

Minipiles



Fig-1: Minipiling Equipment



Fig-2: Drilling Rig



Fig-3: Drop Hammer Rig

Minipiles are small diameter piles that can be installed in almost any type of ground where piles are required, with design working loads as small as 3 tons and as high as 70+ tons. Also known as micropiles, pin piles, needle piles or root piles, minipiles can offer a viable alternative to conventional piling techniques, particularly in restricted access or low headroom situations.

Bullivant Arabia Ltd. brings the same high quality technical expertise to its minipile technology coupled with extensive equipment resources and proven project experience. It allows us to respond quickly to provide the right minipile solution for your needs. Our commitment to excellence is reflected in the successful completion of projects ranging from residential underpinning, to large industrial plant foundations.

Selection of the right minipile to meet design objectives is primarily a function of soil conditions and load transfer requirements. Since soils and structural loads vary from project to project, an equally varied range of minipile options is necessary. Bullivant Arabia Ltd. offers the range of minipiles needed for the most appropriate technical solution, together with innovative methods of connecting piles to existing foundations. We also have the capability of combining our minipile technology with one or more of our other ground improvement techniques to meet unique or complex project requirements cost-effectively and efficiently.

Design Load: The working load of the pile. Test piles are usually tested to two times the static design load.

Minipile Applications

- Underpinning
- Supporting New Loads in Congested Areas
- Arresting Structural Settlement of existing Structures
- Seismic Retrofit
- Increasing Footing Bearing Capacity
- Resisting Uplift/Dynamic Loads
- Excavation Support in Confined Areas

Types of Minipiles

- **Piles for Isolated Footings**
- **Piles for Strip Footings**
- **Piles for Raft Foundations**
- **Piles for Heavy Machine Foundations**
- **Needle Beam & Piles**
- **Cantilever Beam & Piles**
- **Knuckle Beam & Piles**
- **Piles for Grade Slab**
- **Piles for New Boundary Walls**



Fig-4: Track Mounted Rig & Compressor



Fig-5: Grouting Pump & Mixer



Fig-6: Dust Extractor



Fig-7: Shape of Minipile below Isolated Footing

Important Minipile Parameters

- Soil characteristics at pile shaft/soil interface
- Rock at pile tip

Benefits of Minipiles

- High-performance
- Design loads from 3 to 70+ tons
- Can be readily designed for tension/uplift loads
- Appropriate for a wide range of ground conditions
- Suitable for low headroom and restricted access
- Low noise and vibration
- Can penetrate obstacles

Why should you choose a Bullivant Arabia Ltd. Minipile Solution?

For owners and design Engineers contemplating restricted access underpinning projects, the initial low cost of a cast-in-place piling system may often be substantially increased by the expense of extensive utility re-routing, creation of adequate access, waste disposal, and sometimes even a shutdown in facility operations. With our minipiles, these complications are rarely an issue. Our small diameter piles can be easily installed around existing utilities with small compact drilling equipment which can even enter a bathroom. Bullivant Arabia Ltd. works closely with engineers, contractors and owners to ensure that minipile installation minimizes impact on facility operations. Moreover, minipiles greatly alleviate the quality assurance concerns associated with cast in place piling in weak soils.

As a leading **Specialist Structural & Geotechnical Engineering Contractor** in Saudi Arabia, with more than 15 years of experience in minipiling technology, Bullivant Arabia Ltd. has the experience, expertise, equipment and resources to provide the quality solution to your foundation problem.



Fig-8: Upgrading Existing Isolated Footing by Minipiles and new Pile Cap.

Piles for Isolated Footings

Description: Stabilization of an existing/new isolated footing can be achieved by the construction of a group of minipiles through the existing footing, the concentrated load on the footing will be distributed to the group of the constructed minipiles.

Loading capacities: Loading capacities are based upon the bearing capacities of the underlying strata and the size of the minipiles, piles will be designed based on the soil conditions at each site. These piles can be designed as end bearing or friction piles.

General guidelines for minipiles capacities:

<u>Diameter of pile</u>	<u>Safe Working load *</u>
100 mm	upto 70 kN
130 mm	70 - 120 kN
150 mm	120 - 200 kN
175 mm	200 - 300 kN
225 mm	300 - 500 kN

* The higher capacities are for end bearing piles.

Application: To stabilize isolated footings affected by excessive settlement or to accommodate additional loadings on the footings.

