



| نسخه | سریال | نوع مدرک | رشته | تسهیلات | صادرکننده | بسته کاری | پروژه |
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**Status:**



نگهداشت و افزایش تولید میدان نفتی بینک  
سطح الارض  
احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک



شماره پیمان:  
053-073-9184

Calculation Note for Utility Area Sleepers

شماره صفحه: 2 از 29

| نسخه | سریال | نوع مدرک | رشته | تسهیلات | صادرکننده | بسته کاری | پروژه |
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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.

As a part of the Project, a New Gas Compressor Station (adjacent to existing Binak GCS) shall be constructed to gather of 15 MMSCFD (approx.) associated gases and compress & transfer them to Siahmakan GIS.

### GENERAL DEFINITION

The following terms shall be used in this document.

|                              |                                                                                                                    |
|------------------------------|--------------------------------------------------------------------------------------------------------------------|
| CLIENT:                      | National Iranian South Oilfields Company (NISOC)                                                                   |
| PROJECT:                     | Binak Oilfield Development – Surface Facilities; New Gas Compressor Station                                        |
| 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 EPD/EPC CONTRACTOR (GC) and approved by CLIENT (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 CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR. |
| MAY:                         | Is used where a provision is completely discretionary.                                                             |

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| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                      |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                             | صادر کننده                                                                          | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                      |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                   | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                      |

## 2.0 SCOPE

This report covers the Sleeper Pipe Supports foundation Design. The structure modelled by “SAP” software.

## 3.0 NORMATIVE REFERENCES

### 3.1. LOCAL CODES AND STANDARDS

- INBC Part 9 Iranian National Building Code, Part 9 (4th Edition)
- Iranian Standard No.2800 Iranian Code of Practice for Seismic Resistant Design of Buildings (4th Edition)

### 3.2. INTERNATIONAL CODES AND STANDARDS

- ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete
- ACI 318-14 Building Code Requirements for Reinforced Concrete
- ASCE7-10 Minimum Design Loads and Associated Criteria for Buildings and Other Structures-American Society of Civil Engineers
- ISDC-038 Iranian Seismic Design Code for Petroleum Facilities(3rd edition)

### 3.3. THE PROJECT DOCUMENTS

- BK-GCS-PEDCO-120-GT-RT-0001 Geotechnical Investigation Report for Compressor Station
- BK-GNRAL-PEDCO-000-ST-DC-0001 Structural Design Criteria
- BNK-INTER-PI-DWG-1 Sleeper Single Line Diagram For GCS

### 3.4. ENVIRONMENTAL DATA

Refer to "Process Basis of Design; Doc. No. BK-GNRAL-PEDCO-000-PR-DB-0001".

### 3.5. ORDER OF PRECEDENCE

In case of any conflict between the contents of this document or any discrepancy between this document and other project documents or reference standards, this issue must be reported to the CLIENT. The final decision in this situation will be made by CLIENT.

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| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                      |                                                                                     |      |         |           |           |       |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                      |
| نسخه                                                                                       | سریال                                                                                                                                                                                                                                                                                                                                | نوع مدرک                                                                            | رشته | تسهیلات | صادرکننده | بسته کاری | پروژه |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                      |
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## 4.0 MATERIALS

Material properties are delivered in the following table.

**Table1-Material Properties**

|                          |                                                          |
|--------------------------|----------------------------------------------------------|
| Foundation Concrete      | $F'c = 300 \text{ kg/cm}^2$ (28- day cylindrical sample) |
| Long. Reinforcement bar  | $F_y = 4000 \text{ kg/cm}^2$ (AIII)                      |
| Trans. Reinforcement bar | $F_y = 4000 \text{ kg/cm}^2$ (AIII)                      |

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| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادرکننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D02</td><td>0024</td><td>CN</td><td>ST</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |      |         |           |           |       |  |  | نسخه | سریال | نوع مدرک | رشته | تسهیلات | صادرکننده | بسته کاری | پروژه | D02 | 0024 | CN | ST | 120 | PEDCO | GCS | BK | شماره صفحه : 7 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                      |                                                                                     |      |         |           |           |       |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                      |
| نسخه                                                                                       | سریال                                                                                                                                                                                                                                                                                                                                | نوع مدرک                                                                            | رشته | تسهیلات | صادرکننده | بسته کاری | پروژه |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                      |
| D02                                                                                        | 0024                                                                                                                                                                                                                                                                                                                                 | CN                                                                                  | ST   | 120     | PEDCO     | GCS       | BK    |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                      |

