# طرح نگهداشت و افزایش تولید 27 مخزن

# CIVIL DESIGN CRITERIA

## نگهداشت و افزایش تولید میدان نفتی بینک

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**Status:**

**IDC: Inter-Discipline Check**
**IFC: Issued For Comment**
**IFA: Issued For Approval**
**AFD: Approved For Design**
**AFC: Approved For Construction**
**AFP: Approved For Purchase**
**AFQ:** Approved For Quotation
**IFI: Issued For Information**
**AB-R: As-Built for COMPANY Review**
**AB-A: As-Built –Approved**

## REVISION RECORD SHEET

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## 1.0 INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

**GENERAL DEFINITION**

The following terms shall be used in this document.

| | |
|---|---|
| CLIENT: | National Iranian South Oilfields Company (NISOC) |
| PROJECT: | Binak Oilfield Development – General Facilities |
| EPD/EPC CONTRACTOR (GC): | Petro Iran Development Company (PEDCO) |
| EPC CONTRACTOR: | Joint Venture of : Hirgan Energy – Design & Inspection(D&I) Companies |
| VENDOR: | The firm or person who will fabricate the equipment or material. |
| EXECUTOR: | Executor is the party which carries out all or part of construction and/or commissioning for the project. |
| THIRD PARTY INSPECTOR (TPI): | The firm appointed by EPC CONTRACTOR and approved by GC & COMPANY (in writing) for the inspection of goods. |
| SHALL: | Is used where a provision is mandatory. |
| SHOULD: | Is used where a provision is advisory only. |
| WILL: | Is normally used in connection with the action by COMPANY rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR. |
| MAY: | Is used where a provision is completely discretionary. |

## 2.0 SCOPE

This design criteria document outlines the method of calculation and general requirements for civil engineering design. The civil design and construction work includes the following:

- Site facilities
- Surface drainage system

- Sewage treatment
- Pipe crossings

## 3.0 NORMATIVE REFERENCES

### 3.1 LOCAL CODES AND STANDARDS

- IPS-E-PR-725 — Engineering Standard for Process Design of Plant Waste Water Sewer System
- IPS-E-CE-380 — Engineering Standard for Drain and Sewer Systems Outside Buildings

### 3.2 INTERNATIONAL CODES AND STANDARDS

- ASTM — American Society for Testing and Materials
- AASHTO — American Association of State Highway and Transportation Officials

### 3.3 THE PROJECT DOCUMENTS

- BK-GNRAL-PEDCO-000-CV-SP-0004 — Specification for Earth Work
- BK-GNRAL-PEDCO-000-CV-SP-0002 — Specification for Road and Paving
- BK-GNRAL-PEDCO-000-CV-SP-0005 — Specification for Sewer and Drainage

## 4.0 SITE FACILITIES

### 4.1 AREA FILLS AND GRADING

In general, grading shall be performed to provide extensive, reasonably level areas of new and old facilities construction. The site shall be cutting (Minimum 300 mm) from un-suitable top soil However, All fill material shall be suitable for construction thereon, and all fills intended to carry loads shall be compacted to not less than 95% modified AASHTO density.

All areas which are to be excavated or filled shall be cleared of debris and vegetation and stripped to a depth of at least 30cm or as directed by the site engineer to remove all organic materials.

### 4.2 PAVING

#### 4.2.1 Types of paving for various areas shall be as schedule below:

| AREA | MINIMUM THICKNES & SURFACE TYPE | | BASE |
|---|---|---|---|
| Process Operation Areas (subject to heavy mobile equipment) | 250mm reinforced concrete slab on grade | 50mm sand , 500 gauged Polythene film | 150mm Base course, Subgrade soil 95% compacted fill |
| compacted fill Process Operation Areas (not subject to heavy mobile equipment) | 150mm reinforced concrete slab on grade | 50mm sand , 500 gauged Polythene film | 150mm Base course, Subgrade soil 95% compacted fill |
| Areas Subjected to Light mobile equipment or Walk ways | 100mm reinforced concrete slab on grade | 50mm sand , 500 gauged Polythene film | |
| Other non-road areas with in fence | 100mm gravel aggregate | - | |

All Plant Roads and Paved Areas subjected to vehicular loading shall have the following minimum thicknesses:

**a)** Asphalted Roads and Paved Areas

- Wearing Course, 40mm asphaltic concrete.
- Binder Course, 60mm asphaltic concrete.
- Base Course, 150mm granular materials.
- Sub Base Course, 200 mm.