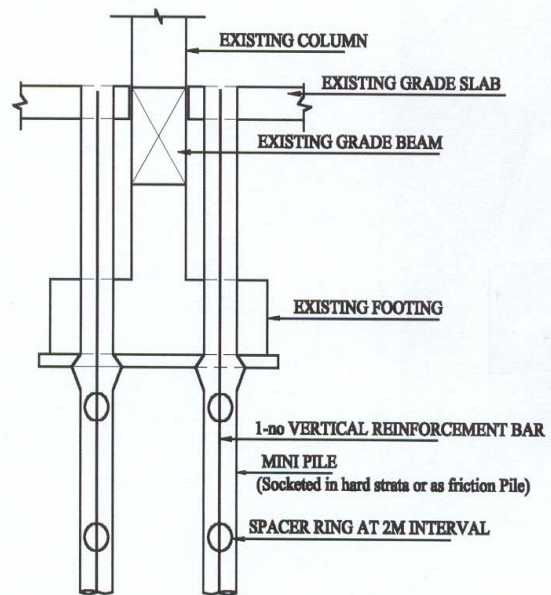
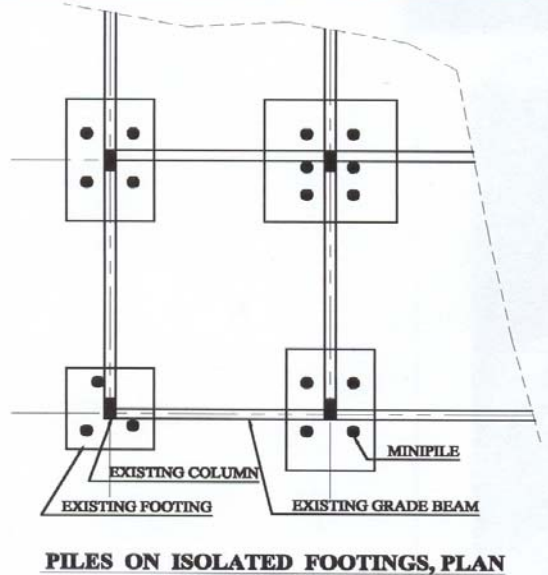
Installation procedure: Minipiles can be constructed either driven, drilled or augured, cased or uncased. Typically a minimum of 3 piles are required for each footing.

Advantages:

1. No excavation is required.
2. Foundation's capacities are upgraded with minimum disruption.
3. Disruption to floor finishes is minimal.
4. Fast operation when compared with all other available methods.
5. Cost effective in saving the structure.

Typical projects undertaken:

1. P.T.T. sub post office, Dhabab street, Riyadh.
2. Euromarche extension project, Riyadh.
3. Residence for Saudi American Bank, Riyadh.
4. Panda Supermarket Extension, Riyadh.
5. P.T.T. Sitteen street, Riyadh.
6. Tower Building, Riyadh Bank, Buraidah.
7. MODA, Military Camp, Sulayyil.
8. More than 50 nos. of residential villas in Riyadh.



Piles for Strip Footings

Description: Stabilization of an existing strip footing can be done by the installation of a group of minipiles through the existing footing, the load on the footing will be distributed to the group of the constructed minipiles.

Loading capacities: Loading capacities are based upon the bearing capacities of the underlying strata and the size of the minipiles, piles will be designed based on the soil conditions at each site. These piles can be designed as end bearing or friction piles.

General guidelines for minipiles capacities:

<u>Diameter of pile</u>	<u>Safe Working load *</u>
100 mm	upto 70 kN
130 mm	70 - 120 kN
150 mm	120 - 200 kN
175 mm	200 - 300 kN

* The higher capacities are for end bearing piles.

Application: To stabilize strip footings affected by excessive settlement or to accommodate additional loadings on the footings.

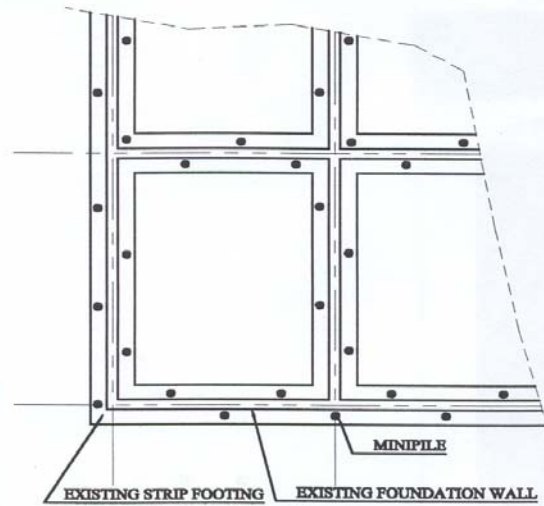
Installation procedure: Minipiles can be constructed either driven, drilled or augured, cased or uncased.