## 5.0 DESIGN INFORMATION

### 5.1 LOCATION OF SLEEPERS

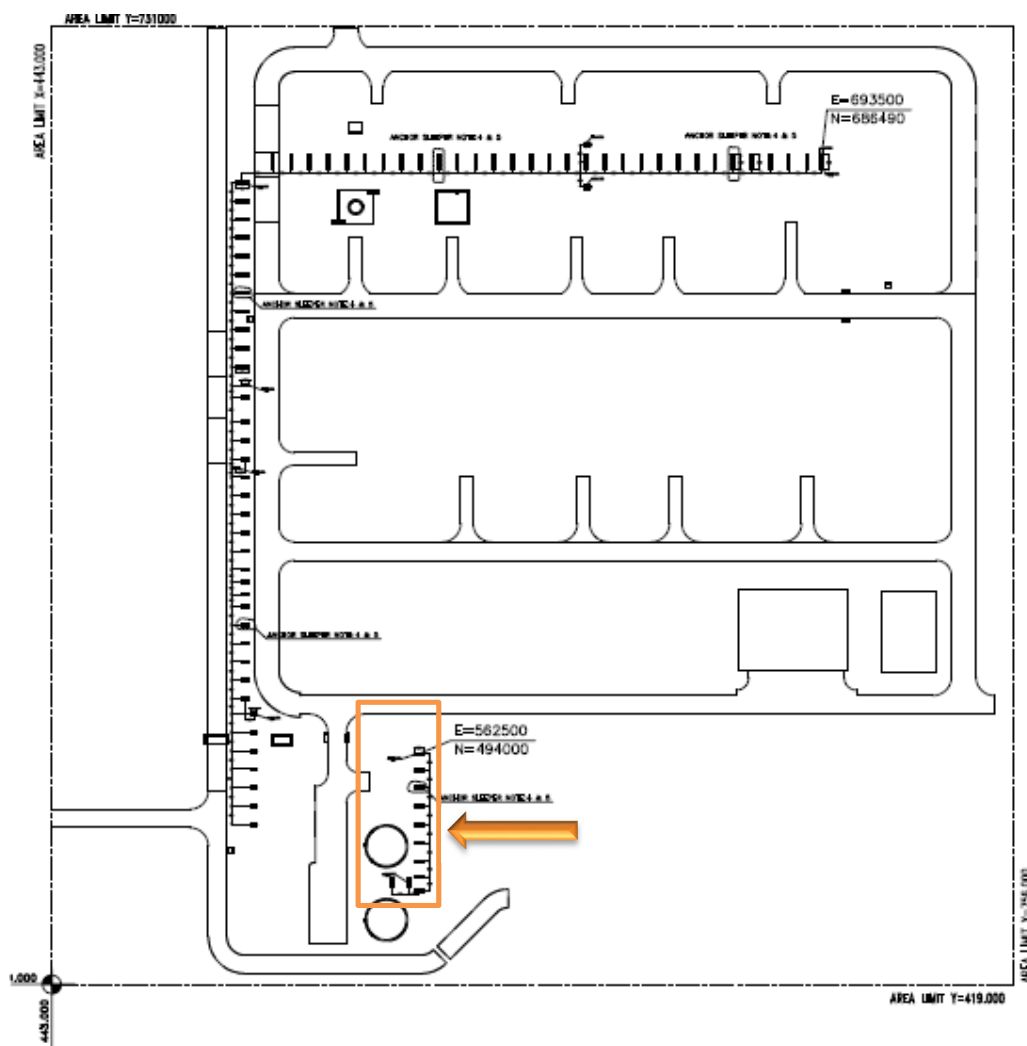


FIG 1 - Location of Utility sleepers According to Piping SLD

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                   |  |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                      |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|------|----------|-------|------|--|--|-------|-----------|------------|---------|------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادر کننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |         |      |          |       |      |  |  | پروژه | بسته کاری | صادر کننده | تسهیلات | رشته | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 8 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                      |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                             | صادر کننده                                                                          | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                      |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                   | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                      |

Sleeper's foundation plan (Type A & B) and section with embedded plate shown as follow:

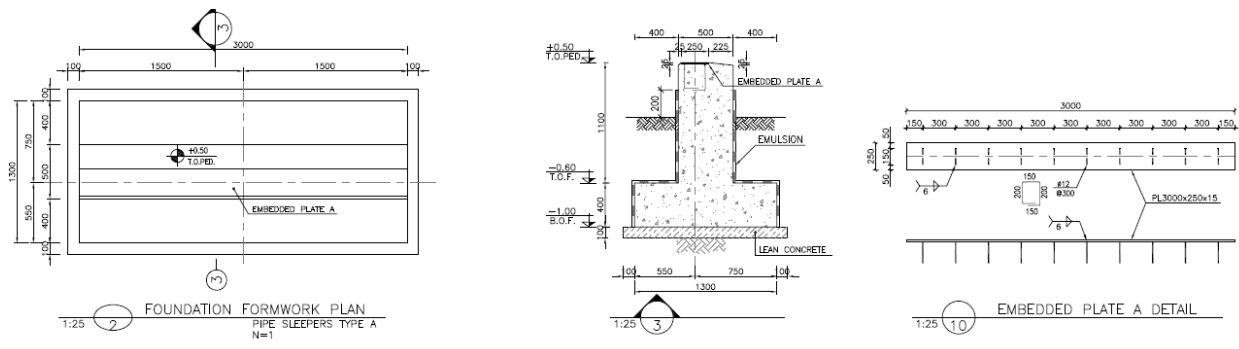


FIG 2 - Sleeper Type A

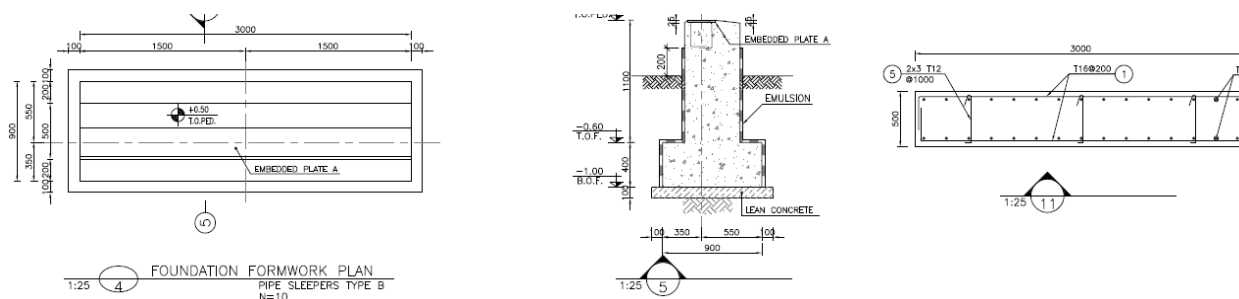


FIG 3 - Sleeper Type B

## 6.0 PIPING WEIGH

Data Received from Piping is as single lines and loading table for each point as bellow:

\*Note:

Lateral & axial Friction loads for uniform loads=0.3\*vertical load

Lateral & axial seismic load for uniform loads = 0.4\* vertical load

Lateral seismic& friction loads for anchor sleepers =0.4\*Vertical Load

Axial seismic & friction loads for anchor sleepers = 0.8\* vertical load

## 7.0 SOIL PARAMETERS

According to Soil Investigation Report, prepared by BKP:

| <br>NISOC | نگهداشت و افزایش تولید میدان نفتی بینک<br>سطح الارض<br><br>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک                                                                                                                                                                                                                            |  |      |        |           |           |       |  |  |      |       |          |      |        |           |           |       |     |      |    |    |     |       |     |    |                      |
|--------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|--------|-----------|-----------|-------|--|--|------|-------|----------|------|--------|-----------|-----------|-------|-----|------|----|----|-----|-------|-----|----|----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تهیلات</th><th>صادرکننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D02</td><td>0024</td><td>CN</td><td>ST</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |      |        |           |           |       |  |  | نسخه | سریال | نوع مدرک | رشته | تهیلات | صادرکننده | بسته کاری | پروژه | D02 | 0024 | CN | ST | 120 | PEDCO | GCS | BK | شماره صفحه : 9 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                     |                                                                                     |      |        |           |           |       |  |  |      |       |          |      |        |           |           |       |     |      |    |    |     |       |     |    |                      |
| نسخه                                                                                       | سریال                                                                                                                                                                                                                                                                                                                               | نوع مدرک                                                                            | رشته | تهیلات | صادرکننده | بسته کاری | پروژه |  |  |      |       |          |      |        |           |           |       |     |      |    |    |     |       |     |    |                      |
| D02                                                                                        | 0024                                                                                                                                                                                                                                                                                                                                | CN                                                                                  | ST   | 120    | PEDCO     | GCS       | BK    |  |  |      |       |          |      |        |           |           |       |     |      |    |    |     |       |     |    |                      |

