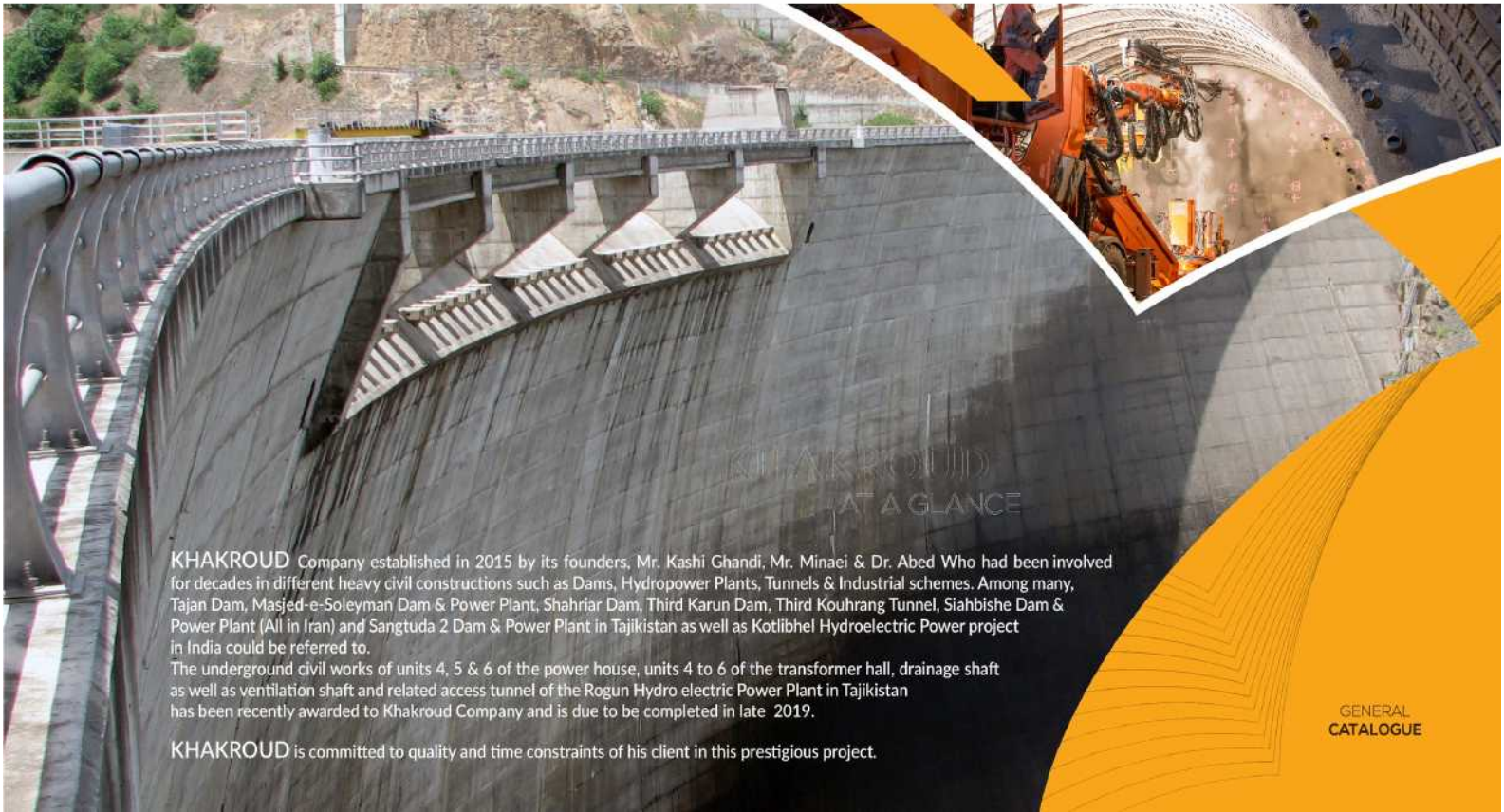
KHAKROUD
ENGINEERING AND COMMERCIAL

www.khakroud.ir
info@khakroud.ir

Unit B6, 6th Floor, No. 26, East Daneshvar Alley, North Shiraz Ave., Mllasadra St., Tehran, Iran.
T: +98 21 88614340 - 88614341 - 88624172 - 88624180 - 88624195 - 88624217



KHAKROUD AT A GLANCE

KHAKROUD Company established in 2015 by its founders, Mr. Kashi Ghandi, Mr. Minaei & Dr. Abed Who had been involved for decades in different heavy civil constructions such as Dams, Hydropower Plants, Tunnels & Industrial schemes. Among many, Tajan Dam, Masjed-e-Soleyman Dam & Power Plant, Shahriar Dam, Third Karun Dam, Third Kouhrang Tunnel, Siahbishe Dam & Power Plant (All in Iran) and Sangtuda 2 Dam & Power Plant in Tajikistan as well as Kotlibhel Hydroelectric Power project in India could be referred to.

The underground civil works of units 4, 5 & 6 of the power house, units 4 to 6 of the transformer hall, drainage shaft as well as ventilation shaft and related access tunnel of the Rogun Hydro electric Power Plant in Tajikistan has been recently awarded to Khakroud Company and is due to be completed in late 2019.

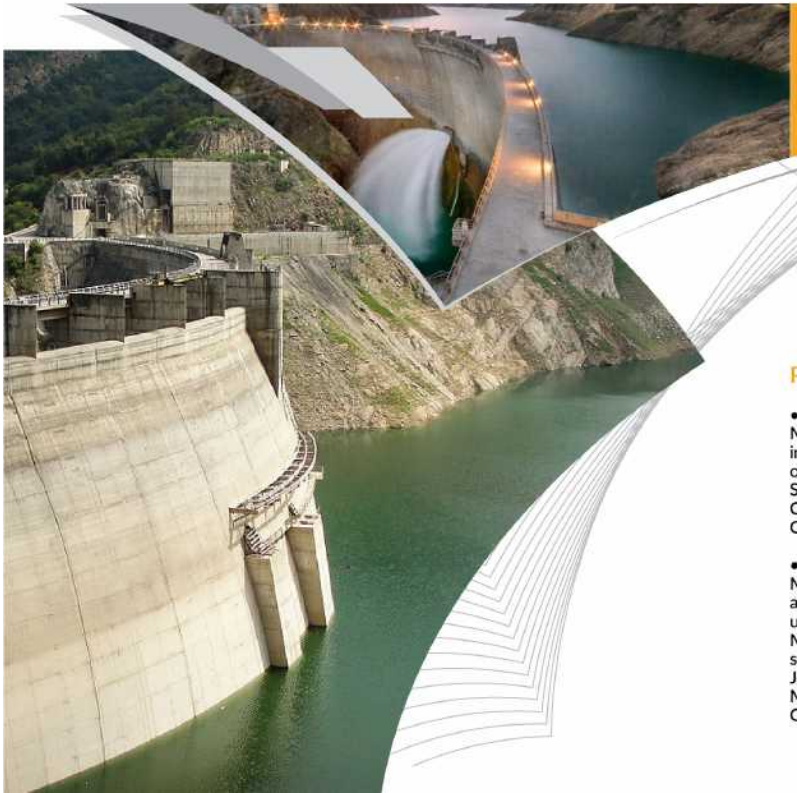
KHAKROUD is committed to quality and time constraints of his client in this prestigious project.

GENERAL
CATALOGUE

ALI AKBAR
KASHI GHANDI

PROFESSION: Civil Engineer

Date of Birth: May 11, 1948



PUBLICATIONS

- Hayati, A.N., Kashighandi, A., Hajjar, M., Dadashi, M., "Use of passive anchors in increasing the stability safety factor of downstream slope of spillway in Shahriar Storage Dam", 2011, Pan-Am CGS, Geotechnical Conference, Toronto, Ontario, Canada, October 2-6, 2011.

- Hayati, A.N., Ahmadi, M.M., Hajjar, M., and Kashighandi, A. "Unsupported advance length in tunnels constructed using New Austrian Tunnelling Method and ground surface settlement", 2012, International Journal for Numerical and Analytical Methods in Geomechanics, Published Online in Wiley Online Library, 2012.

EDUCATION

- M.Sc. in Civil Engineering (Geotechnic)
  University of Michigan, Ann Arbor, Michigan
  USA, 1976
- B.Sc. in Civil Engineering
  Tehran Polytechnic, Iran, 1970

ACADEMIC EXPERIENCE

- Gilan University (1979 – 1988)
  Full-time member of faculty (from 1979 to 1981), and as an Adjunct Lecturer (from 1981 to 1988)

  Taught courses such as, Soil Mechanics, Soil Mechanic Laboratory, Concrete Technology, Construction Scheduling

- Tehran University
  Lecturer for "Construction Methods in Building Dams", Spring 2006, and 2012

ALI AKBAR
KASHI GHANDI

PROJECT: Niayesh Tunnel

Client:	Engineering & Development Org. of Tehran
Contractor:	Tablieh Construction Co.
Consultant:	Pejoohesh Omran Rahvar & D2 Consult J.V
Position:	Member of Executive Committee
Primary contract period:	1988-1991
Location:	Tehran, Iran
Status:	Completed

PROJECT KEY DATA

Excavation:	800,000 m^3
Wire Mesh:	4,000 tonnes
Shotcrete:	124,000 m^3
Concrete Lining:	170,000 m^3

PROJECT OUTLINE

Cities seek to keep their traffic moving, while countries endeavor to improve their transportation networks to meet the challenges of an increasingly competitive world.
The often limited options for surface routes and lack of surface space, combined with a growing environmental awareness, increasingly conspire to bring the tunneling option to the fore. Traffic in Tehran has long been a major problem in this sprawling metropolitan area of over 10 million residents.

