

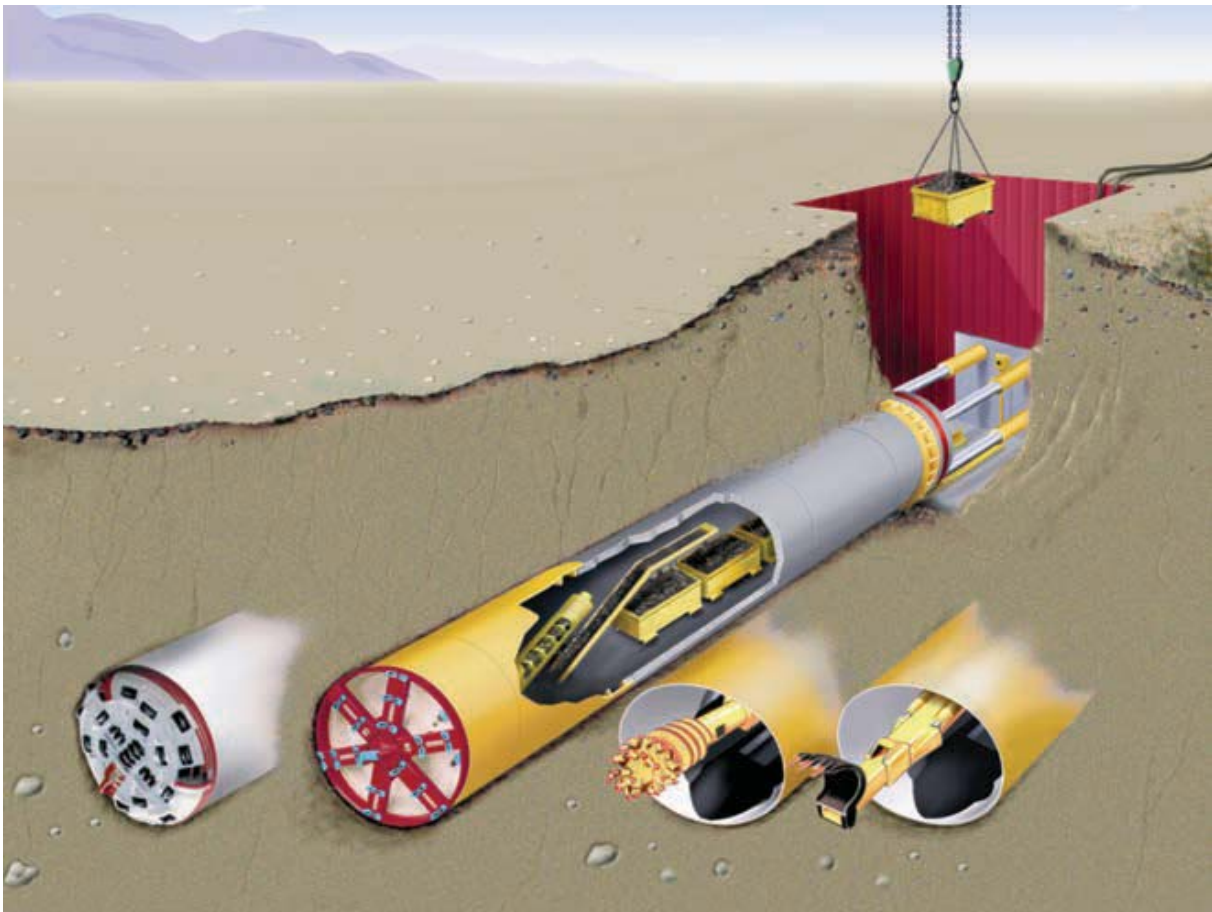
# AN INTRODUCTION TO PIPE JACKING



## THE PIPE JACKING TECHNIQUE

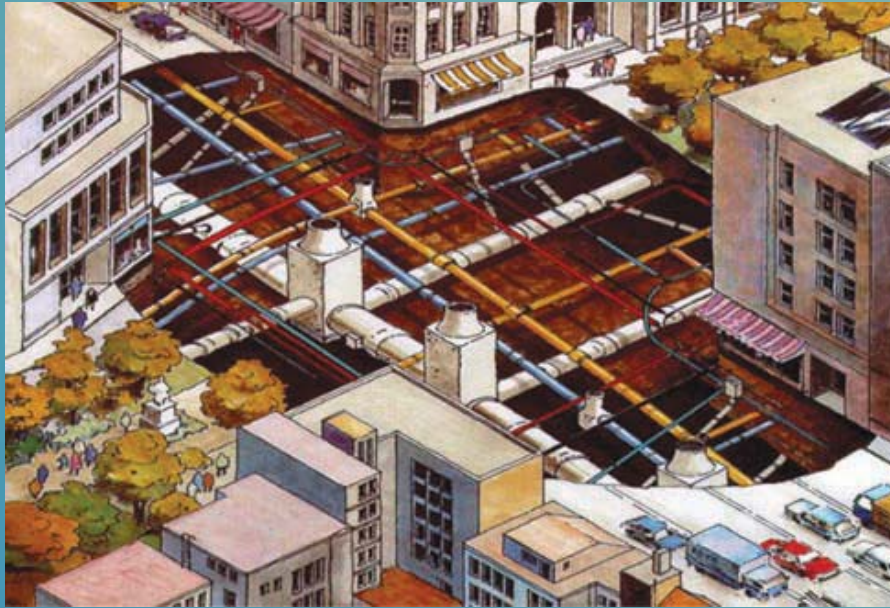
The major applications for pipe jacking and microtunneling include new sewerage and drainage construction, sewer replacement and lining, gas and water mains, oil pipelines, electricity and telecommunications' cable installation, and culverts. Special applications include the installation of rectangular or circular sections for pedestrian subways, road underpasses and bridge abutments.

The technique can be used to negotiate obstacles such as motorways, railways, rivers, canals, buildings and airfields in the path of pipe laying projects; to minimize the surface disruption frequently associated with open cut pipe laying methods in urban areas; or simply to provide a permanent underground tunnel construction.



