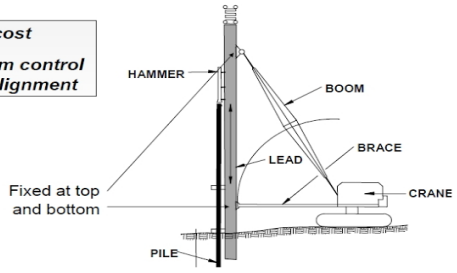
- Top of pile: also known as top, butt, and head
- Bottom of pile: also known as end tip, base, point, bottom, and toe
- Pile Size (Diameter etc.)
- Pile Shape (Sheet, H/I, Cylinder, Square etc.)
- Pile Length
- Pile Inclination or Rake angle
- Inclination / Rake Orientation (direction)
- Shaped pile orientation (H/I, Square, Sheet Piles have an orientation)
- Cut off elevation: Location where pile is cut to meet design elevation
- Pile cushion: Protects pile top while piling
- Blow count: Observed blows of the pile hammer per increment of pile penetration
- Minimum embedment/penetration: Minimum depth into ground that pile must be driven
- Pile splice: Structural (e.g. welded) connection to extend pile length
- Refusal rate: Defined # of blow counts over given distance indicates proper embedment

Key Types of Piling for Sales Opportunity Creation

- Solar Farm Piling
  - Piles are piled to a specific elevation at Top of Pile on irregular or graded terrain
  - Piles are placed in graded ground and are embedded by a certain distance (e.g. 4’ in ground or 4’ remaining out of ground)
  - Typically carried out with mini piling machines such as the PD10 from Vermeer
- Friction Piling
  - Piles are pounded until the friction on the pile provides the desired load bearing capacity. The Pile is deemed to have “met refusal” when the number of blows on the pile by a hammer of a predefined weight and energy exceeds a target number of blows over a given distance interval e.g. the hammer hits the pile 50 times and the pile embeds by less than 0.25m.
  - Typically carried out by large piling machines
- Base Point Termination Piling
  - Piles are pounded into the ground until they hit a target bedrock or solid material layer that provides the load bearing support for the structure to be placed on the piles.
  - Typically carried out by large piling machines