Niayesh Tunnel and Sadr layered highway are two major and important projects which are indicative of high knowledge and capability of the Iranian experts in implementation of great and complicated projects.
Niayesh tunnel consists of two separated unidirectional tunnel tubes those are within 130 m (430 ft) of each other for most of the route, each tunnel carries 2 to 3 lanes of traffic and connects two of the major North–South highways in Tehran Metropolitan Area. For the first time in Iran, there are some embranchments of other tunnels among main tunnels.

The length of the north Tunnel is 2,660 m and the south Tunnel is 2,610 m. The total length of the main tunnels as the second longest urban tunnel in the Asia excluding ramps is 6,658 metres (21,844 ft). The total length of the main tunnels and access tunnels is 10,252 metres (33,635 ft).

The main Tunnels have a cross section of 196 m^2 and are being excavated by NATM (New Austrian Tunneling Method). Intersection caverns derive sizes up to 455 m^2, the drilling of which in alluvial soils is unprecedented in the world. Geology is characterized by medium to high cemented sandy gravel to gravelly sand of the Tehran Alluvium. The project includes also structures as follows: 5 cross passages, ramps, intersections, ventilation building and control station.

Main tunnel execution started 26 March 2011 after finishing the site mobilization. On 19 March 2012 all the excavation finished. The average rate of excavation in tunnel was 18.5 metres (61 ft) per day, which was one of the fastest excavations in the world. The two separate tunnels were awarded to the Tablieh–Iran Shahr Joint Venture by the Tehran Municipality.

RESPONSIBILITIES

As a member of executive committee, concentrated on technical issues.

ALI AKBAR
KASHI GHANDI

PROJECT: Shahid Rajaei (Tajan) Dam

Client:	Mazandaran Regional Water Board
Contractor:	Tablieh Construction Co.
Consultant:	Mahab Ghodss Consulting Engineers
Position:	Deputy Project Manager
Primary contract period:	1991 - 1996
Location:	Mazandaran, Iran
Status:	Completed

PROJECT OUTLINE

Shahid Rajaee Dam, also known as the Soleyman Tangeh Dam, is a high double-curvature concrete arch dam on the Tajan River, located about 38 km (24 mi) south of Sari in Mazandaran Province, Iran.

The dam was built for hydroelectric power production, flood control and to provide water for industrial and agricultural use. The other objectives of the dam include flood protection and tourist attraction in the beautiful forests of Northern Iran, as well as a small hydroelectric power plant.

Tajan Dam was one of the first dams entirely built by Iranian firms, with Tablieh as the member of the Tablieh–Perlite Joint Venture. The height of the dam is 138 m and the length of the crest is 427 m, with a thickness of 27 m at the foundation level, and 7 m at the crest. The volume of concrete for the dam body and the hydraulic structures is 730,000 m.

The volume of excavated rock for the foundation and abutments is 450,000 m^3 .The grout curtain for the abutments is approximately 90,000 m.
It presents more than 105,000 m of drilling, and more than 8,000 tons of cement grout. The discharge rate of the 77 m free spillway is 1,000 m^3/s.

RESPONSIBILITIES

- As deputy project manager, involved in the design of the site installation plant, consisting of the installation of a 28 ton Cable Crane, Batching Plant, and Crushing Plant.
- Finalizing concrete mix design for more than 600,000 m^3 of mass concrete
- Reviewing method statements and monitoring the progress schedule.

PROJECT KEY DATA

Dam type:
Double arched concrete with free spillway

Dam Height:	138 m
Crest length:	427 m
Width of dam in foundation:	27 m
Width of dam in crest:	7 m
Mass & Structural Concrete:	730,000 m^3
Excavation:	550,000 m^3
Drilling & Grouting:	105,000 m^3

ALI AKBAR
KASHI GHANDI

PROJECT: Kouhrang Tunnel

Client:	Esfahan Regional Water Board
Contractor:	Tablieh Construction Co.
Consultant:	Zayand Ab Consulting Engineers
Position:	Project Manager
Primary contract period:	1994 - Present
Location:	Chahar Mahal Bakhtiari Province, Iran
Status:	Under Construction

PROJECT OUTLINE

The 23.4 km long, 4.1 m dia. concrete-lined kouhrang water trasmission tunnel annually conveys a 225 MCM from one of the branches of the famous Karun River to the arid central plains of Iran.

The tunnel passes through complex geological features such as seismic faults and karstic zones with a maximum overburden of approximately 1,300 meters. A variety of excavation techniques such as Tunnel Boring Machines (TBM), road headers, and drill and blast has been utilized with a maximum progress rate of 266 meters per month.

RESPONSIBILITIES

- As project manager, involved in all tunnel excavation methods, including Tunnel Boring Machine (TBM), Road Headers, and also the conventional drilling and blasting method
- Coordinated the use of horizontal jet grouting method for stabilizing 200 meters along the main fault area passing through crushed and mud formations under high water pressure through the complex fault formations.

PROJECT KEY DATA

Tunnel Length (D=4.1 m):	23,409 m
Adits Length:	3,900 m
Excavation by TBM:	246,000 m^3
Excavation by Road Header:	42,000 m^3
Concrete:	280,000 m^3
Reinforcement:	16,000 tonnes

ALI AKBAR
KASHI GHANDI

PROJECT: **Masjed-e-Soleyman Dam and Hydropower Plant**

Client: Iran Water & Power Resources Development Co.
Contractor: Tablieh Construction Co.
Consultant: Nippon Koei (Japan) -Moshanir-Lahmeyer International (Germany)
Position: Technical Coordinator
Primary contract period: 1995 - 2002
Location: Khuzestan, Iran
Status: Completed

PROJECT OUTLINE

The Masjed-e-Soleyman Dam previously named "Godar-e Landar" is one of the cascade dams on the well-known Karun river locating on the famous Karun River some 160 km from the provincial capital, Ahwaz.

It is a 177 meters (581 ft.) high rock fill dam with approximately 14 million cubic meters of embankment, and a 600 meter long spillway (with a concrete volume of 900,000 cubic meters), has an installed capacity of 2,000 MW, and its reservoir holds 261,000,000 cubic meters (212,000 acre ft.) of water.

The dam is a rock-fill structure with a vertical Clay-core and is completed on 2002.

The power station was built in two 1000 MW stages. The first stage was completed in 2003 and the second in September 2007. The spillway gates with the discharge capacity of 21700 m3/s are the largest of this kind in the country.

Tablieh, as the leading member of the Tablieh–Perlite Joint Venture was responsible for over 80% of the project civil works (both above and underground) in the context of various subcontracts from the Korean-Japanese main contractors, the Daelim–Sato Joint Venture.

RESPONSIBILITIES

- As technical project coordinator, coordinated with the Client, Engineer and the Prime Contractor on different aspects of the project, such as river diversion, quarry development for rock fill materials.
- Finalizing concrete mix design for more than 1.1 million cubic meters of concrete.
- Provision of guidelines & method statements for underground excavations (with total volume of half million cubic meters).
- Monitoring the progress schedule of the project.

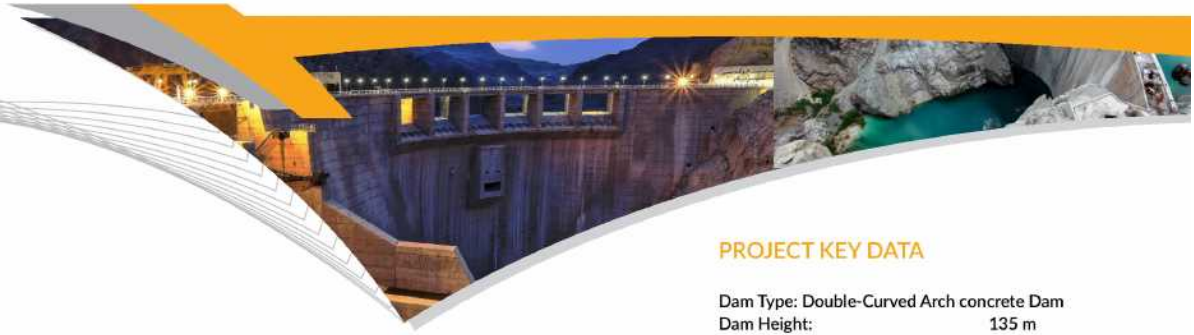
PROJECT KEY DATA

Dam Type: Dam
Dam Height: 177 m
Crest length: 497 m
Concrete: 1,100,000 m³
Excavation: 21,230,000 m³
Embankment: 14,000,000 m³
Reinforcement: 45,000 Tonnes
Power House Cavern:
Size: 155m (L) × 48m (H) × 30m (W)
4 Units of Francis Type Turbine generation (250MW)
Transformer Cavern:
Size: 110m (L) ×23m (H) ×14m (W)
Pressure shafts, upper & lower vertical bend:
Size: H=498m dia=9.5m
Tailrace Tunnels
Size: L=700m dia=11m
Vent shaft & gallery:
Shaft size: H=121m dia=5.6m
Gallery size: L=74m dia=5.6m
SF6 shaft & Bus gallery:
Shaft: H=98m dia=6m
Gallery: L=70m dia=6m
Power Intake:
Size: L= 120 m W= 42 m H= 45.5 m
Concrete Volume: 72,000 m³
Power Outlet:
Size: L= 162m W=34.5m H= 48.5m
Concrete Volume: 122,000 m³

ALI AKBAR
KASHI GHANDI

PROJECT: Shahriar Dam

Client:	East Azarbaijan Regional Water Board
Contractor:	Tablieh Construction Co.
Consultant:	Mahab Ghods Consulting Engineers
Position:	Project Coordinator
Primary contract period:	2001 - 2016
Location:	East Azarbaijan Province, Iran
Status:	Completed



PROJECT OUTLINE

The Sharyar Dam project is located on Ghezel-Ozan River, about 38 kilometres downstream of Mianeh in the north-west region of Iran.