**b)** Concrete Pavements

- 250mm thick concrete slab, reinforced with 200×200×8 mm reinforcing fabric mesh
- 150mm thick base course of granular materials.

Walkways and Paved Areas not subjected to vehicular loading shall have the following minimum thicknesses:

- 100mm thick concrete slab, reinforced with 150×150×8 reinforcing fabric mesh,
- 150mm thick base course of granular materials

### 4.2.2 Paving Definition

#### 4.2.2.1 Heavy Duty Paving

Heavy Duty Paving 250mm thick concrete, reinforced by two layers of 200×200×8 mm reinforcing fabric mesh in areas where large cranes must be positioned for equipment maintenance operations.

Base course: 150mm thick crushed stone compacted or selected granular.

Sub grade: Existing soil compacted to 95% Modified AASHTO.

Polythene sheeting shall be laid before placing the reinforcement and pouring the concrete to prevent absorption of water into the sub base. It shall be a 500 gauge polythene sheet lapped 150mm.

#### 4.2.2.2 Medium Duty Paving

Medium Duty Paving 150mm thick concrete, reinforced with one layer of 150 × 150 × 8 mm reinforcing fabric mesh in areas of process liquid spills, under piping and subject to truck traffic.

Base course: 15cm thick crushed stone or selected granular material.

Sub grade: Existing soil compacted to 95% Modified AASHTO. Polythene sheeting shall be laid before placing the reinforcement and pouring the concrete to prevent absorption of water into the sub base. It shall be a grade 1000 polythene sheet lapped 150mm.

#### 4.2.2.3 Light Duty Paving

Light Duty Paving 100mm thick concrete reinforced with one layer of 150 × 150 × 8 mm reinforcing fabric mesh in areas of process liquid spills & inaccessible to vehicular traffic.

Base course: 15cm thick crushed stone or selected granular material.

Sub grade: Existing soil compacted to 95% Modified AASHTO. Polythene sheeting shall be laid before placing the reinforcement and pouring the concrete to prevent absorption of water into the sub base. It shall be a grade 1000 polythene sheet lapped 300m

### 4.2.3 Paving Elevation

High point of the paving shall be near the center of the process operations areas and it shall be sloped a minimum of 1% to drain. Paving shall slope away from all equipment foundations to prevent water damage to foundation and preserve bearing capacity.

### 4.2.4 Paving Design

Final design thickness of pavements shall be appropriate to vehicular or other acted loadings. Paving slabs adjacent to foundation pedestals columns, etc. shall be separated by remolded joint filler and sealer.

In the case of large areas covered by pavement slabs, the slabs shall be subdivided into square, rectangle or other convenient shapes by use of expansion joints. Such expansion joint should be placed at the high points of the slab in order to discourage infiltration of water below the slab. Other kinds of joints such as contraction, construction, control and etc. should be used as necessary.

Reinforced concrete paving shall be foreseen in areas in which may be hydrocarbon/polluted spillage. Paving in areas liable to the spillage of either caustic or acid solutions shall be curbed and shall proved according to project specifications.

Medium and heavy paving may support minor equipment, like small pumps, and staircase, light skid mounted packages, Pipe Supports with Max weight of 20kN on each support.

Concrete paved areas shall be parted into rectangular sections limited by expansion joints. These joints shall not be more than 16-20m apart and shall extend to the full depth of concrete paving. Expansion joints shall be 20mm width and shall be filled with hot bitumen or with suitable material hydrocarbon resistant. Higher part of joint shall be sealed with polystyrene or with suitable non-extruding material.

In correspondence of expansion joints shall be foreseen dowel bars for transferring at least 20% of the load across the joint. Dowel bars shall consist of smooth steel bar 25mm diameter, 1000mm long with at a spacing of 500mm. Half-dowel bars shall be coated to prevent bond between two sections of R.C. slab.