Pipe jacking is primarily used as an alternative to open cut excavations or other tunneling methods. Significant lengths are attainable at larger diameters using mechanized techniques. Reference should be made to Tables 4c and 4d for specific recommendations.

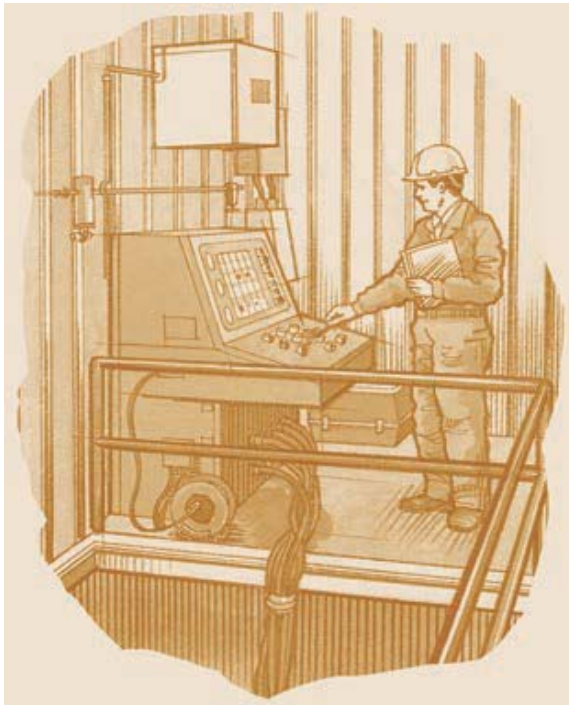
Construction methods are available to cope with both cohesive and non-cohesive soils in dry or water bearing conditions. Excavation techniques are also available for jacking through rock or mixed ground conditions, including cobbles and boulders.



## ADVANTAGES AND DISADVANTAGE: TRENCHLESS METHOD

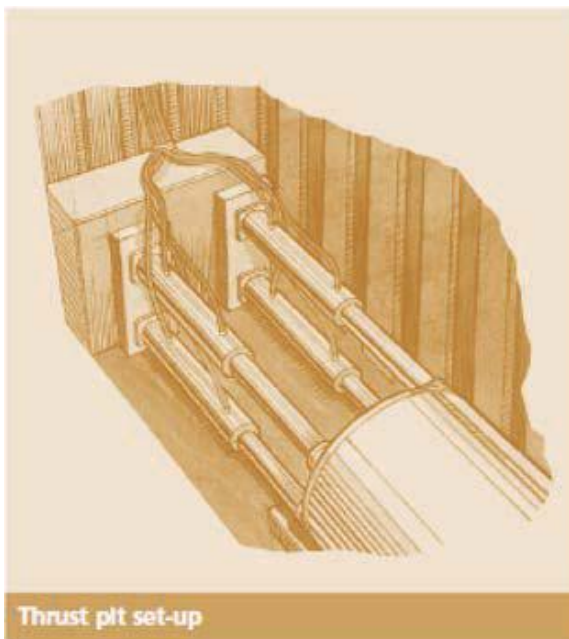
- Decreasing cost of surface repair
- Decrease Time of project ( Trenchless method is very faster than open trench)
- Crossing under the river and other structures
- Less interface with infrastructures
- Less disturbance in Traffic
- Increasing pollutions
- Environmental advantages
- Ability to work under water
- More Safety
- Earth moving is reduced to minimum
- Construction work in all weather