The main objectives of this double arch concrete dam are the provision of irrigation and industrial water for both Azarbaijan and Guilan provinces as well as sedimentation control and removal from the famous Sefidrud Dam downstream.

The deposited sediment reduced the capacity of the storage to about 50 percent of the initial 1,700,000,000 m^3.

This project is one of the very first Design Build Finance (DBF) projects awarded by the Iranian Ministry of Energy.

Tablieh, as the leading member of Tablieh–Farab Consortium, was responsible for the entire civil works of the dam. Tablieh also provided extensive valuable design services in the context of a "Local Design Team" cooperating with the Swiss consulting firms, Stucky – Poyry Joint Venture.

RESPONSIBILITIES

- As project coordinator, involved in reviewing the design of site installation plants and method statements, as well as controlling and overseeing the progress schedule
- Supervision of construction of a cut-off wall (50 meters in height) in deep alluvial deposits, and a concrete-lined diversion tunnel (13 meters in diameter with a discharge capacity of 2,000 cubic meters per second)
- Applied the vertical jet-grouting method for stabilizing the steep slope of deep alluvial deposits, overlying a moderately soft clay zone.

PROJECT KEY DATA

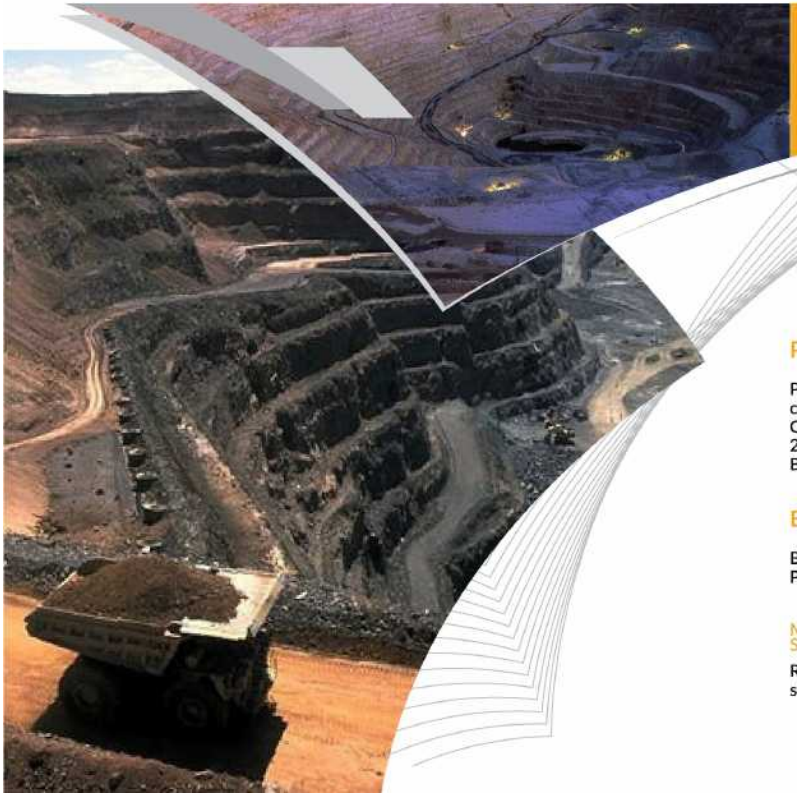
Dam Type: Double-Curved Arch concrete Dam

Dam Height:	135 m
Crest length:	207 m
Mass & Structural Concrete:	577,000 m^3
Open Air Excavation:	3,925,000 m^3
Underground Excavation:	102,000 m^3
Embankment:	623,000 m^3
Drilling & Grouting:	42,200 m
Tunneling:	3,840 m

HAMID REZA **MINAEI**

PROFESSION: **Civil Engineer**

Date of Birth: Oct 7, 1965



PUBLICATIONS

Proper solution in chute spillway concrete works at M.S. HEPP, Considering thermal stress analysis. 22nd congress of the large dams, Barcelona, June 2006.(Q.84-R.58)

EDUCATION

B.S. Civil Engineering, Tehran Polytechnic University Feb. 1990

MEMBERSHIP OF PROFESSIONAL SOCIETIES

Registered engineer in Iranian construction engineers organization, Registration No.: 10-3-0-06780

KEY QUALIFICATIONS

Senior Civil Engineer with 25 years of professional experience in technical management, hydropower and dam engineering and design, Project planning and control, large under-ground construction; Responsible for technical management of various projects, as well as planning, design and optimization of dams and hydropower projects.

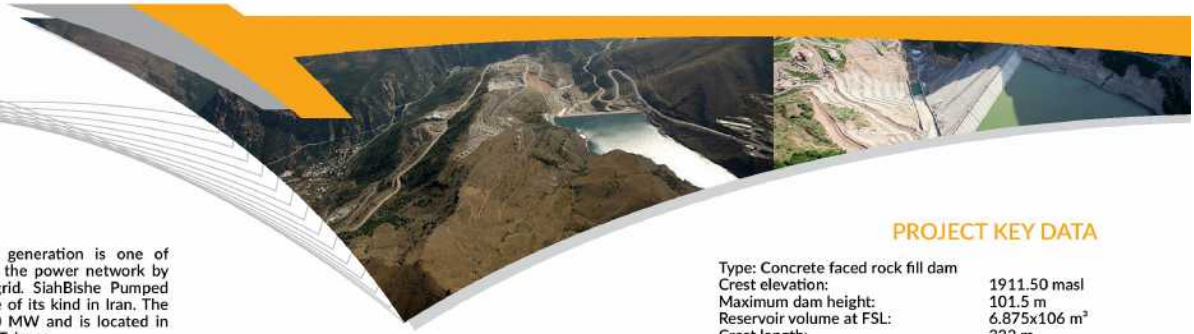
Extensive experience in the fields of construction planning and design, including site installation design, development and implementation of method statements for different construction works, as well as quality control in related disciplines in the field of dams and underground power plant construction, specifically large underground and open air excavation and concrete works.

Specialized in hydraulic design having full knowledge of related softwares in the field of hydraulic analysis.

HAMID REZA **MINAEI**

PROJECT: **Siah Bishe Pumped Storage**

Client:	Iran Water & power resources Development Co.
Contractor:	Contract A : Kayson, Beta & Soils Engineering Services (SES)
Contract B :	Tablieh & Farab
Consultant:	Moshanir , Colenco, Tiwag, Sakoo
Position:	Design manager, Technical Coordinator
Primary contract period:	60 months
Location:	Siah Bishe, Mazandaran province, Iran
Status:	Completed



PROJECT OUTLINE

Pumped storage hydroelectric power generation is one of the most efficient methods to balance the power network by supplying high peak demand in the grid. SiahBishe Pumped Storage Power Plant is the first scheme of its kind in Iran. The plant has an installed capacity of 1000 MW and is located in Mazandaran province, 125 Km North of Tehran.

The scheme includes two Concrete Face Rock fill Dams (CFRD) and an underground Power House. The dams also are the first CFRDs, which are constructed in the country.
The project is basically intends to supply electricity at the times of peak demand, while balance the power consumption in the grid during low demand hours. Decline in the annual costs of depreciation of thermal power plants up to $19 M, creation of a touristic environment in the region as well as employment in the project area during the construction and operation periods are some of the secondary advantage of the present project. In a tender held on 2003, the Siah Bishe project was awarded to the selected contractors, through two design-build contracts. On Aug.3, 2003, Beta, soils engineering services (SES) and Kayson company entered into a joint venture agreement with the last-named party as the leader of the consortium, to carry out contract "A" which includes design and construction of the two concrete-face the rock fill dams and their appurtenant structures, as well as the main parts of the headrace tunnels and related installations.
In June 2010 construction of the complementary operations of the two dams was notified to the parties.
A team of Iranian designers and a foreign consultant engineers "Poyry" from Switzerland carried out the design of CFRD dams and their appurtenant structures.
The underground power plant including powerhouse & transformer caverns, two 500 m height inclined steel lined pressure shafts as well as tailrace tunnels and other related structures was awarded to the joint venture of Farab and Tablieh under a desihn-build contract called contract "B". The civil works carried out by the Tablieh, while Farab was responsible for hydromechanical & electrical equipment. The design of the power plant and its related structures carried out by a local design team and Lahmeyer International from Germany.

RESPONSIBILITIES (In both Contracts A & B)

- Design management, coordination of design activities between foreign and local design teams.
- Development and implementation of method statements for construction through optimization of construction alternatives and procedures.
- Design review and optimization.
- Technical management, coordination between design office and construction site.