Contraction joints shall not be more than 6m apart. They shall be 10mm wide and 10mm deep sealed with suitable material non-extruding. The cut in concrete shall be made after casting.

Isolation joints shall be foreseen between paving and foundations projecting above grade.

## 4.3 ROADS

### 4.3.1 General

Roads in and around process areas shall be for movement of the mobile equipment planned for the facilities.

All roads shall be min. 6 meters wide. Shoulder should be used as necessary.

Shoulder width shall be as shown on drawings.

### 4.3.2 Loads

Traffic loads shall be in accordance with Iranian bridge loading code (Pub. No 139 of Planning and Budget Organization).

### 4.3.3 Asphalt Paving

Design for flexible paving shall be based on local conditions at the individual plant sites because of the varying soil conditions and availability of base materials.

Road ways shall be sloped min.2% on the crown. Subgrade shall be shaped and rolled to provide a uniform compacted surface for application of base course material.

If fill is necessary, the engineer shall specify the removal of all top soil, organic material, or other soil incapable of supporting intended loads. In general, the minimum of fills will be 200mm. Following the removal of unsuitable soils the Subgrade shall be scarified to a depth of 150mm and compacted to 95% of the maximum density obtainable by the ASTM P1557 method of compaction.

If borrow is required, the engineer shall specify suitable material. Fill shall be compacted to 95% unless otherwise required by soil report.

Suitability of borrow shall be confirmed by the Engineer based upon inspection of the source by certified laboratory tests of samples for plasticity index, sieve analysis, compaction, CBR, swell and etc. Design thickness shall be based upon the design CBR or the subgrade given in soil report or estimated from classification data.

# 5.0 SURFACE DRAINAGE SYSTEM

## 5.1 GENERAL

For all cited areas, it is essential that surface water be carried away promptly, other by surface runoff resulting from a suitable cross section, or by separate storm drains. Adequate subgrade drainage is provided by either elevating the section, ditching, nullah drains or sub drains.

The surface drainage system of the PLANT shall be based mainly on open drainage ditches. The use of catch basins, storm drains and culverts shall be minimized.

## 5.2 STORM WATER

Amount of storm water and its gathering network should be based on the various Intensity-duration foundations of rainfall, depends on the region as reported by the meteorological authorities. (for more information see specification for sewer & drainage. )

The surface storm water runoff shall be determined by rational method from the following equation:

Q = 2.778 C.I.A.

Where

Q = Rate of Runoff (liters/sec)

C = Runoff Coefficient

I = Design Rainfall Intensity

A = Area of the Drained Surface (hectares)

The run off coefficient C shall be taken as follows:

- Paved areas and roof surfaces: 1.0
- Roads and Roads shoulders: 1.0
- Graveled and unpaved areas: 0.5
- Landscaped areas (sandy soil): 0.1
- Landscaped areas (clayey soil): 0.5

The surface storm water is discharged directly to a nearby natural watercourse.

For the calculation of each gathering line “time of concentration” shall be considered for using the intensity rainfall equation.

## 5.3 DRAINAGE AREA

Paved process areas shall be divided into individual drainage areas having a maximum surface of 400 $m^2$.

The paving slope towards relevant catch basin or drain shall be within 1% to 4%.

Unpaved areas upstream of any plant area road or yard may drain into ditches or catch basins.

## 5.4 CLEARANCE BETWEEN LINES

Minimum clear space between underground piping and sewer lines shall be 300mm, to be increased to 460mm for cooling water lines

## 5.5 VELOCITY

Flow velocities within 0.9 m/s and 1.2 m/s are recommended in gravity pipe systems.

Minimum velocity for lines flowing full shall be 0.6 m/s. This shall be increased to 0.9 m/s where water should carry solid particles such as sand or etc.

Maximum velocity shall be 1.5 m/s, higher velocity may be reached for short runs (5m) only.