جدول 1-6. مدول عکس العمل بستر پی مربعی، مستطیلی و نواری برای عمق یک متر

| B(m) | مدول عکس العمل بستر پی سطحی (kg/cm <sup>3</sup> ) |       |       |        |
|------|---------------------------------------------------|-------|-------|--------|
|      | L/B=1                                             | L/B=2 | L/B=5 | L/B=10 |
| 1.0  | 1.69                                              | 1.33  | 1.14  | 1.09   |
| 2.0  | 1.00                                              | 0.85  | 0.78  | 0.77   |
| 3.0  | 0.78                                              | 0.69  | 0.65  | 0.64   |
| 4.0  | 0.68                                              | 0.60  | 0.57  | 0.57   |
| 5.0  | 0.61                                              | 0.55  | 0.53  | 0.53   |

جدول 1-7. ضرایب فشار جانبی برای لایه‌های خاک طبیعی با فرض پر کردن پشت دیوار با خاکریز دانه‌ای

| ضرایب فشار جانبی                       | علامت مشخصه | مقادیر عددی ضرایب فشار جانبی<br>$\Phi = 30^\circ$<br>برای لایه خاکریز درشت دانه |
|----------------------------------------|-------------|---------------------------------------------------------------------------------|
| ضریب فشار جانبی سکون                   | $K_0$       | 0/50                                                                            |
| ضریب فشار جانبی محرک در حالت استاتیکی  | $K_a$       | 0/33                                                                            |
| ضریب فشار جانبی مقاوم در حالت استاتیکی | $K_p$       | 3/00                                                                            |

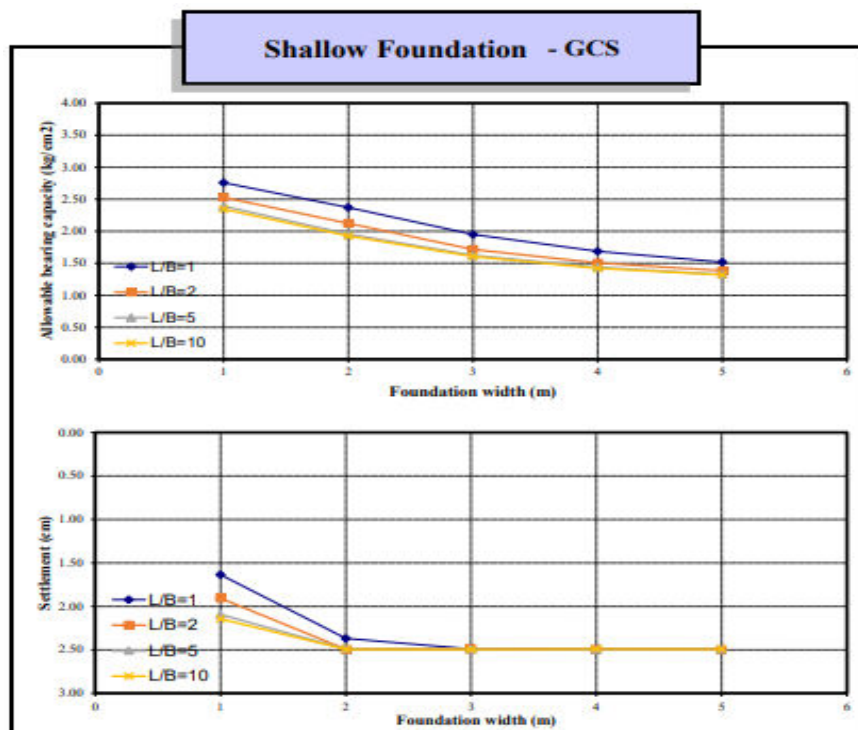


FIG 4 - Geotechnical Parameters

## 8.0 LOADING

### 8.1. DEAD LOAD

Dead load of pipes according to piping documents assign in model.

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                  |  |         |      |          |       |      |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|------|----------|-------|------|--|--|-------|-----------|-----------|---------|------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادرکننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |         |      |          |       |      |  |  | پروژه | بسته کاری | صادرکننده | تسهیلات | رشته | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 10 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                      |                                                                                     |         |      |          |       |      |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                            | صادرکننده                                                                           | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                  | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |

## 8.2. LIVE LOAD

Live load (operation) of pipes according to piping documents assign in model.

## 8.3. SEISMIC LOAD

Seismic load (occasional) pipes according to piping documents assign in model.

## 8.4. WIND LOAD

Wind load is not applicable for pipe support foundation.

## 9.0 LOAD COMBINATION FOR DESIGN

According to ASCE07-10 structures, components, and foundations shall be designed, so that their design strength equals or exceeds that effect of factored loads in the following combination

$$^{**}E_v = \alpha S_{Ds} * D$$

$$Ev = 0.2 * 0.75 * S_{us} = 0.15 * D$$

Vertical seismic load applied at combinations with load combination with coefficient of 0.15\*dead load in combinations with earthquake load.

| TABLE:  |            |            |          |
|---------|------------|------------|----------|
| LoadPat | DesignType | SelfWtMult | AutoLoad |
| SUS     | Dead       | 1          |          |
| OPE     | Live       | 0          |          |
| OCCX    | Quake      | 0          | None     |
| OCCY    | Quake      | 0          | None     |
| HYD     | Dead       | 0          |          |
| LIVE    | Live       | 0          |          |
| FRX     | Other      | 0          |          |
| FRY     | Other      | 0          |          |
| Ev      | Quake      | 0          | None     |
| H       | Other      | 0          |          |

| TABLE:    |            |            |          |             |             |
|-----------|------------|------------|----------|-------------|-------------|
| ComboName | ComboType  | AutoDesign | CaseName | ScaleFactor | SteelDesign |
| D+L+FR    | Linear Add | No         | SUS      | 1           | Strength    |

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                   |  |      |         |            |           |       |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|---------|------------|-----------|-------|--|--|------|-------|----------|------|---------|------------|-----------|-------|-----|------|----|----|-----|-------|-----|----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D02</td><td>0024</td><td>CN</td><td>ST</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |      |         |            |           |       |  |  | نسخه | سریال | نوع مدرک | رشته | تسهیلات | صادر کننده | بسته کاری | پروژه | D02 | 0024 | CN | ST | 120 | PEDCO | GCS | BK | شماره صفحه : 11 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |      |         |            |           |       |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
| نسخه                                                                                       | سریال                                                                                                                                                                                                                                                                                                                                 | نوع مدرک                                                                            | رشته | تسهیلات | صادر کننده | بسته کاری | پروژه |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
| D02                                                                                        | 0024                                                                                                                                                                                                                                                                                                                                  | CN                                                                                  | ST   | 120     | PEDCO      | GCS       | BK    |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |

| TABLE:             |            |            |          |             |             |
|--------------------|------------|------------|----------|-------------|-------------|
| ComboName          | ComboType  | AutoDesign | CaseName | ScaleFactor | SteelDesign |
| D+L+FR             |            |            | FRx      | 1           |             |
| D+L+FR             |            |            | OPE      | 1           |             |
| HYD+FR             | Linear Add | No         | HYD      | 1           | None        |
| HYD+FR             |            |            | FRx      | 1           |             |
| 1.4D               | Linear Add | No         | SUS      | 1.4         | None        |
| 1.35D+L+EX+FR+1.6H | Linear Add | No         | SUS      | 1.35        | Strength    |
| 1.35D+L+EX+FR+1.6H |            |            | OCCX     | 1           |             |
| 1.35D+L+EX+FR+1.6H |            |            | OPE      | 1           |             |
| 1.35D+L+EX+FR+1.6H |            |            | FRx      | 1           |             |
| 1.35D+L+EX+FR+1.6H |            |            | FRY      | 1           |             |
| 1.35D+L+EX+FR+1.6H |            |            | H        | 1.6         |             |
| 1.35D+L-EX+FR+1.6H | Linear Add | No         | SUS      | 1.35        | Strength    |
| 1.35D+L-EX+FR+1.6H |            |            | OCCX     | -1          |             |
| 1.35D+L-EX+FR+1.6H |            |            | OPE      | 1           |             |
| 1.35D+L-EX+FR+1.6H |            |            | FRx      | 1           |             |
| 1.35D+L-EX+FR+1.6H |            |            | FRY      | 1           |             |
| 1.35D+L-EX+FR+1.6H |            |            | H        | 1.6         |             |
| 1.35D+L+EY+FR+1.6H | Linear Add | No         | SUS      | 1.35        | Strength    |
| 1.35D+L+EY+FR+1.6H |            |            | OCCY     | 1           |             |
| 1.35D+L+EY+FR+1.6H |            |            | FRx      | 1           |             |
| 1.35D+L+EY+FR+1.6H |            |            | OPE      | 1           |             |
| 1.35D+L+EY+FR+1.6H |            |            | FRY      | 1           |             |
| 1.35D+L+EY+FR+1.6H |            |            | H        | 1.6         |             |
| 1.35D+L-EY+FR+1.6H | Linear Add | No         | SUS      | 1.2         | Strength    |
| 1.35D+L-EY+FR+1.6H |            |            | OCCY     | -1          |             |
| 1.35D+L-EY+FR+1.6H |            |            | FRx      | 1           |             |
| 1.35D+L-EY+FR+1.6H |            |            | OPE      | 1           |             |
| 1.35D+L-EY+FR+1.6H |            |            | FRY      | 1           |             |
| 1.35D+L-EY+FR+1.6H |            |            | H        | 1.6         |             |
| 0.9D+Ex+1.6H       | Linear Add | No         | SUS      | 0.9         | Strength    |
| 0.9D+Ex+1.6H       |            |            | OCCX     | 1           |             |
| 0.9D+Ex+1.6H       |            |            | H        | 1.6         |             |
| 0.9D-Ex+1.6H       | Linear Add | No         | SUS      | 0.9         | Strength    |
| 0.9D-Ex+1.6H       |            |            | OCCX     | -1          |             |
| 0.9D-Ex+1.6H       |            |            | H        | 1.6         |             |
| 0.9D-Ey+1.6H       | Linear Add | No         | SUS      | 0.9         | Strength    |
| 0.9D-Ey+1.6H       |            |            | OCCY     | -1          |             |

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                   |  |      |         |            |           |       |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|---------|------------|-----------|-------|--|--|------|-------|----------|------|---------|------------|-----------|-------|-----|------|----|----|-----|-------|-----|----|-----------------------|
| شماره پیمان:<br>053 - 073 - 9184                                                           | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D02</td><td>0024</td><td>CN</td><td>ST</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |      |         |            |           |       |  |  | نسخه | سریال | نوع مدرک | رشته | تسهیلات | صادر کننده | بسته کاری | پروژه | D02 | 0024 | CN | ST | 120 | PEDCO | GCS | BK | شماره صفحه : 12 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |      |         |            |           |       |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
| نسخه                                                                                       | سریال                                                                                                                                                                                                                                                                                                                                 | نوع مدرک                                                                            | رشته | تسهیلات | صادر کننده | بسته کاری | پروژه |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
| D02                                                                                        | 0024                                                                                                                                                                                                                                                                                                                                  | CN                                                                                  | ST   | 120     | PEDCO      | GCS       | BK    |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |

| TABLE:               |            |            |                      |             |             |
|----------------------|------------|------------|----------------------|-------------|-------------|
| ComboName            | ComboType  | AutoDesign | CaseName             | ScaleFactor | SteelDesign |
| 0.9D-Ey+1.6H         |            |            | H                    | 1.6         |             |
| 0.9D+Ey+1.6H         | Linear Add | No         | SUS                  | 0.9         | Strength    |
| 0.9D+Ey+1.6H         |            |            | OCCY                 | 1           |             |
| 0.9D+Ey+1.6H         |            |            | H                    | 1.6         |             |
| 1.2D+1.6L+1.6FR+1.6H | Linear Add | No         | SUS                  | 1.2         | Strength    |
| 1.2D+1.6L+1.6FR+1.6H |            |            | OPE                  | 1.6         |             |
| 1.2D+1.6L+1.6FR+1.6H |            |            | FRx                  | 1.6         |             |
| 1.2D+1.6L+1.6FR+1.6H |            |            | FRY                  | 1.2         |             |
| 1.2D+1.6L+1.6FR+1.6H |            |            | H                    | 1.6         |             |
| 0.75D-Ex             | Linear Add | No         | SUS                  | 0.75        | Strength    |
| 0.75D-Ex             |            |            | OCCX                 | -1          |             |
| 0.75D-Ey             | Linear Add | No         | SUS                  | 0.75        | Strength    |
| 0.75D-Ey             |            |            | OCCY                 | -1          |             |
| 0.75D+Ey             | Linear Add | No         | SUS                  | 0.75        | Strength    |
| 0.75D+Ey             |            |            | OCCY                 | 1           |             |
| 0.75D+Ex             | Linear Add | No         | SUS                  | 0.75        | Strength    |
| 0.75D+Ex             |            |            | OCCX                 | 1           |             |
| Envelope Strength    | Envelope   | No         | 1.4D                 | 1           | None        |
| Envelope Strength    |            |            | 1.35D+L+EY+FR+1.6H   | 1           |             |
| Envelope Strength    |            |            | 1.35D+L+EX+FR+1.6H   | 1           |             |
| Envelope Strength    |            |            | 1.35D+L-EY+FR+1.6H   | 1           |             |
| Envelope Strength    |            |            | 1.35D+L-EX+FR+1.6H   | 1           |             |
| Envelope Strength    |            |            | 1.2D+1.6L+1.6FR+1.6H | 1           |             |
| Envelope Strength    |            |            | 0.9D+Ey+1.6H         | 1           |             |
| Envelope Strength    |            |            | 0.9D+Ex+1.6H         | 1           |             |
| Envelope Strength    |            |            | 0.9D-Ey+1.6H         | 1           |             |
| Envelope Strength    |            |            | 0.9D-Ex+1.6H         | 1           |             |
| Envelope Strength    |            |            | 0.75D-Ex             | 1           |             |
| Envelope Strength    |            |            | 0.75D-Ey             | 1           |             |
| Envelope Strength    |            |            | 0.75D+Ey             | 1           |             |
| Envelope Strength    |            |            | 0.75D+Ex             | 1           |             |
| D+L+H                | Linear Add | No         | SUS                  | 1           | None        |
| D+L+H                |            |            | OPE                  | 1           |             |
| D+L+H                |            |            | H                    | 1           |             |
| D+0.7OCCX+H          | Linear Add | No         | SUS                  | 1           | None        |
| D+0.7OCCX+H          |            |            | OCCX                 | 0.7         |             |
| D+0.7OCCX+H          |            |            | H                    | 1           |             |