PROJECT KEY DATA

Type: Concrete faced rock fill dam

Crest elevation:	1911.50 masl
Maximum dam height:	101.5 m
Reservoir volume at FSL:	6.875x106 m^3
Crest length:	332 m
Crest width:	12 m
Fill volume:	2,477,950 m^3
Area of concrete face slab:	38,977 m^2
Plinth length:	497 m

SPILLWAY

Type: Stepped Spillway with free ogee weir

Discharge capacity (PMF):	910 m^3/s
Ogee crest width:	30.00 m
Total Length:	197 m
Stilling basin:	Width=30 m; length=45 m

GROUT CURTAIN

Total length:	743 m
Area:	42'791 m^2
Total Drilling length:	41,469 m

HEADRACE TUNNELS

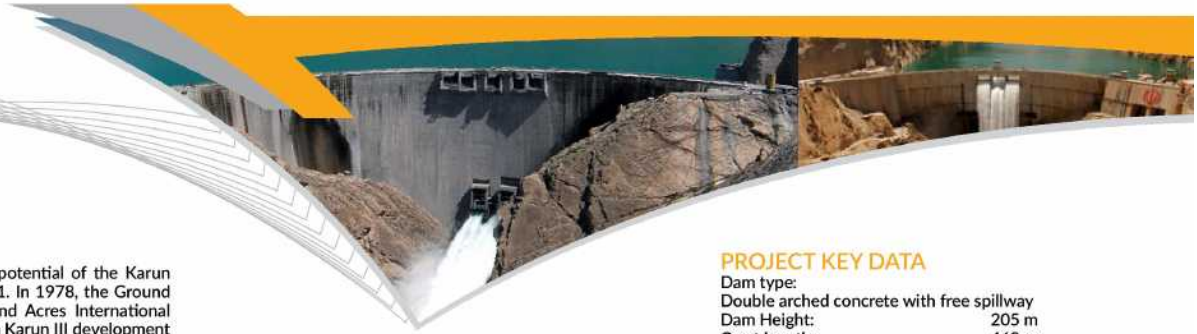
Tunnel section:	Circular
Concrete lined section:	5.7 m dia

Concrete lined section : 1191 m (right); 1953 m (left)
Discharge (max.):
128 m^3/s (turbine mode), 100 m^3/s (pump mode)

HAMID REZA **MINAEI**

PROJECT: **Karun III Development project**

Client:	Iran Water & power resources Development Co.
Contractor:	Tablieh Construction Company
Consultant:	Mahab Ghodss-Acres (Canada)
Position:	Technical Expert
Primary contract period:	2001 - 2004
Location:	Khuzestan Province, Iran
Status:	Completed



PROJECT OUTLINE

The first studies on the hydropower potential of the Karun River were completed from 1961-1971. In 1978, the Ground Water Resources Development Co, and Acres International were assigned the feasibility studies on Karun III development project with the intention of utilizing the hydroelectric potential of the melting snows of the Zagros Mountain Range in Southwest of Iran.

Karun 3 dam and hydro-electric power plant is located about 28km from Izeh city on Khuzestan province of Iran on Karun River. The dam as one of the highest concrete dams in the series of cascade dams on Karun River is a 205 m high double arch concrete type with an underground power plant of 2280 MW installed capacity and 1000MW extension is the largest hydroelectric plant in Iran.

The turbines are vertical Francis type of 285MW capacity. The total capacity of the spillways including 3bays main gated chute spillway, five bays crest spillway and two orifice spillways exceeds 15000 CMS.

The energy of discharged flows from spillways dissipates in a 400m length by 70m width concrete lined plunge pool of 70m depth. The 70m high concrete walls of the plunge pool are constructed against rock slope of heavily reinforced with more than 100 Km of pre-stressed rock anchors. Construction of the dam and power plant is completed on 2005 and power plant is now in operation. Construction of plunge pool, tail pond dam, left thrust block of the dam and left tailrace and outlet structure including more than 100 km of pre-stressed anchor installation as well as 750000 m^3 of concrete works is carried out by Tablieh Construction Co. from 2001 to early 2004.

RESPONSIBILITIES

- Construction Planning and implementation
- Cost planning
- Site installation planning
- Development and implementation of method statements for construction
- Claim management

PROJECT KEY DATA

Dam type:
Double arched concrete with free spillway

Dam Height:	205 m
Crest length:	462 m
Tunnel Length:	21 km
Tunnel Diameter:	6.5 – 14.5 m
Concrete:	707,132 m^3
Formwork:	123,300 m^2
Reinforcement:	25,590 Tons
Rock Bolting, Anchoring & Doweling:	130,000 m
Turbine Configuration:	8 X 285 MW Francis

HAMID REZA
MINAEI

PROJECT: Masjed-e-Soleyman Dam and Hydropower Plant

Client:	Iran Water & Power Resources Development Co.
Contractor:	Tablieh Construction Co.
Consultant:	Nippon Koei (Japan) -Moshanir-Lahmeyer International (Germany)
Position:	Technical office manager
Primary contract period:	1995 - 2001
Location:	Khuzestan, Iran
Status:	Completed

PROJECT KEY DATA

Dam Height:	177 m
Crest length:	497 m
Concrete:	1,100,000 m^3
Excavation:	21,230,000 m^3
Embankment:	14,000,000 m^3
Reinforcement:	45,000 Tonnes

Power House Cavern:
Size: 155m (L) × 48m (H) × 30m (W)
4 Units of Francis Type Turbine generation (250 MW)

Transformer Cavern:
Size: 110m (L) ×23m (H) ×14m (W)

PROJECT OUTLINE

Godar-e-Landar dam and H.E.P.P is located some 160 km northeast of Ahwaz in southwest of Iran on Karun river. The dam is a 177 m high rock fill type with impervious clay core with an underground powerhouse of 2000 MW installed capacity including 8 units of 250 MW capacity vertical Francis turbines.

The two bays chute spillway includes five bays of gated Ogee crests of 13.25m width, with a total discharge capacity of 21700 CMS ended in a stilling basin of 238m length and 72.5 m width. Construction of the dam and power plant is completed on 2001 and the first four units are in operation since 2002.

The main contractor of the project was a joint venture of Dailim (South Korea) – Sato (Japan), in cooperation with Tablieh -Perlite joint veture Construction company (Iran) as main sub-contractor in charge of more than 50% of open excavations with a volume of more than 10MCM, all underground excavations as well as all concrete works of open air and underground structures with a total volume of more than 1.1 MCM.

RESPONSIBILITIES

- Technical management (1999~2001)
- Development and implementation of method statements for construction through optimization of construction alternatives and procedures.
- Development of method statement for concurrent excavation and concrete works of the spillway structure.
- Technical office manager for underground works (1997~1998).
- Construction planning and implementation using primavera software (1996~1997).

HAMID REZA **MINAEI**

PROJECT: **Satarkhan Dam**

Client:	East Azarbaijan Regional Water Board
Consultant:	Band-Ab Consultant Engineer
Position:	Chief hydraulic designer
Primary contract period:	1993 - 1996
Location:	East Azarbaijan Province, Iran Status: Completed

PROJECT OUTLINE

The Satarkhan dam (Ahar Dam) is located some 750 km northwest of Tehran. The dam is constructed to control and regulate the surface flow of Ahar River to provide water for 12,000 ha of land downstream of the dam as well as potable and industrial water for Ahar city.

The construction of the dam is completed in 1998, a year ahead of schedule, and the project came into operation accordingly in a ceremony attended by the IRI President.

The annual water yield is 90 MCM. The Project includes an earth fill dam of 59 m height and 350 m length and a side channel spillway of 770 m chute length designed for an inflow of 2,300 CMS.The intake system includes a dry-intake cylinder tower.

RESPONSIBILITIES

As the chief designer of hydraulic structures of the scheme, following main duties were carried out by me in different stages of the design:

- Feasibility and Preliminary Design Stage:
  Design of hydraulic structures such as Spillway and related energy dissipation system, Diversion scheme, bottom outlet, intake structure and related conveyance structure; through study of different alternatives and selection of most technically and economically feasible design.
- Detail Design Stage:
  Detail design of all hydraulic Structures of the scheme including detail hydraulic design, preparation of layouts and required details in close coordination with geotechnical and structural designers; as well as required coordination between different design departments.
- Tender Design Stage:
  Preparation of General and Technical Specification as well as Bill of Quantity and other related documents for tender stage.

PROJECT KEY DATA

Rock Excavation:	625,000 m^3
Earthwork:	4 MCM
Formwork:	41,000 m^2
Concrete:	60,000 m^3

HAMID REZA **MINAEI**

PROJECT: **Aidoghmush Dam**

Client:	East Azarbaijan Regional Water Board
Consultant:	Band-Ab Consultant Engineer
Position:	Senior Design Engineer (Consultant)
Primary contract period:	1993 - 1994
Location:	East Azarbaijan Province, Iran Status: Completed

PROJECT OUTLINE

The Aidoghmush dam located some 20 Km southwest of Miane city in East Azerbaijan – in Northwest of Iran. The dam was constructed to control flow of Aidoghmush River which is a major tributary of the Ghezelozune River. It is designed for the irrigation of 15000 ha of land in the area.

The annual water yield is 228 MCM.The Project includes an earth fill dam of 65 m height and 347 m length and a free Ogee crested spillway of 65 m width and 125 m chute length designed for an inflow of 2750 CMS. The intake system includes a dry-intake cylinder tower equipped with 3 bulkhead gates in different levels. The project is under operation since 2006.