Pipe jacking, generally referred to in the smaller diameters as microtunneling, is a technique for installing underground pipelines, ducts and culverts. Powerful hydraulic jacks are used to push specially designed pipes through the ground behind a shield at the same time as excavation is taking place within the shield. The method provides a flexible, structural, watertight, finished pipeline as the tunnel is excavated. There is no theoretical limit to the length of individual pipe jacks although practical engineering considerations and economics may

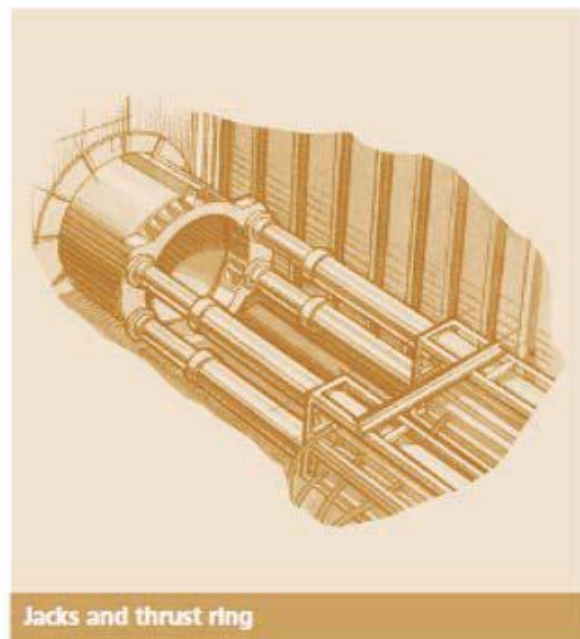


impose restrictions. Drives of several hundred meters either in a straight line or to a radius or a series of radii are readily achievable. A number of excavation systems are available including manual, mechanical and remote control. Pipes in the range 150mm to 3000mm, can be installed by employing the appropriate system. Construction tolerances are comparable with other tunneling methods, and the pipe jacking method generally requires less overbreak than segmental tunnels and provides ground support and reduces potential ground movement.

Mechanical excavation methods are similar to those employed in other forms of tunneling. Shields, excavation and face support can be provided for a wide variety of ground conditions.