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                   |  |      |         |            |           |       |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|---------|------------|-----------|-------|--|--|------|-------|----------|------|---------|------------|-----------|-------|-----|------|----|----|-----|-------|-----|----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D02</td><td>0024</td><td>CN</td><td>ST</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |      |         |            |           |       |  |  | نسخه | سریال | نوع مدرک | رشته | تسهیلات | صادر کننده | بسته کاری | پروژه | D02 | 0024 | CN | ST | 120 | PEDCO | GCS | BK | شماره صفحه : 13 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |      |         |            |           |       |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
| نسخه                                                                                       | سریال                                                                                                                                                                                                                                                                                                                                 | نوع مدرک                                                                            | رشته | تسهیلات | صادر کننده | بسته کاری | پروژه |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
| D02                                                                                        | 0024                                                                                                                                                                                                                                                                                                                                  | CN                                                                                  | ST   | 120     | PEDCO      | GCS       | BK    |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |

| TABLE:             |            |            |                    |             |             |
|--------------------|------------|------------|--------------------|-------------|-------------|
| ComboName          | ComboType  | AutoDesign | CaseName           | ScaleFactor | SteelDesign |
| D-0.7OCCX+H        | Linear Add | No         | SUS                | 1           | None        |
| D-0.7OCCX+H        |            |            | OCCX               | -0.7        |             |
| D-0.7OCCX+H        |            |            | H                  | 1           |             |
| D+0.7OCCY+H        | Linear Add | No         | SUS                | 1           | None        |
| D+0.7OCCY+H        |            |            | OCCY               | 0.7         |             |
| D+0.7OCCY+H        |            |            | H                  | 1           |             |
| D-0.7OCCY+H        | Linear Add | No         | SUS                | 1           | None        |
| D-0.7OCCY+H        |            |            | OCCY               | -0.7        |             |
| D-0.7OCCY+H        |            |            | H                  | 1           |             |
| D+0.75L+0.75OCCX+H | Linear Add | No         | SUS                | 1           | None        |
| D+0.75L+0.75OCCX+H |            |            | OPE                | 0.75        |             |
| D+0.75L+0.75OCCX+H |            |            | OCCX               | 0.75        |             |
| D+0.75L+0.75OCCX+H |            |            | H                  | 1           |             |
| D-0.75L-0.75OCCX+H | Linear Add | No         | SUS                | 1           | None        |
| D-0.75L-0.75OCCX+H |            |            | OPE                | 0.75        |             |
| D-0.75L-0.75OCCX+H |            |            | OCCX               | -0.75       |             |
| D-0.75L-0.75OCCX+H |            |            | H                  | 1           |             |
| D+0.75L+0.75OCCY+H | Linear Add | No         | SUS                | 1           | None        |
| D+0.75L+0.75OCCY+H |            |            | OPE                | 0.75        |             |
| D+0.75L+0.75OCCY+H |            |            | OCCY               | 0.75        |             |
| D+0.75L+0.75OCCY+H |            |            | H                  | 1           |             |
| D-0.75L-0.75OCCY+H | Linear Add | No         | SUS                | 1           | None        |
| D-0.75L-0.75OCCY+H |            |            | OPE                | 0.75        |             |
| D-0.75L-0.75OCCY+H |            |            | OCCY               | -0.75       |             |
| D-0.75L-0.75OCCY+H |            |            | H                  | 1           |             |
| D+H                | Linear Add | No         | H                  | 1           | None        |
| D+H                |            |            | SUS                | 1           |             |
| Envelope allowable | Envelope   | No         | D+L+H              | 1           | None        |
| Envelope allowable |            |            | HYD+FR             | 1           |             |
| Envelope allowable |            |            | D+L+FR             | 1           |             |
| Envelope allowable |            |            | D+H                | 1           |             |
| Envelope allowable |            |            | D+0.7OCCY+H        | 1           |             |
| Envelope allowable |            |            | D+0.7OCCX+H        | 1           |             |
| Envelope allowable |            |            | D+0.75L+0.75OCCY+H | 1           |             |
| Envelope allowable |            |            | D+0.75L+0.75OCCX+H | 1           |             |
| Envelope allowable |            |            | D-0.75L-0.75OCCX+H | 1           |             |
| Envelope allowable |            |            | D-0.75L-0.75OCCY+H | 1           |             |

|  | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                  |  |      |         |           |           |       |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                       |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|---------|-----------|-----------|-------|--|--|------|-------|----------|------|---------|-----------|-----------|-------|-----|------|----|----|-----|-------|-----|----|-----------------------|
| شماره پیمان:<br>053 - 073 - 9184                                                  | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادرکننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D02</td><td>0024</td><td>CN</td><td>ST</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |      |         |           |           |       |  |  | نسخه | سریال | نوع مدرک | رشته | تسهیلات | صادرکننده | بسته کاری | پروژه | D02 | 0024 | CN | ST | 120 | PEDCO | GCS | BK | شماره صفحه : 14 از 29 |
| Calculation Note for Utility Area Sleepers                                        |                                                                                                                                                                                                                                                                                                                                      |                                                                                     |      |         |           |           |       |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                       |
| نسخه                                                                              | سریال                                                                                                                                                                                                                                                                                                                                | نوع مدرک                                                                            | رشته | تسهیلات | صادرکننده | بسته کاری | پروژه |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                       |
| D02                                                                               | 0024                                                                                                                                                                                                                                                                                                                                 | CN                                                                                  | ST   | 120     | PEDCO     | GCS       | BK    |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                       |

| TABLE:             |           |            |          |             |             |
|--------------------|-----------|------------|----------|-------------|-------------|
| ComboName          | ComboType | AutoDesign | CaseName | ScaleFactor | SteelDesign |
| Envelope allowable |           |            | 0.75D+Ey | 1           |             |
| Envelope allowable |           |            | 0.75D+Ex | 1           |             |
| Envelope allowable |           |            | 0.75D-Ex | 1           |             |
| Envelope allowable |           |            | 0.75D-Ey | 1           |             |