RESPONSIBILITIES

- Feasibility studies
- Preliminary project layout
- Preliminary civil design
- Chief designer of hydraulic structures
- Detail hydraulic calculation of the project

HAMID REZA
MINAEI

PROJECT: **Sahand Dam**

Client:	East Azarbaijan Regional Water Board
Consultant:	Band-Ab Consultant Engineer
Position:	Senior Design Engineer (Consultant)
Primary contract period:	1993 - 1993
Location:	East Azarbaijan Province, Iran Status: Completed

RESPONSIBILITIES

- Feasibility studies
- Preliminary project layout
- Preliminary civil design
- Chief designer of hydraulic structures

PROJECT OUTLINE

Sahand dam is constructed on the main branch of the Qaranghoochai river, the major fork of Qezelozan river in the Caspian sea drainage basin, and located some 550 Km northwest of Tehran.

The dam is built to improve the irrigation of 12000 ha of land southwest of Hashtrud and west of Mianeh and will significantly improve the overall economy of the area. The project is now in operation.

The dam is an earth fill type with impervious clay core located in an adverse geological condition which led to special measures for foundation treatment and water-tightening.

The annual water yield is 149 MCM. The scheme includes an earth fill dam of 47 m height and 350m length and a free spillway of 140 m chute length designed for an inflow of 1850 CMS.

HAMID REZA **MINAEI**

PROJECT: **Ardebil Dam**

Client:	East Azarbaijan Regional Water Board
Consultant:	Band-Ab Consultant Engineer
Position:	Senior Design Engineer (Consultant)
Primary contract period:	1992 - 1992
Location:	Ardebil Province, Iran
Status:	Completed

RESPONSIBILITIES

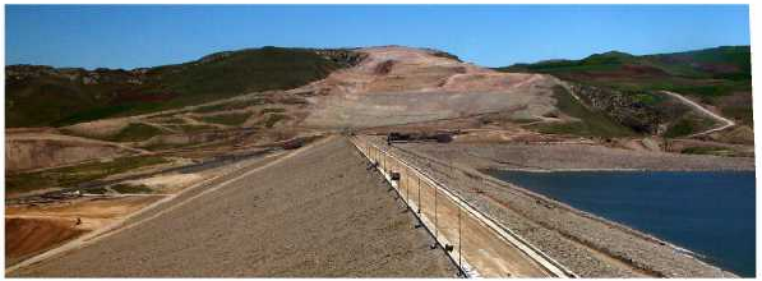
- Feasibility studies
- Preliminary project layout
- Preliminary civil design
- Chief designer of hydraulic structures
- Detail hydraulic calculation of the project

PROJECT OUTLINE

The Ardebil dam is located about 590 km northwest of Tehran on Balukhluchai River, a fork of Qaresu and Arass rivers.
The main purpose of the project was to provide potable water for Ardebil city and also irrigation of some 15000 ha of land. Construction activities of the dam were finished at the beginning of 2004 and the dam is in operation now.

The annual water yield is 102 MCM. The Project includes an earth fill dam of 61m height and 860m length and a side channel spillway of 420 m chute length designed for an inflow of 2030 CMS.

High seismic potential of the area as well as special condition at dam foundation led to special consideration in the design of the different structures in this project.



HAMID REZA **MINAEI**

PROJECT: **Adjabshir Dam**

Client:	East Azarbaijan Regional Water Board
Consultant:	Band-Ab Consultant Engineer
Position:	Design Engineer (Consultant) Primary
contract period:	1992 - 1992
Location:	Ardebil Province, Iran
Status:	Completed

RESPONSIBILITIES

- Feasibility studies
- Preliminary project layout
- Preliminary civil design
- Chief designer of hydraulic structures
- Detail hydraulic calculation of the project

PROJECT OUTLINE

The Adjabshir dam is located about 720 km northeast of Tehran on Qalechai River. The main purpose of the project was to provide potable water for Ardebil city and also irrigation of some 10,000 ha of land. Construction activities of the dam were finished in late 2006.

The annual water yield is 76 MCM. The Project includes an earth fill dam of 72 m height and 300 m length and a side channel spillway of 230 m chute length designed for an inflow of 1200 CMS.

Due to special condition of the dam site, extensive studies had performed to optimize the design.

HAMID REZA **MINAEI**

PROJECT: **Ahar Diversion Dam**

Client:	East Azarbaijan Regional Water Board
Consultant:	Band-Ab Consultant Engineer
Position:	Design Engineer (Consultant) Primary
contract period:	1991 - 1992
Location:	East Azarbaijan Province, Iran Status: Completed

RESPONSIBILITIES

- Feasibility studies
- Preliminary project layout
- Preliminary civil design
- Chief designer of hydraulic structures
- Detail hydraulic calculation of the project
- Check of detail design

PROJECT OUTLINE

Ahar diversion dam is located at downstream of the Satarkhan dam to divert the regulated water released through dam irrigation outlet to the irrigation system.

It includes an Ogee crested concrete structure with a gated sluice way and a disilting basin.

The diversion dam is constructed and is on operation now as the intake system for the irrigation network of the Satarkhan project.

HAMID REZA **MINAEI**

PROJECT: **Shoor River Diversion Dam**

Client:	Iran National Copper Company
Consultant:	Band-Ab Consultant Engineer
Position:	Design Engineer (Consultant)
Primary contract period:	1991 - 1991
Location:	Kerman Province, Iran
Status:	Completed

RESPONSIBILITIES

- Feasibility studies
- Preliminary project layout
- Preliminary civil design
- Chief designer of hydraulic structures
- Detail hydraulic calculation of the project

PROJECT OUTLINE

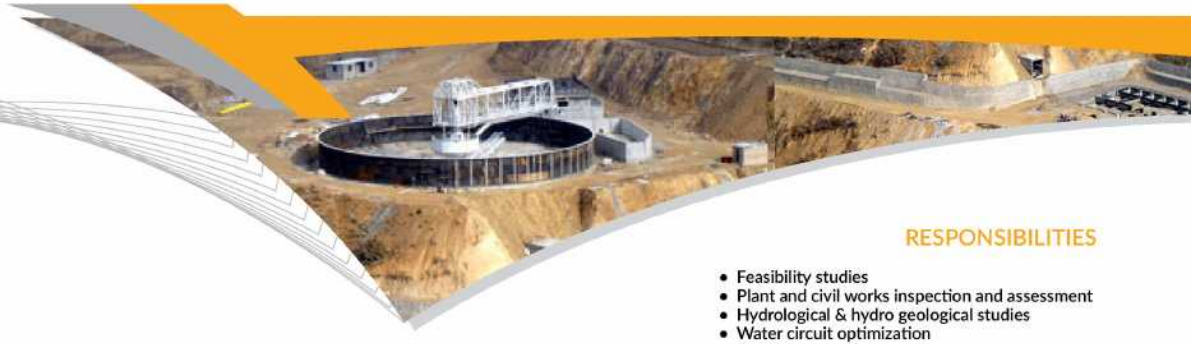
Shoor river diversion dam is located 20 km upstream of the Sarcheshme copper industry at Kerman – Iran.

The dam is constructed to divert the water from the Shoor River to the factory to compensate the water loss in the closed circuit of the system. It includes an Ogee crested concrete structure equipped with a gated sluice way and a disilting basin.

HAMID REZA **MINAEI**

PROJECT: Sarcheshmeh Cooper industry

Client:	Iran National Copper Company
Consultant:	Band-Ab Consultant Engineer
Position:	Design Engineer (Consultant)
Primary contract period:	1991 - 1991
Location:	Kerman Province, Iran
Status:	Completed



RESPONSIBILITIES

- Feasibility studies
- Plant and civil works inspection and assessment
- Hydrological & hydro geological studies
- Water circuit optimization
- Preliminary project layout
- Preliminary civil design
- Designer of hydraulic structures
- Detail hydraulic calculation of the project including pumping station

PROJECT OUTLINE

Sarcheshmeh cooper complex in Kerman-Iran is one of the biggest cooper mines in the word. The design of the water supply system as well as waste management is of utmost important in operation of the system specially in the central part of the country with almost dry climate.

Serious limitations in water sources as well as environmental requirements to prevent pollution of the region by releasing water from the tailing dam made it necessary to optimize the water circuit, making a close circuit in the system.

The goal was to minimize the water supply from the underground sources, while minimizing the required pumping capacity from the tailing dam to the factory.
This was achieved by increasing the capacity of the tailing dam at the downstream and in the meantime diverting the Shoor River at the upstream of the factory.

Extensive studies had been carried out to find the optimum solution.

HAMID REZA **MINAEI**

PROJECT: Sarcheshmeh Tailing Dam

Client:	Iran National Copper Company
Consultant:	Band-Ab Consultant Engineer
Position:	Assistant Engineer (Consultant)
Primary contract period:	1990 - 1991
Location:	Kerman Province, Iran
Status:	Completed

RESPONSIBILITIES

- Feasibility studies
- Preliminary civil design
- Designer of hydraulic structures
- Detail hydraulic calculation of the project

PROJECT OUTLINE

Sarcheshmeh tailing dam is located about 20 km downstream of the Sarcheshmeh cooper complex in Kerman – Iran.

The dam is an earth fill type with impervious clay core. The dam height was increased by 25 m in order to provide enough reservoir capacity for the waste material of the cooper factory as well as providing required water storage for the factory.