Advantages:

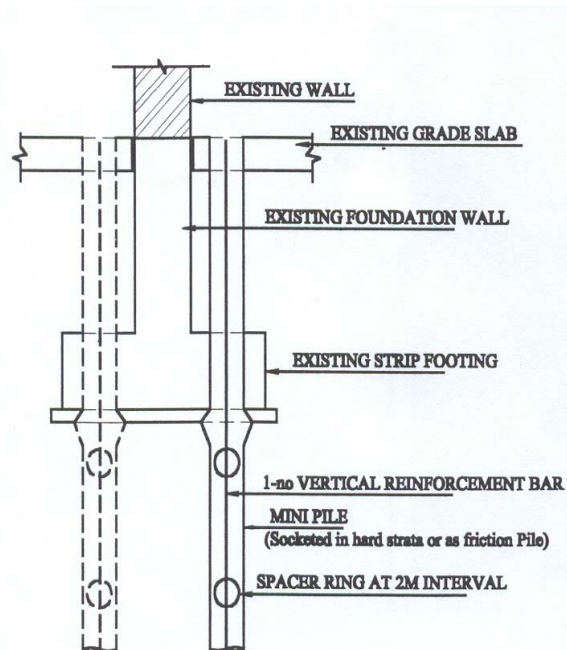
1. No excavation is required.
2. Foundation's capacities are upgraded with minimum disruption.
3. Disruption to floor finishes is minimal.
4. Fast operation when compared with all other available methods.
5. Cost effective is saving the structure.

Typical projects undertaken:

1. SAMA Housing – 20 villas, Riyadh.
2. SRECO Housing – 15 villas, Riyadh.
3. King Saud University - villas, Riyadh.
4. King Saud University - flats, Riyadh.
5. Ministry of Interior – 10 villas, Arar.
6. MODA – 10 Military Barracks, Tabuk.



PILES ON STRIP FOOTING , PLAN



PILES CONSTRUCTED ON STRIP FOOTING , SECTION

Piles for Raft Foundations

Description: Stabilization of an existing raft foundation can be done by the installation of a group of minipiles through the existing footing, the load from the foundation will be distributed to the constructed minipiles.

Loading capacities: Loading capacities are based upon the bearing capacities of the underlying strata and the size of the minipiles, piles will be designed based on the soil conditions at each site. These piles can be designed as end bearing or friction piles.

General guidelines for minipiles capacities:

<u>Diameter of pile</u>	<u>Safe Working load *</u>
100 mm	upto 70 kN
130 mm	70 - 120 kN
150 mm	120 - 200 kN
175 mm	200 - 300 kN
225 mm	300 - 500 kN

* The higher capacities are for end bearing piles.

Application: To stabilize raft foundations affected by excessive settlement or to accommodate additional loadings on the foundation.

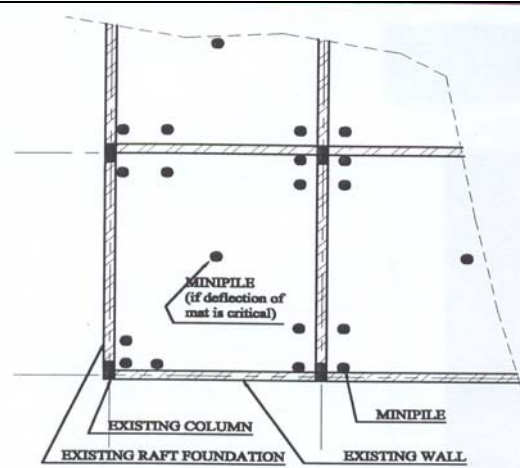
Installation procedure: Minipiles can be constructed either driven, drilled or augured, cased or uncased.

Advantages:

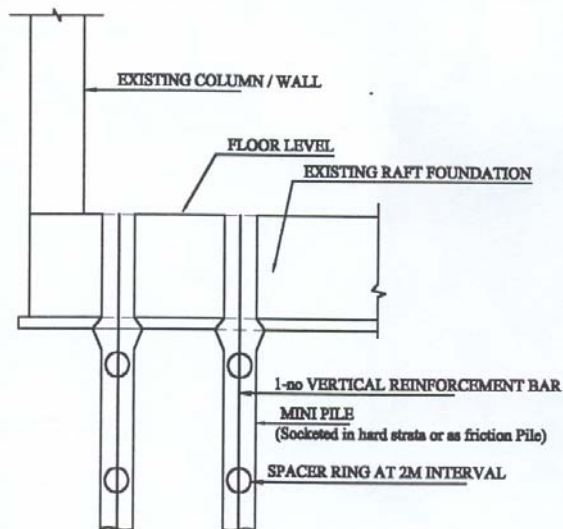
1. No excavation is required.
2. Foundation's capacities are upgraded with minimum disruption.
3. Disruption to floor finishes is minimal.
4. Fast operation when compared with all other available methods.
5. Cost effective is saving the structure.