## 10.0 FOUNDATION ANALYSIS

### 10.1. SLEEPER

#### PIPING LOAD DATA

| FWA-113-0010-AN04-10*-PT<br>BNK-GCS-CN-002_REV.03 |        |        |      |        |      |      |
|---------------------------------------------------|--------|--------|------|--------|------|------|
|                                                   | HYD(N) | DPE(N) |      | DCC(N) |      |      |
|                                                   | Fy     | Fx     | Fy   | Fz     | Fx   | Fz   |
| NODENO.<br>1260<br>P65.                           | 7700   | -      | 8300 | 2300   | -    | 1700 |
| NODENO.<br>1270<br>P66.                           | 5000   | -      | 5200 | -      | -    | -    |
| NODENO.<br>1280<br>P67.                           | 5800   | -      | 5900 | 1900   | -    | 1900 |
| NODENO.<br>1290<br>P68.                           | 5500   | 8000   | 5500 | -      | 9100 | -    |
| NODENO.<br>1300<br>P69.                           | 6000   | -      | 6000 | 2000   | -    | 2000 |
| NODENO.<br>1310<br>P70.                           | 4100   | -      | 4300 | -      | -    | -    |
| NODENO.<br>1320<br>P71.                           | 6700   | -      | 6900 | 2400   | -    | 1800 |
| NODENO.<br>1370<br>P72.                           | 5900   | -      | 6900 | -      | -    | -    |
| NODENO.<br>1380<br>P73.                           | 4900   | 500    | 6400 | -      | 700  | -    |

| FWA-113-0007-AN04-12*-PT<br>BNK-GCS-CN-002_REV.03 |        |        |       |        |       |      |
|---------------------------------------------------|--------|--------|-------|--------|-------|------|
|                                                   | HYD(N) | DPE(N) |       | DCC(N) |       |      |
|                                                   | Fy     | Fx     | Fy    | Fz     | Fx    | Fz   |
| NODENO.<br>675<br>P74.                            | 7500   | -      | 8000  | 1300   | -     | 1100 |
| NODENO.<br>710<br>P75.                            | 13800  | -      | 15200 | 3500   | -     | 2500 |
| NODENO.<br>720<br>P76.                            | 5800   | -      | 5900  | 1900   | -     | 1900 |
| NODENO.<br>760<br>P77.                            | 7200   | 13600  | 7200  | 2200   | 11500 | 2300 |
| NODENO.<br>770<br>P78.                            | 7900   | -      | 7900  | -      | -     | -    |
| NODENO.<br>780<br>P79.                            | 5700   | -      | 6000  | 2400   | -     | 2100 |
| NODENO.<br>790<br>P80.                            | 8800   | -      | 8900  | -      | -     | -    |
| NODENO.<br>840<br>P81.                            | 8000   | -      | 9200  | -      | -     | -    |
| NODENO.<br>850<br>P82.                            | 6100   | 700    | 8000  | -      | 900   | -    |

| FWA-113-0025-AN04-12*-PT<br>BNK-GCS-CN-002_REV.03 |        |        |       |        |       |      |
|---------------------------------------------------|--------|--------|-------|--------|-------|------|
|                                                   | HYD(N) | DPE(N) |       | DCC(N) |       |      |
|                                                   | Fy     | Fx     | Fy    | Fz     | Fx    | Fz   |
| NODENO.<br>200<br>P60.                            | 15000  | -      | 14500 | 3900   | -     | 3800 |
| NODENO.<br>190<br>P61.                            | 3900   | -      | 5800  | -      | -     | -    |
| NODENO.<br>250<br>P62.                            | 9200   | -      | 12000 | 3000   | -     | 3400 |
| NODENO.<br>270<br>P63.                            | 8100   | 13100  | 7200  | -      | 10600 | -    |
| NODENO.<br>290<br>P64.                            | 5300   | -      | 5300  | -      | -     | 1700 |

| FWA-113-0006-AN04-12*-PT<br>BNK-GCS-CN-001_REV.04 |        |        |       |        |       |      |
|---------------------------------------------------|--------|--------|-------|--------|-------|------|
|                                                   | HYD(N) | DPE(N) |       | DCC(N) |       |      |
|                                                   | Fy     | Fx     | Fy    | Fz     | Fx    | Fz   |
| NODENO.<br>220<br>P83.                            | 11800  | -      | 11700 | 19900  | -     | 2200 |
| NODENO.<br>200<br>P84.                            | 11200  | -      | 11200 | 17400  | -     | 2200 |
| NODENO.<br>190<br>P85.                            | 7400   | 12500  | 7400  | 2400   | 14000 | 3100 |
| NODENO.<br>180<br>P86.                            | 7600   | -      | 7500  | -      | -     | -    |
| NODENO.<br>170<br>P87.                            | 6900   | -      | 7000  | 4700   | -     | 3900 |
| NODENO.<br>160<br>P88.                            | 6200   | -      | 7600  | -      | -     | -    |
| NODENO.<br>120<br>P89.                            | 4700   | -      | 5800  | 2900   | -     | 2700 |
| NODENO.<br>90<br>P90.                             | 6000   | -      | 3300  | -      | -     | -    |
| NODENO.<br>85<br>P91.                             | 7400   | -      | 19000 | -      | -     | -    |
| NODENO.<br>540<br>P92.                            | 6300   | -      | 3500  | -      | -     | -    |
| NODENO.<br>530<br>P93.                            | 730    | -      | 19000 | -      | -     | -    |

#### 10.1.1. Operating weight of Piping

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                   |  |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|------|----------|-------|------|--|--|-------|-----------|------------|---------|------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادر کننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |         |      |          |       |      |  |  | پروژه | بسته کاری | صادر کننده | تسهیلات | رشته | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 15 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                             | صادر کننده                                                                          | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                   | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |

This type of loading is operating weight of pipes that are considered by Piping and illustrated in tables and is equal to OPR for each point.