HAMID REZA **MINAEI**

PROJECT: **Kotlibhel H.E. Stages IA, IB & II**

Client:	National Hydroelectric Power Corporation Limited (India)
Contractor:	Tablieh - Simplex Joint Venture
Position:	Technical Manager, Authorized Signatory (Contractor)
Primary contract period:	2007 - 2008
Location:	India
Status:	Completed

PROJECT OUTLINE

Bid preparation for international tender. Kotlibhel HE project stage -1A (3x65=195 MW) is located near village muneth about 3.8 km upstream of the confluence of river Bhagirathi andalaknanda at devprayag in distt. Thehri garhwal of Uttaranchal, India. The project is a run of the river scheme on river Bhagirathi and proposes to harness the hydro potential of the river.

A net head of 63.33 m is proposed to be utilized for power generation. The powerhouse will have an installed capacity of 195 MW & The project will generate 1025.5 MU in a 90% dependable year with 95% machine availability. A concrete gravity dam with 82.5 m height from deepest foundation level and 140 m length at top with 5 bays of orifice type spillway with breast wall will be installed. Intake structure for the head race tunnel, located just upstream of dam on the left bank and a diversion tunnel of 7.5 m dia. and 460 m long through the right abutment of dam with upstream and downstream cofferdams.

The Kotlibhel Hydroelectric Project Stage IB is located in the district Tehri Garhwal of Uttaranchal about 2.2 km upstream of the confluence of river Bhagirathi and Alaknanda of Devprayag, along national highway from Delhi-Rishikesh-Srinagar-Badrinath-Mana Pass. The project is located on the river Alaknanda and comprises a 90m high concrete gravity dam, four numbers independent intakes are located in the power dam block on the right side adjacent to spillway block, 5.5 m diameter steel penstock a surface powerhouse at the toe of dam in the right bank and a short tail race channel and other capacity of 320 MW (4*80 MW).

The kotlibhel hydroelectric project stage II is located in the district tehri garhwal of Uttaranchal about 30 km downstream of the confluence of river Bhagirathi and alaknanda at devprayag, along national highway NO. NH-580. the project headquarters are about 350 km from new delhi.

The project comprises a 82 m high concrete gravity dam, an underground power house having 8 units of 66.25 MW each (530 MW) on its left bank, 8 No. circular shaped inclined steel lined pressure shaft of 6.8 m dia and 140 m length each to carry water of power house and 4 nos. 10.0 m diameter horse shoe shaped tailrace tunnels of about 350 m, 350 m, 345 m & 320 m lengths to carry water from power house back to the river.

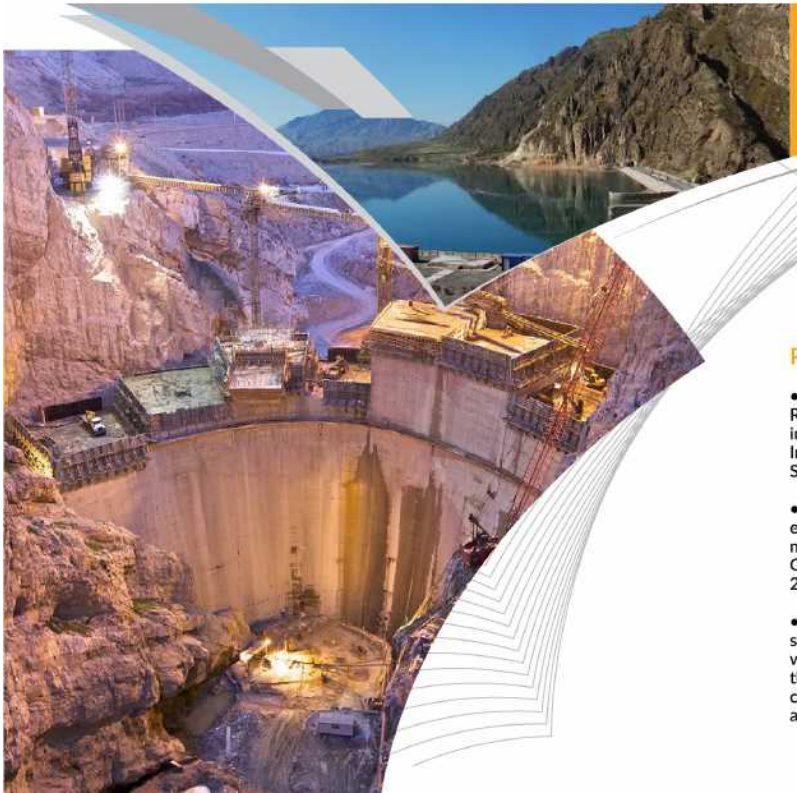
RESPONSIBILITIES

- Technical management for Preparation of tender document
- Development of method statements for construction through optimization of construction alternatives and procedures
- Construction Planning
- Site installation planning including mobilization planning
- Clarification with the Owner and getting approval for technical proposal
- Cost estimation and preparation of cost proposal in collaboration with QS department

JAVAD ABED

PROFESSION: Civil & Geotechnical Engineer

Date of Birth: : June 05, 1972



PUBLICATIONS

- Abednamini, J. & Baghery, R., 2002. Results of grouting tests carried out in Upper Gotwand dam site.Proc. 3rd Int. Conference on Dam Engineering, Singapore, pp. 49-56.
- Abednamini, J., 2002. Impact effects in dynamic compaction method. Proc. 1st Conference on Ground Improvement, Tehran, pp. 247-258.
- Abednamini, J., Minaie h., Proper solution in chute spillway concrete works at M.S. HEPP, considering thermal stress analysis. Icold conference, Barcelona June 2006, accepted for publishing.
- Abednamini, J., Using dynamic compaction method in improving rehabilitated lands along the Persian Gulf, not published yet.

EDUCATION

- B.Sc. in Civil Engineering
  Tabriz University, Tabriz, Iran, 1995
- M.Sc. in Soil Mechanics & Foundation
  Amir-Kabir University of Technology, Tehran, Iran, 1997
- Accomplishment of the educational course of the PH.D
  Soil and Foundation (grade: 17.5) Amir-Kabir University Technology, Tehran, Iran, 2001
- Passing the PH.D inclusive test , 2001
- Commencement of activities for the dissertation thesis, 2002

JAVAD ABED

PROJECT: Sangtuda 2 Hydroelectric Power Plant

Client:	Engineering & Development Org. of Tehran
Contractor:	Farab International Co.
Consultant:	Mahab Ghods Consulting Engineers Co.
Position:	Civil Manager
Primary contract period:	2006-2011
Location:	Khatlan Province, Tajikistan
Status:	Completed

PROJECT OUTLINE

Sangtuda 2 H.E.P.P is located Close to Ghazal Village on Vakhsh River in Khatlan Province of Tajikistan.

Construction commenced during the Soviet period in the 1980s, but halted in the beginning of the 1990s due to lack of financing. In 1995, Iran expressed interest in helping to finish the project, but an agreement was not signed until 2005. Building work restarted on 20, December 2006.

The first unit was inaugurated on 6 September 2011 by presidents Emomalii Rahmon and Mahmoud Ahmadinejad. It operates simultaneously with Sangtuda 1 Hydroelectric Power Plant. It uses gates of Nurek reservoir.
The dam is an earth fill dam with clay core. The run-of-river type power plant consist of two units able to produce 1 TWh of electricity a year.
The generating equipment is manufactured in China. Revenues during first 12 years would be paid to Iran and after that, ownership would be transferred to Tajikistan.

RESPONSIBILITIES

Civil Engineering Manager

PROJECT KEY DATA

Dam Configuration

Dam type:	Earthfill with Clay Core
Concrete Volume:	320,000 m³
Reservior Volume:	66,500,000 MCM
Type of Overflow:	Gated
Type of Floodgate:	Radial, 5 Series