Typical projects undertaken:

1. Private villas, different areas in Riyadh.
2. SADAF Salt Plant, Jubail.



MINIPILES ON RAFT FOUNDATION , PLAN



PILES CONSTRUCTED ON RAFT FOUNDATION , SECTION

Piles for Heavy Machine Foundations

Description: Construction of minipiles for heavy equipment foundations, where high load capacity is required in limited space.

Loading capacities: Loading capacities are based upon the bearing capacities of the underlying strata and the size of the minipiles, piles will be designed based on the soil conditions at each site. The piles can be designed as end bearing or friction piles.

General guidelines for minipiles capacities:

<u>Diameter of pile</u>	<u>Safe Working load *</u>
100 mm	upto 70 kN
130 mm	70 - 120 kN
150 mm	120 - 200 kN
175 mm	200 - 300 kN
225 mm	300 - 500 kN
300 mm	500 - 750 kN

* The higher capacities are for end bearing piles.

Application: Piles for new/existing foundations, which require working in congested space and high load carrying capacity of machine and plant foundations.

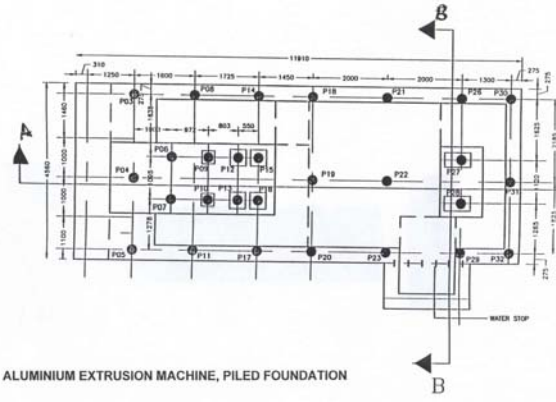
Installation procedure: Minipiles can be constructed either driven, drilled or augured, cased or uncased.

Advantages:

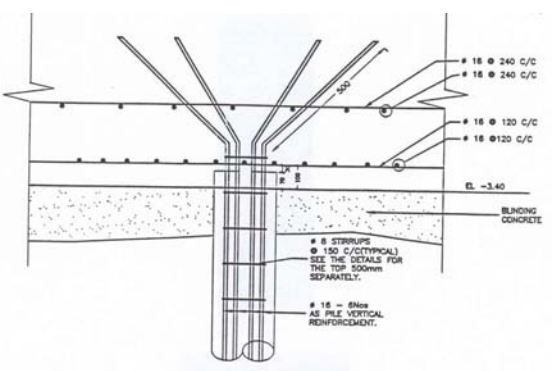
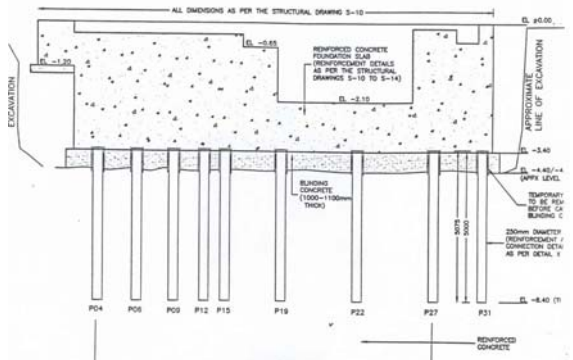
1. No excavation is required.
2. Fast operation when compared with all other available methods.
3. High load carrying capacity of the foundations.
4. Cost effective in constructing the structure.

Typical projects undertaken:

1. Aluminum extrusion machine foundation, Riyadh.
2. Desalination evaporator unit foundation, SWCC, Jubail.



PLAN SHOWING LOCATION OF PILES



PILE REINFORCEMENT DETAILS

Needle Beam & Piles

Description: Stabilization of an existing grade beam can be done by the installation of a group of minipiles in pairs connected by a new reinforced concrete needle beam constructed underneath the grade beam.

Loading capacities: Loading capacities are based upon the bearing capacities of the underlying strata and the size of the minipiles, piles will be designed based on the soil conditions at each site. These piles can be designed as end bearing or friction piles. The needle beam will be designed according to the load exerted on it.

General guidelines for minipiles capacities:

Diameter of pile	Safe Working load *
100 mm	upto 70 kN
130 mm	70 - 120 kN
150 mm	120 - 200 kN
175 mm	200 - 300 kN

* The higher capacities are for end bearing piles.

Application: Grade beam stabilization for framed structures with independent isolated footings and grade beams where the grade beams are not designed to span between the columns.