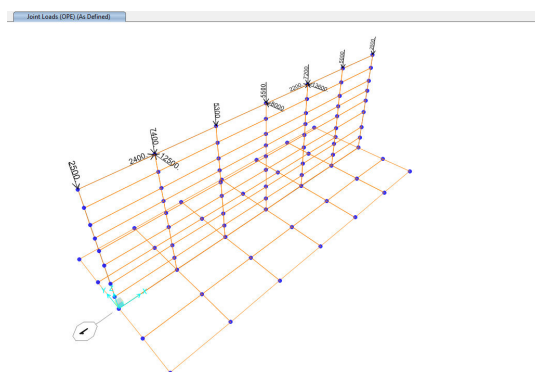


FIG 5 - OPE Points Loads on sleeper TYPE A

#### 10.1.2. PURE SEISMIC WEIGHT OF PIPING (OCCX & OCCY)

Seismic loads of pipes according to piping documents assign in model. In some cases when the earthquake load is not provided by piping, the earthquake coefficient is calculated as follow:

Lateral & axial seismic load for uniform loads =  $0.4 \times$  vertical load

Lateral & axial friction loads for anchor sleepers =  $0.8 \times$  vertical load

$$Occx, y = 5000 \text{ N/m} \times 1\text{m} \times 0.4 = 2000 \text{ N}$$

$$Occx, y(\text{each point}) = 2000 \text{ kg} \div 2(\text{point}) = 1000 \text{ N}$$

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                   |  |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|------|----------|-------|------|--|--|-------|-----------|------------|---------|------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادر کننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |         |      |          |       |      |  |  | پروژه | بسته کاری | صادر کننده | تسهیلات | رشته | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 16 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                             | صادر کننده                                                                          | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                   | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |

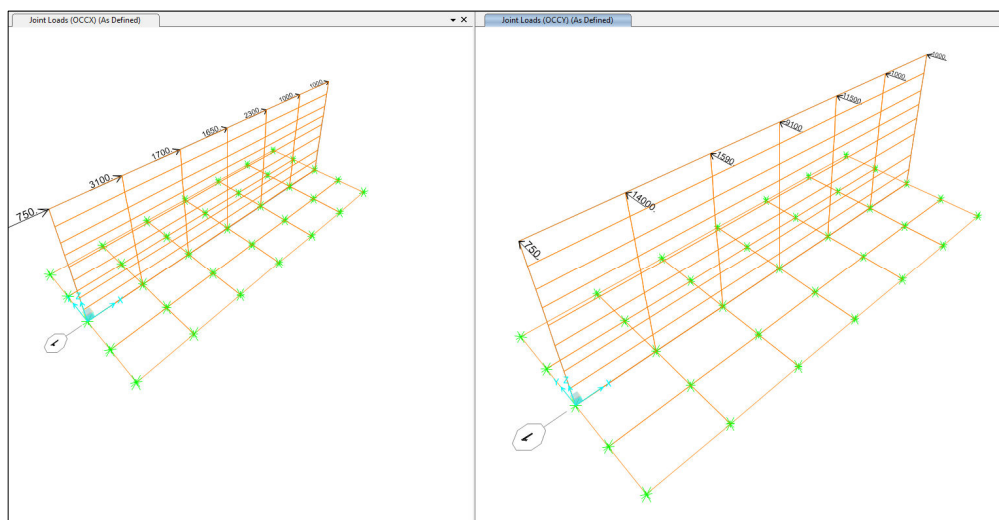


FIG 6 - OCCX,Y Points Loads on sleeper

### 10.1.3.Friction Load (FRX & FRY)

Thermal displacement due to Operating condition and the friction between pipes and the sleepers, causes lateral forces according to piping documents assign in model. In some cases when the Friction load is not provided by piping, the Friction coefficient is calculated as follow:

Lateral & axial Friction loads for uniform loads=0.3\*vertical load

Lateral & axial loads for anchor sleepers = 0.8\* vertical load

$$FR_{x,y} = 5000 \text{ N/m} \times 1\text{m} \times 0.3 = 1500 \text{ N}$$

$$FR_{x,y}(\text{each point}) = 1500 \text{ N} \div 2(\text{point}) = 750 \text{ N}$$

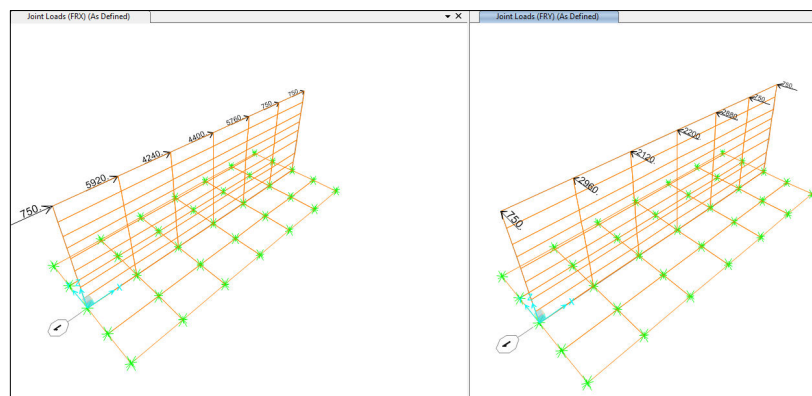


FIG 7 - FRX,Y Points Loads on sleeper

|                                                                                            |                                                                                                                                                                                                                                                                                                                |                                                                                     |           |           |          |       |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------|-----------|----------|-------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                            |  |           |           |          |       |          |       |      |    |     |       |     |    |    |      |     |                       |
| شماره پیمان:<br>053-073-9184                                                               | <p>Calculation Note for Utility Area Sleepers</p> <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادرکننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | پروژه                                                                               | بسته کاری | صادرکننده | تسهیلات  | رشته  | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 17 از 29 |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                      | صادرکننده                                                                           | تسهیلات   | رشته      | نوع مدرک | سریال | نسخه     |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                            | PEDCO                                                                               | 120       | ST        | CN       | 0024  | D02      |       |      |    |     |       |     |    |    |      |     |                       |

#### 10.1.4. Vertical seismic load

The vertical seismic load effect,  $E_v$ , shall be determined in accordance with the following Equation ASCE7-16 Eq. (12.14-6):

$$E_v = 0.2S_{DS}D \quad (\text{ASCE7/ Eq. 12.14-6})$$

$S_{DS}$  = Design, 5% damped, spectral response acceleration parameter (g) at short periods (0.2 sec). = 0.75

D = effect of dead load

Loads case name:  $EQZ = 0.2 \times 0.75 \times W = 0.15 \times W$

(where  $W = DL + OPR1 + OPR \text{ FUTURE}$ )

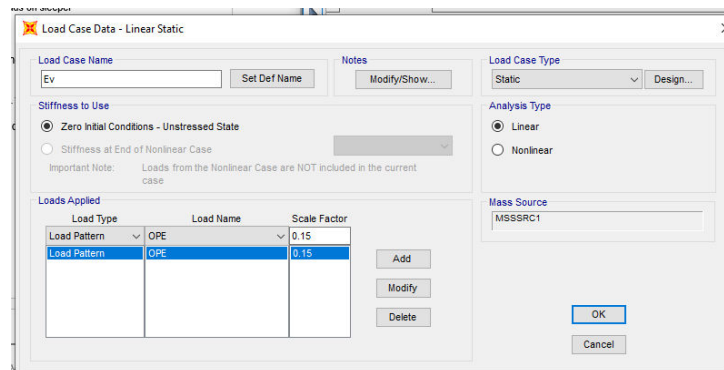


FIG 8 - applied  $E_v$  load

#### 10.1.5. Soil load on foundation

Soil load weight has been applied on foundation as below

$$\gamma_{soil} = 1850 \text{ kg/m}^3$$

$$h_{soil} = 0.6 \text{ m} \quad P = \gamma h = 1850 \times 0.6 = 1110 \frac{\text{kg}}{\text{m}^2}$$