## 5.6 STORM WATER DESIGN

### 5.6.1 Cross Section Sizing

Pipes and ditches shall be calculated according to Manning Formula:

$V = Q/S = (1/n) \times R^{2/3} \times s^{1/2}$ Velocity (m/s)

Q = Flow Rate ($m^3/s$)

A = Cross Section Wet Area ($m^2$)

P = Perimeter Wet Area (m)

R = A/P = Hydraulic Radius (m)

n = Manning Roughness Coefficient ($s/m^{1/3}$)

Cast and Ductile Iron : 0.013

Carbon Steel : 0.013

Concrete : 0.013

Asbestos Cement : 0.011

Concrete Ditches : 0.014

s = Bottom slope

### 5.6.2 Minimum slope in ditches

Minimum slopes in ditches shall be as follows:

- Trapezoidal ditches : 0.001
- Rectangular ditches : 0.0015

Any change in slopes may be evaluated properly for a minimum and maximum flows expected in the ditch.

### 5.6.3 Free Board

Free boards of ditches shall be added to above calculated water level of drainage as follows:

- 0.15 m for drainage ditches with capacities up to 0.5 $m^3/s$.
- 0.30 m for drainage ditches with capacities up to 1.4 $m^3/s$.
- 0.45 m for drainage ditches with capacities 1.4 $m^3/s$ and above.

# 6.0 SEWAGE SYSTEM

## 6.1 SOURCE

Sanitary sewer will collect waste from lavatories, toiles, shower, urinals, drinking fountains, kitchen facilities, sinks and may include building floor drains where hydrocarbon is not present.

Drains where hydrocarbon, rain water, etc. should not be discharged into this sewer.

## 6.2 FLOW OF SEWER

The rate of flow for the sanitary sewer shall be estimated based on following consideration.

a) Person/day/shift to be considered.

b) Average daily consumption of water per capital.

c) Any exceptional peak discharge due to simultaneous to fixtures in a building like shower

building.

Generally 90% of the total water supply is converted to waste water and considering delivered to sewers.

## 6.3 SANITARY WASTE COLLECTION

Sanitary waste shall be collected from lavatories, showers, toilets, urinals, kitchen facilities, sinks, building floor drains, drinking fountains by underground/above ground pipes.

Each building shall have a sewer connection which shall be connected to main sewer/lateral sewer lines through manholes.

All building sewers are collected from a group of buildings and finally join with main sewer of the plant.

Main sewer shall carry the total waste to treatment plant. It is preferred to discharge by gravity system, in the treatment plant based on available level. However if levels do not permit, then intermediate pumping shall be provided.

## 6.4 SEWER DESIGN

Sanitary sewer shall be designed based on following considerations. The velocity in sewer should not be less than 0.6 m/s when running 1/2 full. normally this velocity may be kept as 0.90 m/s at design flow. So that slope of sewer can be designed accordingly which shall be minimum slope.

The maximum velocity in the sewer is recommended as 1.5m/s when running ¾ full at a slope which shall be maximum slope.

## 6.5 SIZE OF SEWER PIPE

The minimum size from a building shall be of diameter 150mm, however the minimum size will be 200mm in case of serving more than one building.

## 6.6 HYDRAULIC FORMULA

Manning's formula shall be used for sizing the sewer .

## 6.7 SEWER APPEARANCES

Manholes shall be provided on sanitary sewer (gravity system). The location of manhole shall be as given below:

a) Where main sewer header direction changes.

b) Where there are abrupt changes of gradient or invert level of sewer.

c) Where there is change in pipe diameter.

d) Where there is an interconnection of main sewer headers with lateral headers.

Manholes spacing shall be as given below.

| **Sewer diameter** | **Recommend max spacing of manhole** |
|---|---|
| Up to 300 (12”) | 40 |
| 350 (14”) and above | 60 |

All manholes shall be liquid-tight and of reinforced concrete construction.

## 6.8 MATERIAL

Material of sanitary sewer that commonly used is given as below:

a) Concrete pipes.
b) Cast Iron pipes.
c) HDPE, PVC pipes.
d) GRP pipes.

Material of sewers shall be selected based on type of soil, practice and strength of pipes required as per the requirements of designer and owner.

# 7.0 PIPE CROSSINGS

Piping below roads shall be run in sleeves or culverts, as applicable. Direct burial for non-process lines is usually the rule. Pipe crossings shall be installed so that the angle between the road way axis and the axis of the crossing is as near 90 degrees as is practicable. After pipe has been installed the trench shall be backfield with approved material and compacted. The base course and surface coat shall be installed according to the original road specifications.