Thrust pit set-up



Jacks and thrust ring

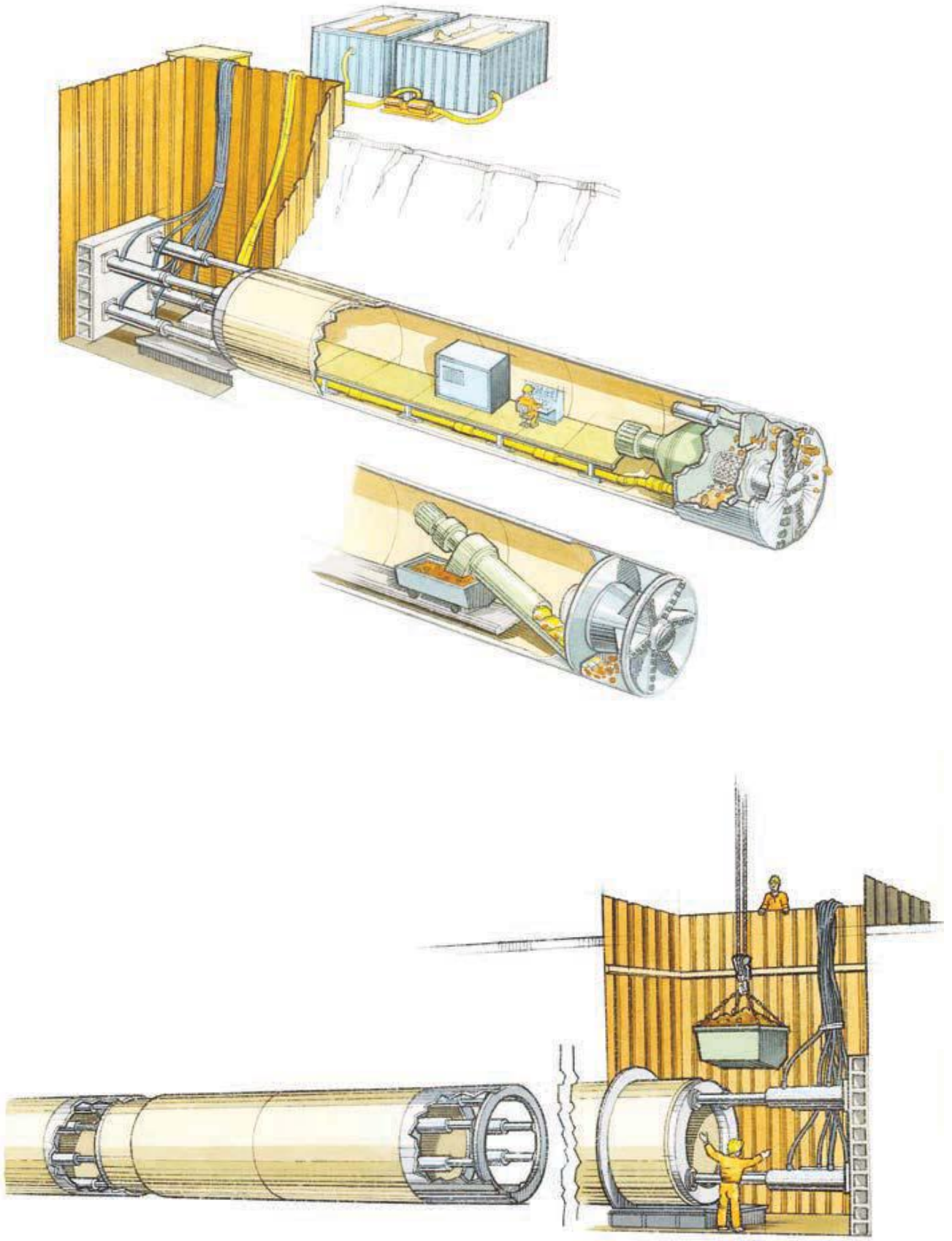
In order to install a pipeline using this technique, thrust and reception pits are constructed, usually at manhole positions. The dimensions and construction of a thrust pit vary according to the specific requirements of any drive with economics being a key factor. Pit sizes will vary according to the excavation methods employed, although these can be reduced if required by special circumstances.

A thrust wall is constructed to provide a reaction against which to jack. To ensure that the jacking forces are distributed around the circumference of a pipe being jacked, a thrust ring is used to transfer the loads. The jacks are interconnected hydraulically to ensure that the thrust from each is the same.



A reception pit of sufficient size for removal of the jacking shield is normally required at the completed end of each drive. The initial alignment of the pipe jack is obtained by accurately positioning guide rails within the thrust pit on which the pipes are laid. To maintain accuracy of alignment during pipe jacking, it is necessary to use a steerable shield, which must be frequently checked for line and level from a fixed reference.

For short or simple pipe jacks, these checks can be carried out using traditional surveying equipment. Rapid excavation and remote control techniques require sophisticated electronic guidance systems using a combination of lasers and screen based computer techniques.



## SAFETY BENEFITS

Pipe jacking is an inherently safer method of working than open trench construction or traditional segmental tunneling. When considering the risks associated with deep, large section, open excavations, Health and Safety Executive guidance suggests these risks should be reduced “if appropriate using ‘trenchless’ technology to avoid the need to excavate the trench in the first place”. Given gang size differences between the techniques and the resulting reduction in man-hours, opportunities for accidents to occur are less with pipe jacking. There is also significant reduction in the risk of injury as a result of utility strikes and interface with the public.



## ENVIRONMENTAL BENEFITS

There are substantial environmental benefits to be gained by the use of pipe jacking techniques when compared with the traditional open trench approach. Typically the ‘trenchless’ method will reduce the quantities of incoming and outgoing materials, with a consequent reduction in tipping of spoil and quarrying of imported stone fill. This in turn leads to reduced vehicle movements and subsequently less associated disruption. **In many cases use of pipe jacking techniques instead of open trenching will contribute positively towards workplace safety, the interface with the general public, and the local and wider environment.**

## TECHNICAL BENEFITS

*Technical benefits associated with pipe jacking are:*

- Inherent strength of lining
- Smooth internal finish giving good flow characteristics
- No requirement for secondary lining
- Considerably less joints than a segmental tunnel
- Prevention of ground water ingress by use of pipes with sealed flexible joints
- Provision of invert channels in larger pipes to contain the dry weather flow of a sewer in a combined system
- Less risk of settlement
- Minimal surface disruption
- Minimal reinstatement
- Reduced requirement for utilities diversions in urban areas