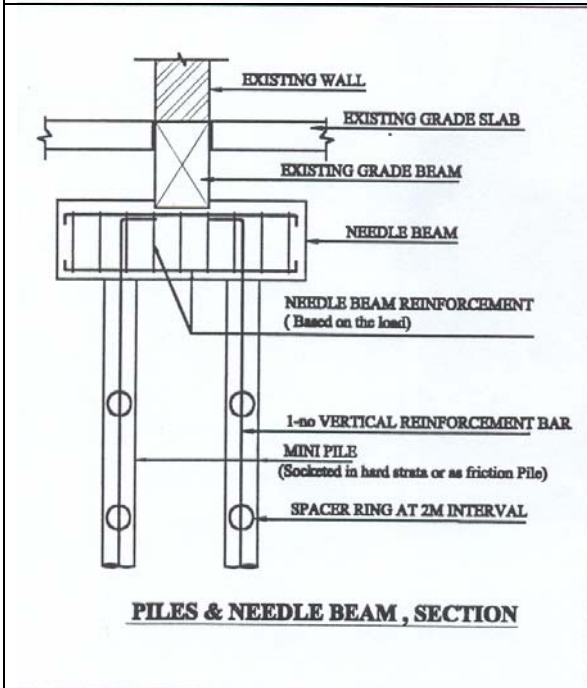
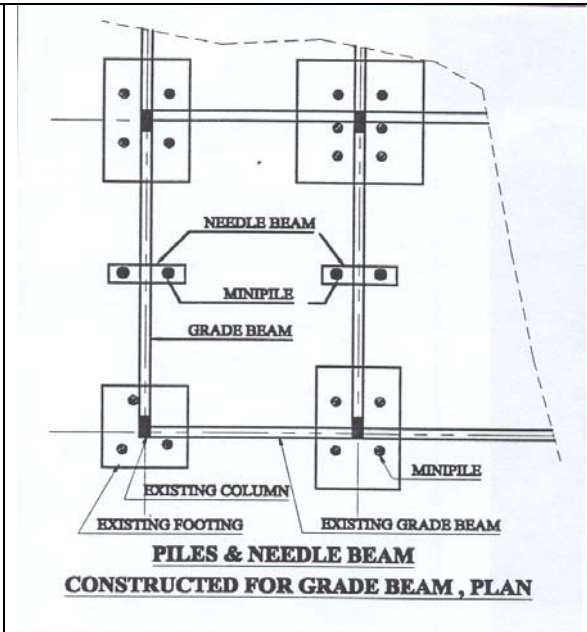
Installation procedure: Minipiles can be constructed either driven, drilled or augured, cased or uncased and needle beams can be constructed under the grade beam to connect the minipiles.

Advantages:

5. Disruption to floor finishes is minimal.
6. Fast operation when compared with all other available methods.
7. Cost effective is saving the structure.

Typical projects undertaken:

3. Several residential villas in Riyadh.
4. Panda Supermarket, Riyadh.
5. SAMA Housing, Riyadh.
6. SRECO villas, Riyadh.



Cantilever Beam & Piles

Description: Stabilization of an existing grade beam can be done by the installation of minipiles in pairs, one as tension pile, one as compression pile connected by a new reinforced concrete cantilever beam constructed underneath the grade beam.

Loading capacities: Loading capacities are based upon the bearing capacities of the underlying strata and the size of the minipiles, piles will be designed based on the soil conditions at each site. These piles can be designed as end bearing or friction piles. The cantilever beam will be designed according to the load exerted on it.

General guidelines for minipiles capacities:

<u>Diameter of pile</u>	<u>Safe Working load *</u>
100 mm	upto 70 kN
130 mm	70 - 120 kN
150 mm	120 - 200 kN
175 mm	200 - 300 kN

* The higher capacities are for end bearing piles.

Application: For the grade beam stabilization for framed structures with independent isolated footings and grade beams where the grade beams are not designed to span between the columns.