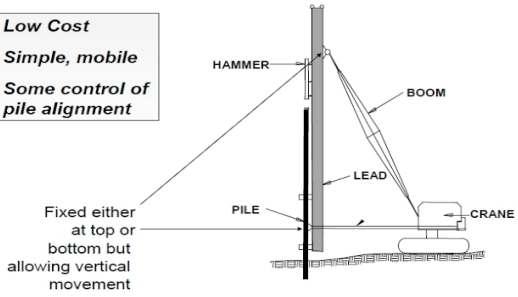
Fixed Lead System

- *Higher cost*
- *Maximum control of pile alignment*



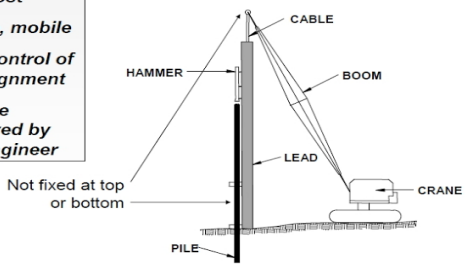
Semi-fixed Lead System

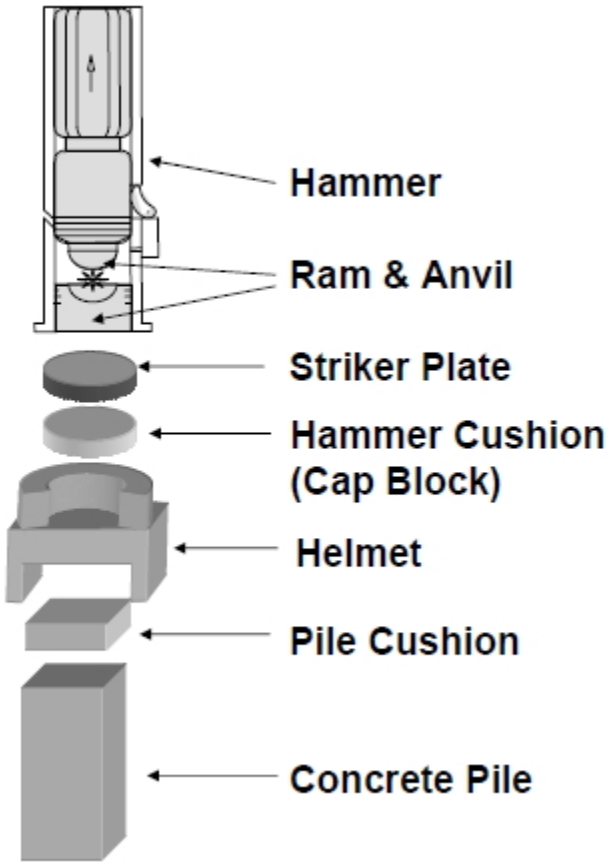
- *Low Cost*
- *Simple, mobile*
- *Some control of pile alignment*



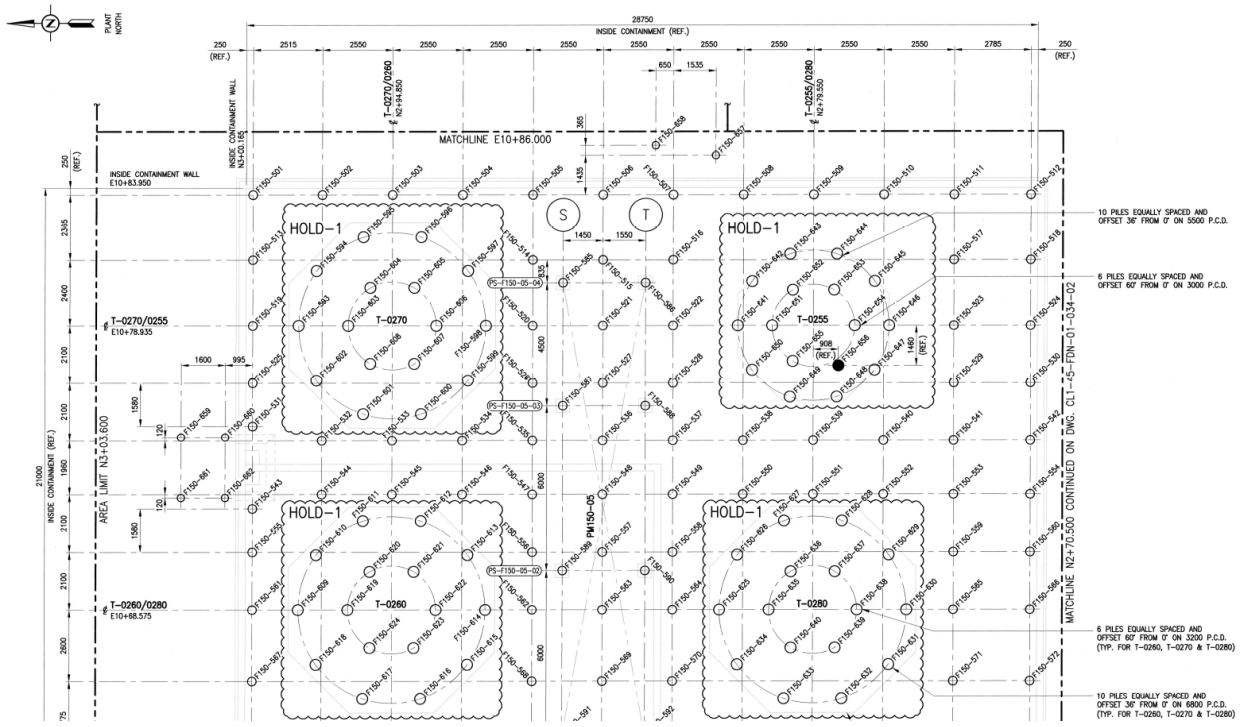
Swinging Lead System

- *Low Cost*
- *Simple, mobile*
- *Less control of pile alignment*
- *Must be approved by The Engineer*