Main Equipment

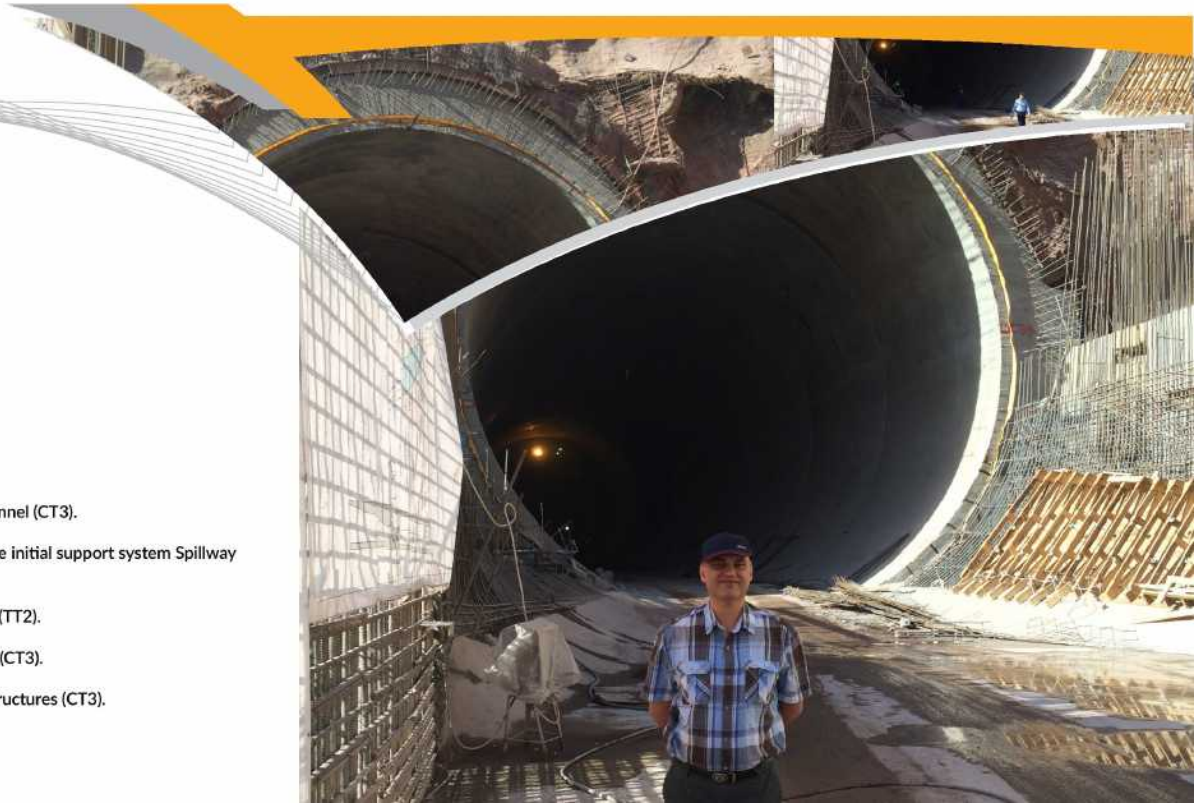
Type of Plant:	Surface
Number of Units:	2×110 MW
Capacity:	220 MW
AAPG:	994 milion Kwh

Turbines: Kaplan Turbine, 1100 tons (each units), 71.4 rpm
Generators: Vertical Shaft Synchronized, 13.8 KV, 1100 tonnes (each unit), 71.4 rpm, with an approx. weight 1100 tons (each unit)
Transformers: Three phase step-up, Initial Voltage: 13.8 KV, Output Voltage: 230 KV, 110 tons (each unit)

JAVAD ABED

PROJECT: Rogun Dam & Hydropower Plant-Diversion Tunnel (CT3)

Client:	Rogunskava HPS JSCo.
Contractor:	Omran Maroon & Tana Energy Co.
Position:	Project Manager
Location:	Tajikistan



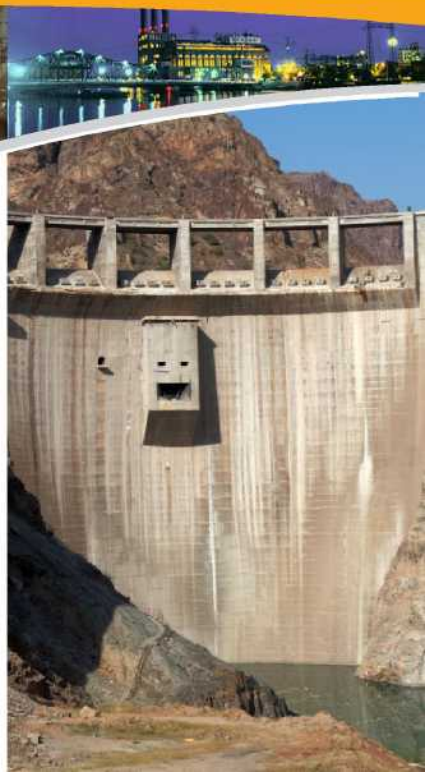
RESPONSIBILITIES

- Geological design of the spillway tunnel (CT3).
- Determination and estimation of the initial support system Spillway tunnel (CT3).
- Design of the initial support tunnel (TT2).
- Structural design of spillway tunnel (CT3).
- Hydraulic design of Appurtenant Structures (CT3).

JAVAD
ABED

PROJECT: **Aini Dam and H.E.P.P**

Contractor: Farab International Co. Consultant: Mahab Ghods Consulting
Engineers Position: Project Manager
Location: Tajikistan
Status: Designed



PROJECT OUTLINE

Construction of a power plant with a dam which has a total water storage capacity of around 66.5 MCM and can generate 130 MW of electricity per hour.

RESPONSIBILITIES

- Feasibility and Preliminary Design of hydraulic structures such as Spillway and related energy dissipation system, Diversion scheme, bottom outlet, intake structure and related conveyance structure; through study of different alternatives and selection of most technically and economically feasible design.

- Detail design of all hydraulic Structures of the scheme including detail hydraulic design, preparation of layouts and required details.

PROJECT KEY DATA

Dam type: Double arched concrete.
Storage Volume: 66,500,000 m^3

JAVAD ABED

PROJECT: **Shahriar Dam**

Client:	East Azarbaijan Regional Water Board
Contractor:	Tablieh Construction Co.
Consultant:	Mahab Ghods Consulting Engineers
Position:	Manager of Geotechnical Division of Local Designer Team (LDT)
Primary contract period:	2001 - 2006
Location:	East Azarbaijan Province, Iran
Status:	Completed

PROJECT OUTLINE

The Sharyar Dam project is located on Ghezel-Ozan River, about 38 kilometres downstream of Mianeh in the north-west region of Iran. The main objectives of this double arch concrete dam are the provision of irrigation and industrial water for both Azarbaijan and Guilan provinces, between Ostour and Sefidd-Rud storages, as well as sedimentation control and removal from the famous Sefidrud Dam downstream.

The deposited sediment reduced the capacity of the storage to about 50 percent of the initial 1,700,000,000 m^3.

The storage level was fixed at elevation 1,035 masl and stored water is proposed to be used for irrigation and forced removal of sediment in the Sefid-Rud storage reservoir downstream. This project is one of the very first Design Build Finance (DBF) projects awarded by the Iranian Ministry of Energy. Tablieh, as the leading member of Tablieh–Farab Consortium, was responsible for the entire civil works of the dam. Tablieh also provided extensive valuable design services in the context of a "Local Design Team" cooperating with the Swiss consulting firms, Stucky – Poyry Joint Venture.

RESPONSIBILITIES

- Designing of the upstream and downstream cofferdams and pertaining excavations and also cooperation with their foreign consultants the Swiss Stucky and Electrowatt
- Four-year period cooperation with Dr. P. Brenner in designing of the upstream cofferdam and excavation of almost 50m in alluvium
- Design for increasing the clay strength parameter before the excavation works, using Jet Grouting method
- Geotechnical Design

PROJECT KEY DATA

Dam Type:	Double-Curved Arch concrete Dam
Dam Height:	135 m
Crest length:	207 m
Mass & Structural Concrete:	577,000 m^3
Open Air Excavation:	3,925,000 m^3
Underground Excavation:	102,000 m^3
Embankment:	623,000 m^3
Drilling & Grouting:	42,200 m
Tunneling:	3,840 m

JAVAD ABED

PROJECT: Masjed-e-Soleyman Dam and Hydropower Plant

Client:	Iran Water & Power Resources
Contractor:	Moshanir Consulting Co.
Consultant:	Nippon Koei (Japan) -Moshanir-Lahmeyer International (Germany)
Position:	Geotechnical Designer
Primary contract period:	1995 - 2001
Location:	Khuzestan, Iran
Status:	Completed

PROJECT OUTLINE

The Masjed-e-Soleyman Dam (also known as Karun-2 Dam) previously named "Godar-e Landar" is one of the cascade dams on the well-known Karun river locating on the famous Karun River some 160 km from the provincial capital, Ahwaz. It is a 177 meters (581 ft.) high earth fill dam with approximately 14 million cubic meters of embankment, and a 600-meter long spillway (with a concrete volume of 900,000 cubic meters), has an installed capacity of 2,000 MW, and its reservoir holds 261,000,000 cubic meters (212,000 acre.ft.) of water.

The dam is a rock-fill structure with a vertical clay-core and was completed on 2002. The power station was built in two 1000 MW stages. The first stage was complete in 2003 and the second in September 2007.

The spillway gates with the discharge capacity of 21700 m^3/s are believed to be the largest of this kind in the country. Tablieh, as the leading member of the Tablieh–Perlite Joint Venture was responsible for over 80% of the project civil works (both above and underground) in the context of various subcontracts from the Korean-Japanese main contractors, the Daelim–Sato Joint Venture.

RESPONSIBILITIES

Cooperation with Lahmeyer and Nippon Koei experts. E.g.

PROJECT KEY DATA

Dam Height:	177 m
Crest length:	497 m
Concrete:	1,100,000 m^3
Excavation:	21,230,000 m^3
Embankment:	14,000,000 m^3
Reinforcement:	45,000 Tonnes

Power House Cavern:
Size: 155 m (L) × 48 m (H) × 30 m (W)
4 Units of Francis Type Turbine generation (250 MW)

Transformer Cavern:
Size: 110 m (L) ×23 m (H) ×14 m (W)

Pressure shafts, upper & lower vertical bend:
Size: H=498 m dia=9.5 m

Tailrace Tunnels
Size: L=700 m dia=11 m

Power Intake:
Size: L= 120 m W= 42 m H= 45.5 m
Concrete Volume: 72,000 m^3

Power Outlet:
Size: L= 162 m W=34.5 m H= 48.5 m
Concrete Volume: 122,000 m^3

JAVAD ABED

PROJECT: Seimareh Dam and H.E.P.P

Client:	Iran Water & Power Resources Development Co.
Contractor:	Perlite Construction Co.
Consultant:	Mahab Ghods Consulting Engineers
Position:	Geotechnical Designer
Primary contract period:	1997
Location:	Ilam Province, Iran
Status:	Completed

PROJECT OUTLINE

Seimareh Dam, also known as Hini Mini or spelled Seimareh, is an arch dam on the Seimareh River in Darreh shahr County on Ilam Province of Iran.