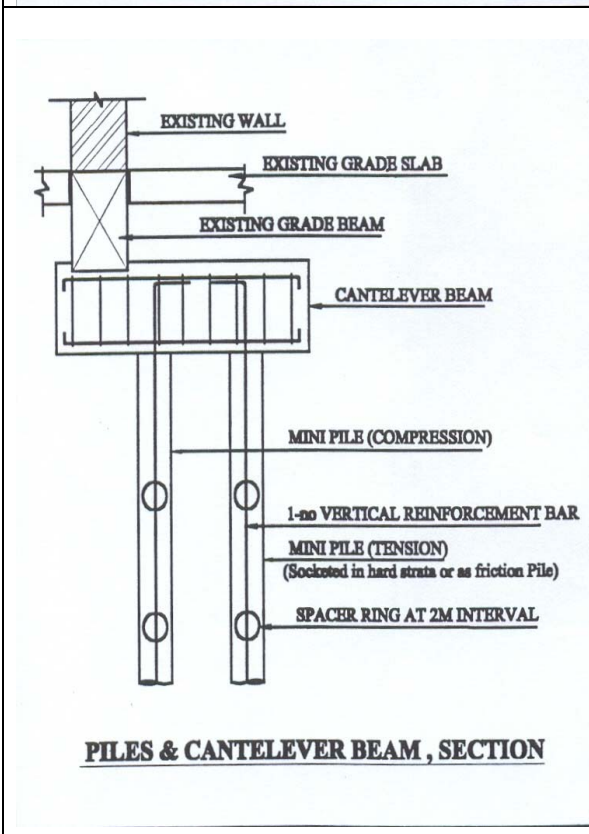
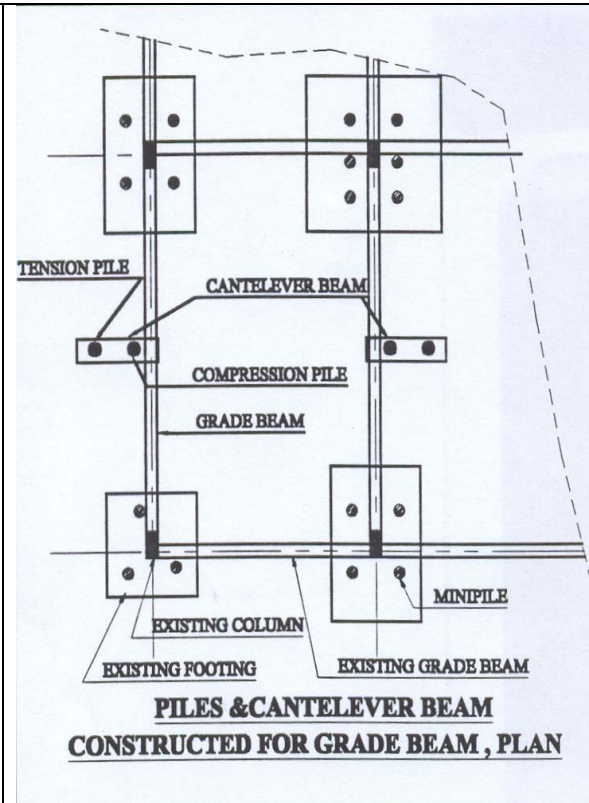
Installation procedure: Minipiles can be constructed either driven, drilled or augured, cased or uncased and cantilever beams can be constructed under the grade beam to connect the minipiles.

Advantages:

1. As the cantilever beam can be constructed in one side of the grade beam, the system is suitable for external grade beams without the need to enter the structure.
2. Disruption to floor finishes is minimal.
3. Fast operation when compared with all other available methods.
4. Cost effective is saving the structure.

Typical projects undertaken:

1. Several residential villas in Riyadh.
2. Panda Supermarket, Riyadh.
3. SAMA Housing, Riyadh.
4. SRECO villas, Riyadh.
5. Military Survey Building, Riyadh.



Knuckle Beam & Piles

Description: Stabilization of an existing grade beam or a narrow footing can be done by the installation of minipiles connected by a new reinforced concrete knuckle beam constructed on the side of the grade beam or the narrow footing.

Loading capacities: Loading capacities of piles are based upon the bearing capacities of the underlying strata and the size of the minipiles, piles will be designed based on the soil conditions at each site. These piles can be designed as end bearing or friction piles. The knuckle beam will be designed according to the load and moment exerted on it, in many cases the moment on the knuckle beam may be a detrimental factor. If two knuckle beams are provided from both side of the grade beam, moment will be zero.

General guidelines for minipiles capacities:

<u>Diameter of pile</u>	<u>Safe Working load *</u>
175 mm	200 - 300 kN

* The higher capacities are for end bearing piles.

Application: For the grade beam stabilization for framed structures with independent isolated footings and grade beams, where the grade beams are not designed to span between the columns. Also applicable to stabilize existing footings with very narrow offset, so that the footing can't accommodate a pile.