## PIPE JACKING PROJECT OF KAYSON

### Hamedan Sewerage Project by Pipe Jacking Method

**Client:** Hamedan Province Water & Wastewater Company

**Financed by:** Islamic Development Bank

**Location:** Hamedan, Iran

**Contract Period:** 36 Months

**Partner:** Mushrif of Kuwait

#### *Key Statistics*

- Reception & drive shafts: 64
- Manholes: 64
- 1200 mm diameter pipes: 5329 meters
- 1400 mm diameter pipes: 1564 meters
- Excavation: 60,000 cubic meters
- Concrete: 8,000 cubic meters
- Formwork: 12,000 square meters



### Tehran, Khaje Abdullah Ave.

**Client:** Tehran Water & Wastewater Company  
Ministry of Power

**Financed by:** Ministry of Power

**Location:** Tehran, Iran

**Contract Period:** 12 Months

#### *Key Statistics*

- Drive shafts: 34
- Manholes: 33
- 1400 mm diameter pipes: 552 meters
- 1600 mm diameter pipes: 2170 meters
- 1800 mm diameter pipes: 1180 meters
- Excavation: 10,620 cubic meters
- Concrete: 8,814 cubic meters
- Formwork: 5,810 square meters



### Tehran, Region 2, 5 and 9 of Tehran

**Client:** Tehran Water & Wastewater Company  
Ministry of Power

**Financed by:** Ministry of Power

**Location:** Tehran, Iran

**Contract Period:** 20 Months

#### *Key Statistics*

- Drive shafts: 39
- Manholes: 39
- 1600 mm diameter pipes: 4283 meters
- 1800 mm diameter pipes: 612 meters
- Excavation: 9,632 cubic meters
- Concrete: 2,880 cubic meters
- Formwork: 9,410 square meters





## POLYMER CONCRETE PIPES

Polymer concrete is a high strength, corrosion resistant concrete product which is created when thermosetting polyester resin is used to bond the highest quality of quartz aggregates under strictly controlled temperature and moisture conditions. The polyester resin, which acts as the bonding agent, after curing, gives the pipes the additional positive properties of elasticity, fracture and corrosion resistance. No water or cement is used in the manufacture of polymer concrete products. Polymer concrete products are corrosion-resistant during usage for flows with a PH range of 1.0 to 12.0. The glass-reinforced-plastic (GRP) couplings are made to connect plain end pipes quickly and easily and provide the added benefit of leak-proof joints, thus making polymer concrete pipes the natural choice for use in demanding municipal and industrial sewage management systems.

It should be pointed out that the object of establishing PCPMC Co. in Iran are as follows:



a) Approach to Sustainable Development in water and wastewater industry of Iran

b) Production of environment friendly and recyclable pipes for wastewater industries



c) Production of corrosion resistant and durable pipes for sewage transportation

d) Improving Science and Technology in the field of Composites and polymer Concrete Materials and Products

## DESIGN AND CONSTRUCTION METHODS

Prior to embarking on a detailed construction design and method analysis, the client's engineer will generally have ascertained the basic design parameters to meet the requirements of the scheme.

For a sewerage system these are likely to include:

- Hydraulic requirements
- Preferred route
- Depth
- Gradient

Following an assessment of engineering, environmental and cost parameters, pipe jack excavation method and shaft construction will also be governed by a number of factors which include:

- Ground conditions
- Details of existing services and underground structures
- Location of manholes and working areas
- Lengths required
- Diameters of pipeline
- Economics

Ground conditions will play a major role in determining the type of shaft to be constructed, the pipe jack excavation method and any ground support systems to be used. Each of these may have limitations in terms of either the diameter or length of drive. The interface between these variables, together with physical considerations, such as the location of manholes and the size of working areas, will provide an optimum solution or range of solutions which can then be appraised on the basis of cost and value engineering.







Telephone: (+9821) 88072501-9 / Fax: (+9821) 88072500  
Email: [info@kayson-ir.com](mailto:info@kayson-ir.com) / Website: [www.kayson-ir.com](http://www.kayson-ir.com)  
Head Office Address: Iranzamin Bldg., 2288 Iranzamin Ave., Shahrak  
Qods, Tehran 1465613763, Iran

DESIGNED AND PUBLISHED BY KAYSON COMPANY