Real World Example of Pile Planning Data



PILE SCHEDULE

PILE MARK No.	QUANTITY	SHAFT DIA. (mm)	WALL THICKNESS (mm)	OVERALL LENGTH (mm)	DESIGN PILE EMBEDMENT LENGTH (mm)	T.O. CAP PL ELEVATION (m)	PILE CUT-OFF ELEVATION (m)	GRADE ELEVATION (m)	CAP PL TYPE	EQUIPMENT / MODULE DESCRIPTION
BUILDING BU-0861										
F150-1 TO F150-102	102	324	9.53	18000	17000	97.550	97.525	98.000	B	BUILDING SLAB & COLUMN PEDESTAL PERIMETER
F150-103 TO F150-113	11	324	9.53	18000	17000	97.850	97.825	98.000	B	BUILDING SLAB
F150-114 TO F150-117	4	324	9.53	18000	17000	97.850	97.825	98.000	B	PIPERACK PM150-04 PEDESTALS
F150-118 TO F150-132	15	324	9.53	18000	17000	97.850	97.825	98.000	B	BUILDING SLAB
F150-133 TO F150-150	18	324	9.53	18000	17000	97.850	97.825	98.000	B	V-0220D/E/F
F150-151 & F150-152	2	324	9.53	18000	17000	97.850	97.825	98.000	B	PS-F150-07-02 PEDESTALS
F150-153 TO F150-159	7	324	9.53	18000	17000	97.850	97.825	98.000	B	BUILDING SLAB
F150-160 TO F150-177	18	324	9.53	18000	17000	97.850	97.825	98.000	B	V-0220A/B/C
F150-178 TO F150-186	9	324	9.53	18000	17000	97.850	97.825	98.000	B	BUILDING SLAB
F150-187 TO F150-214	28	324	9.53	18000	17000	97.550	97.525	98.000	B	PIPERACK PM150-03 PEDESTALS
F150-215 TO F150-238	24	324	9.53	18000	17000	97.550	97.525	98.000	B	PIPERACK PM150-02 PEDESTALS
F150-239 TO F150-262	24	324	9.53	18000	17000	97.550	97.525	98.000	B	PIPERACK PM150-01 PEDESTALS
F150-263 & F150-264	2	406	9.53	18000	17000	98.300	98.275	98.000	A	PS-F150-01-01
F150-265 TO F150-347	83	324	9.53	18000	17000	97.850	97.825	98.000	B	BUILDING SLAB
F150-348 TO F150-351	4	273	9.27	18000	17000	95.500	95.475	98.000	C	SUMP Z-0861
F150-352 TO F150-363	12	324	9.53	18000	17000	97.850	97.825	98.000	B	V-0230C/D
F150-364 & F150-365	2	324	9.53	18000	17000	97.850	97.825	98.000	B	PS-F150-03-06 PEDESTALS
F150-366 TO F150-376	11	324	9.53	18000	17000	97.850	97.825	98.000	B	BUILDING SLAB
F150-377 TO F150-388	12	324	9.53	18000	17000	97.850	97.825	98.000	B	V-0230A/B
F150-389 TO F150-400	12	324	9.53	18000	17000	97.850	97.825	98.000	B	BUILDING SLAB
F150-401 TO F150-424	24	324	9.53	18000	17000	97.850	97.825	98.000	B	F-0180A/B/C/D
F150-425 & F150-426	2	219	8.18	16000	15000	98.214	98.194	98.000	A	BU-0860 PLATFORM
F150-427 TO F150-430	4	324	9.53	18000	17000	98.241	98.216	98.000	A	BU-0860 LAB BLDG. SKID
F150-431 & F150-432	2	273	9.27	18000	17000	98.300	98.275	98.000	A	MISC. PIPE SUPPORTS