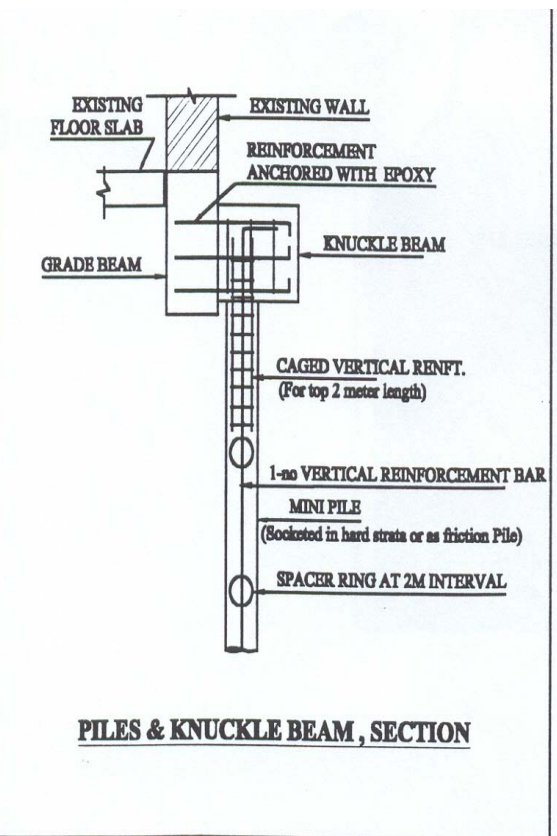
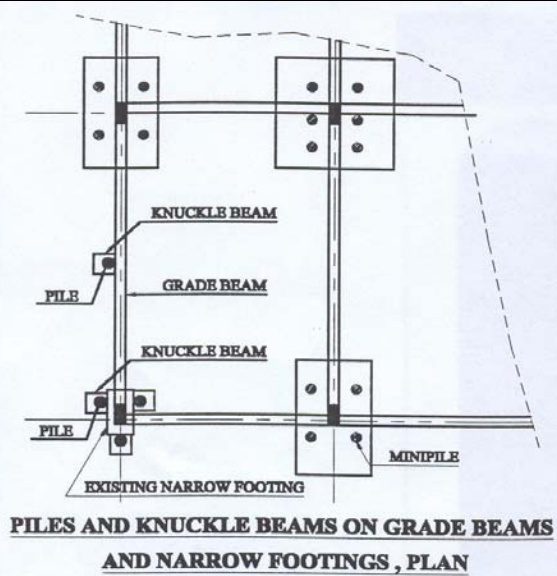
Installation procedure: Minipiles can be constructed driven, drilled or augured, cased or uncased. Anchor reinforcement of the knuckle beam to be fixed to the grade beam and the knuckle beam can be casted.

Advantages:

1. As the knuckle beam can be constructed in one side of the grade beam, the system is suitable for external grade beams without the need to enter the structure.
2. Less number of piles compare with cantilever beams.

Typical projects undertaken:

1. Several residential villas in Riyadh.
2. MODA, Mess Hall, Tabuk.



Piles for Grade Slab

Description: Stabilization of an existing grade slab can be done by the installation of a group of minipiles through the existing slab, the load from the slab will be distributed to the group of minipiles.

Loading capacities: Loading capacities are based upon the bearing capacities of the underlying strata and the size of the minipiles, piles will be designed based on the soil conditions of each site. These piles can be designed as end bearing or friction piles. The adequacy of existing slab to span between the piles will be the detrimental factor in the design.

General guidelines for minipiles capacities:

Diameter of pile	Safe Working load *
100 mm	upto 70 kN
130 mm	70 - 120 kN
150 mm	120 - 200 kN

* The higher capacities are for end bearing piles.

Application: To stabilize the grade slab affected by excessive settlement or to accommodate additional loading on the grade slab.

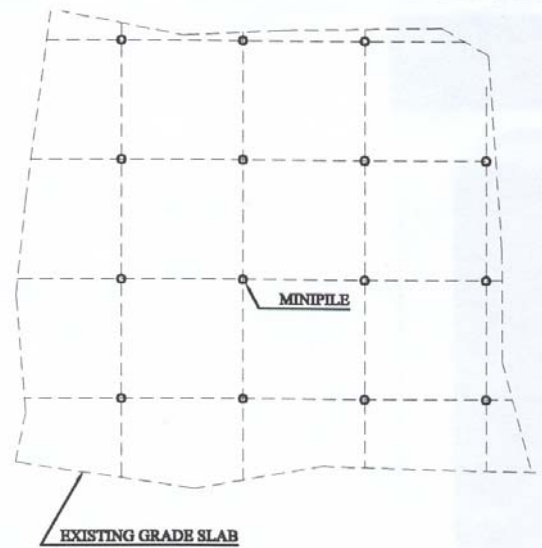
Installation procedure: Minipiles can be either driven, drilled or augured, cased or uncased.