The primary purpose of the dam is hydroelectric power generation. Studies for the dam were carried out in the mid to late 1970s and construction began on the diversion works in 1997. In 2006, concrete placement began and on 19, May 2011, the dam began to impound the river.

The dam's first generator became operational in 2013. The power plant, located downstream, houses three 160 MW Francis turbine-generators with an installed capacity of 480 MW.

RESPONSIBILITIES

Direct cooperation with Professor W. Wittke and his team in designing the upstream cofferdam and excavation of almost 45m in the alluvium in Perlite Construction Co.

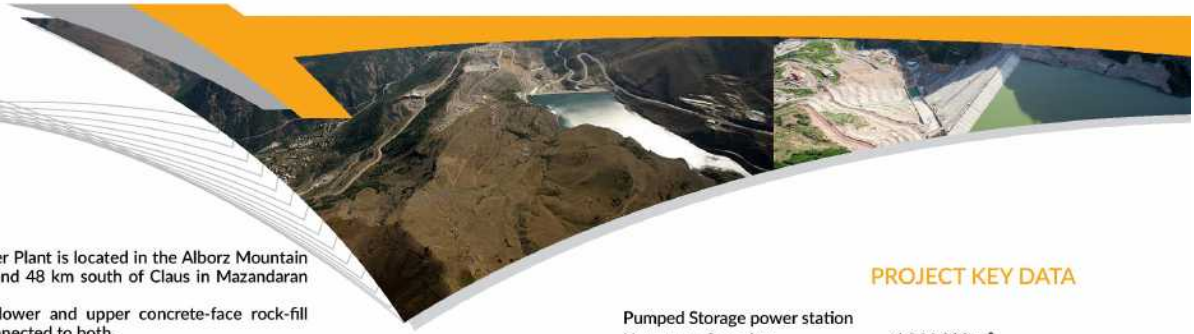
PROJECT KEY DATA

Dam type:	Variable-radius arch
type Dam Height:	180 m
Crest length:	202 m
Width of dam in foundation:	28 m
Width of dam in crest:	6 m
Mass & Structural Concrete:	550,000 m^3
Reservoir Surface:	69.5 km^2
Reservoir Capacity:	3,200,000,000 m^3
Open Air Excavation:	60,000 m^3
Concrete:	70,000 m^3
Reinforcement:	3,500 Tonnes
Formwork:	48,000 m^2
Powerhouse:	3×160 MW Francis units
Powerhouse Dimensions:	97.70 m (L) × 51.65 m (H) × 57.15 m (W)

JAVAD ABED

PROJECT: **Siah Bishe Pumped Storage Power Plant**

Client:	Iran Water & power resources Development Co.
Contractor:	Tablieh & Farab
Consultant:	Moshanir , Colenco, Tiwag, Sakoo
Position:	Manager of Geotechnical Division of Local Design Team (LDT)
Primary contract period:	60 months
Location:	Siah Bisheh, Mazandaran province, Iran
Status:	Completed



PROJECT OUTLINE

The Siah Bishe Pumped Storage Power Plant is located in the Alborz Mountain range near the village of Siah Bishe and 48 km south of Claus in Mazandaran Province, Iran.
The power plant operates using a lower and upper concrete-face rock-fill reservior along with a power plant connected to both.

Having an installed capacity of 1,000 MW, the power plant uses the pumped-storage hydroelectric method to generate electricity during periods of high energy demand, making it a peak power plant, intended to fulfill peak electricity demand in Tehran. Water is either pumped from the lower to the upper reservior to serve as stored energy or released from the upper to the lower reservior to generate electricity.

Pumping occurs during low demand, cheap electricity, periods such as night and generating will occur during peak demand, expensive electricity, hours such as during the day.

RESPONSIBILITI ES

- Design of all underground Tunnels except (Caverns).
- Geotechnical investigation and Design monitoring of all underground works.

PROJECT KEY DATA

Pumped Storage power station

Upper res. Capacity:	4,344,220 m³
Lower res. Capacity:	6,874,709 m³
Hydraulic Head:	Normal: 504 m Maximum: 520 m
Pump Generators:	4 × 260 MW Francis pump turbine

KHAKROUD
ENGINEERING AND COMMERCIAL

Client: Ragunskava HPS JSCo.
Contractor: Khakroud Co.
Primary contract period: 2016.03.11 - present
Location: Rogun, Tajikistan
Status: Under Construction

ROGUN PROJECT

PROJECT OUTLINE

Rogun Hydroelectric Project is located in Tajikistan on the Vakhsh River, about 340 km upstream of the river junction with Pyanj River.

The site is located at some 110 km north east from Dushanbe, to which is connected via the main highway M41 running from the Republic capital to Pamir, passing through Obigarm. Rogun dam site is situated about 80 km upstream of the existing Nurek HEPP, in a narrow and deep V-shaped valley with steep slopes on both banks (about 50°) that reaches up to 400 to 500 m above the river.

According to the design updated in 2010, the project includes a 335 m high earthfill dam to be constructed in continuous stages, the first of which would allow starting generating electricity with two units in temporary configuration, as well as power generation facilities and floods control facilities. The total volume of the final dam fill amounts at 71.4 MCM, 7.2 MCM of which represent the impervious central core. The excavations sum up to a total volume of 4.6 hm^3.

Average slopes of upstream and downstream faces are 2.9H/1V and 2.6H/1V respectively.

ROGUN PROJECT

THE POWER GENERATION FACILITIES INCLUDE:

- Six independent power waterways, each composed by a horizontal headrace tunnel with internal circular section of 7.5 m diameter; a vertical curve connects the tunnels with the vertical penstock shafts with 7 m diameter.
- An underground powerhouse 220 m long, 21 m wide and almost 69 m high from the top of the roof to the draft tube bottom, in which 6 generating units, 600 MW each, would be housed.
- Parallel to the powerhouse hall, at some 62.5 m distance between axes, the transformer cavern, about 200 m long and 19 m wide, with maximum height from the top of the roof to the lower floor of almost 40 m. The transformer cavern houses six three-phase transformers close to the wall at powerhouse side, on the opposite side provisions are made to handle the stoplogs of the discharge tunnels, which underpass the cavern and connect with the discharge collectors.
- 6 bus duct galleries which connect the transformers cavern with the powerhouse.
- Two cables galleries starting from the eastern side of the transformers hall and running to south for some 700 m, and the outdoor switchyard.
- Six draft tubes which join three by three into two collectors are provided for releasing water to the two diversion tunnels.

ROGUN PROJECT

- The downstream reach of the diversion tunnels is due to be converted to tailrace tunnels, while the upstream portion will be plugged just before the junction with the draft-tubes collectors and will be abandoned.
- The protection against floods during the various phases of the project implementation and along the operation period is provided by a system of tunnels developing both in the right and in the left bank, namely:
- Diversion tunnels number one and two with total length of about 1,200 m, the tunnels are concrete-lined and their internal section is mostly D-shaped, 17 m high and 14 m wide along the downstream stretch of some 700 m that will be used as tailrace tunnel.
- Diversion Tunnel No. 3, some 1,600 m long, entirely located in the right bank, intake of which, at el. 1,035 masl., is located some 300 m downstream from the diversion tunnel No. 2 entrance. The upstream stretch up to the gates chamber, about 700 m long, has an internal section of approximately 175 m². The tunnel outlet is provided with a chute and terminal flip bucket, located a few meters above the riverbed.
- A grout curtain around 100 m deep is set up in the foundation, prolonging the impervious core alignment within the banks. The grouting works would be carried out from galleries excavated within the banks at regularly spaced levels over the whole dam height (6 different levels).
- Third level operation tunnel, some 1450 m long, located in the left bank, with intake at el. 1,145 masl.
- Remote spillway tunnel and operation shaft spillway, composed as follows:
  - Tunnel spillway with intake at el. 1,145 masl.
  - Operation shaft spillway, with an entrance equipped with three radial gates 14 m wide, elevation of sill at 1,283.5 masl., 12 m diameter.

The project includes a large number of tunnels, both permanent and temporary, and several construction adits which have been used to provide access to the underground structures at different elevations, as well as diffrent caverns with dimentions up to 45 m in height and 20 m in width.

KHAKROUD
ENGINEERING AND COMMERCIAL

ROGUN
PROJECT

SCOPE OF WORK

- Site Installation, Residential, Office & Workshops Excavation & Concrete works of units Nos. 5 & 6 of Powerhouse.
- Excavation & Concrete works in Draft-Tubes Nos. 4 & 5 & 6.
- Excavation in Transformer cavern Nos. 4 & 5 & 6.
- Anchoring works in Powerhouse & Transformer Caverns.
- More than 16 km of monobar installation till now.
- Excavation of 4 shafts using Raise Climber (Alimak).
- Excavation, supporting and concreting of drainage shaft (50 meters height).
- Construction of carpentry workshop with around 1,000 m^2 of area and advanced equipment.
- Construction of Residential places for more than 400 people.
- Construction of more than 1,000 m^2 offices.

KHAKROUD
ENGINEERING AND COMMERCIAL