Advantages:

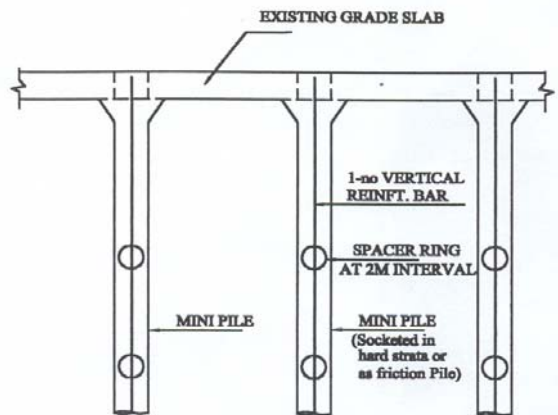
1. No excavation is required.
2. Grade slabs capacities are upgraded with minimum disruption.
3. Disruption to floor finishes is minimal.
4. Fast operation when compared with all other available methods.
5. Cost effective is saving the structure.

Typical projects undertaken:

1. King Abdulaziz Military Academy – Several buildings, Riyadh.
2. MODA, Market, Studio & Theatre, Tabuk.
3. Several residential villas, Riyadh.
4. MODA, Military camp, Sullayil



PILES ON GRADE SLAB , PLAN



PILES ON GRADE SLAB , SECTION

Piles for New Boundary Walls

Description: Construction of cast-in-placed piles as foundation to support the compound walls.

General Guidelines for Minipile Capacities:

Diameter of pile	Safe Working Load*	Pile spacing
Type A 135mm	up to 120 kN	4000 mm
Type B 150mm	120 – 220 kN	4000 mm

* The higher capacities are for end bearing piles.

Recommended size of beam:

Type	H	B	Bot. Bar	Top Bar	Ties
	mm	mm	mm	mm	mm
A	400	200	2-16 dia.	2-16 dia.	10dia @200
B	500	200	4-16 dia.	2-16 dia.	10 dia @200

Recommended size of reinforcement, column and pile:

Type	Pile Vert. Bar	Column Vert. Bar	W
	mm	mm	mm
A	2-16 dia.	4-12 dia.	300
B	2-16 dia.	2-16 dia.	300

Advantages:

1. Fast, simple construction
2. Eliminates excavation for footing construction.
3. Guarantee of no cracks.
4. Full design and build back-up service.
5. Cost effective.

Installation Procedure (See figure 1):

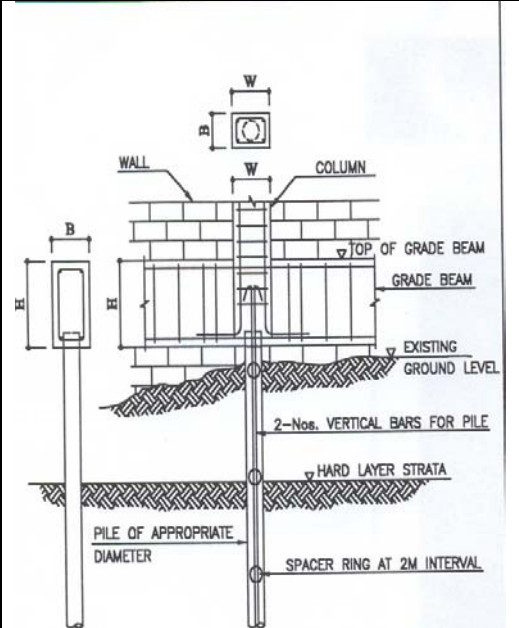
1. Piles are formed by drilling a hole in the ground.
2. Hole is grouted and reinforced with two 16mm dia.
3. Reinforcement with prefixed galvanized wire spacers.
4. Bottom level of the new grade beam varies, installation of blocks are required to level the new grade beam if necessary.
5. New grade beam will be constructed directly on top of pile.

Design Requirements:

1. All reinforcement shall be ASTM A615-90 with specified yield strength of 42 MPa.
2. All concrete compressive strength shall be 30 MPa after 28 days.

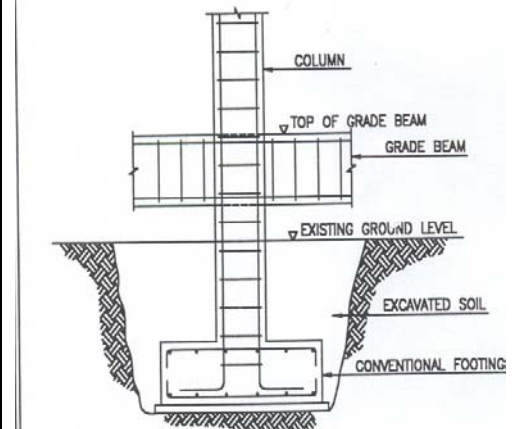
Typical projects undertaken:

1. Private farm house, Riyadh.
2. Compound wall for a residential villa in Khozama area, Riyadh.



NEW FOUNDATION SYSTEM

FIGURE 1



CONVENTIONAL METHOD

FIGURE 2