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                  |  |         |      |          |       |      |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|------|----------|-------|------|--|--|-------|-----------|-----------|---------|------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادرکننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |         |      |          |       |      |  |  | پروژه | بسته کاری | صادرکننده | تسهیلات | رشته | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 18 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                      |                                                                                     |         |      |          |       |      |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                            | صادرکننده                                                                           | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                  | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |



FIG 9 - applied soil load on foundation type A(1110Kg)

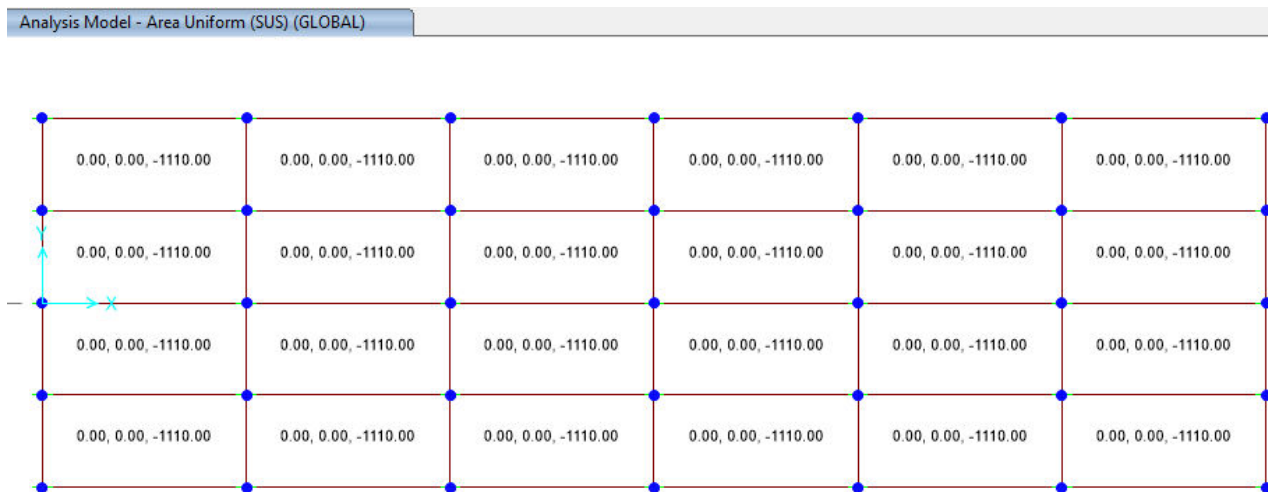


FIG 10 - applied soil load on foundation type B(1110Kg)

#### 10.1.6. Soil Pressure on wall of sleeper

According to drawings approximately 0.6m is underground that horizontal pressure applied on model as below:

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                   |  |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|------|----------|-------|------|--|--|-------|-----------|------------|---------|------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادر کننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |         |      |          |       |      |  |  | پروژه | بسته کاری | صادر کننده | تسهیلات | رشته | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 19 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                             | صادر کننده                                                                          | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                   | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |

Assign Joint Pattern Data

General

Joint Pattern Name: SOIL

Pattern Assignment Type

☒ X, Y, Z Multipliers (Pattern Value = Ax + By + Cz + D)

☐ Z Coordinate at Zero Pressure and Weight per Unit Volume

Pattern Value = Ax + By + Cz + D

Constant A: 0 1/m

Constant B: 0 1/m

Constant C: -0.61 1/m

Constant D: 0.366

Restrictions

☒ Use All Values

☐ Zero Negative Values

☐ Zero Positive Values

Options

☒ Add to Existing Values

☐ Replace Existing Values

☐ Delete Existing Values

Reset Form to Default Values

OK Close Apply

FIG 11 - Define joint Pattern

Analysis Model - Area Surface Pressure - Face Top (H)

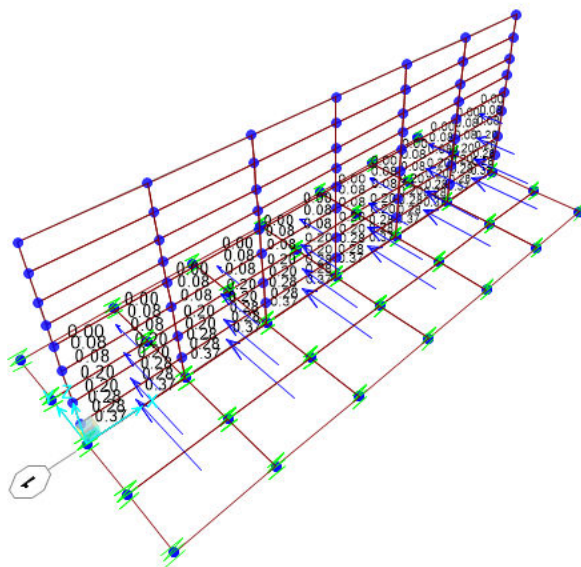


FIG 12 - Applied soil pressure load on sleeper Type A

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                   |  |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|------|----------|-------|------|--|--|-------|-----------|------------|---------|------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادر کننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |         |      |          |       |      |  |  | پروژه | بسته کاری | صادر کننده | تسهیلات | رشته | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 20 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                             | صادر کننده                                                                          | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                   | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |

Analysis Model - Area Surface Pressure - Face Top (H)

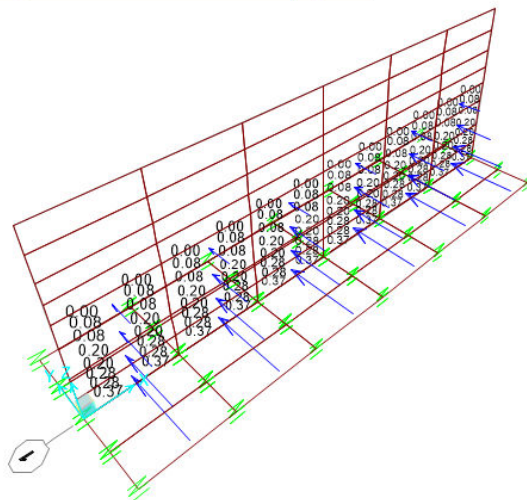


FIG 13 - applied soil pressure load on sleeper Type B

## 10.2. WALL DESIGN

- SAP2000 has been used in order to modeling, analyses and design of this wall & foundation.

wall thickness = 500 mm

according to sap model  $M_{max} = 0.70 \text{ ton.m}$

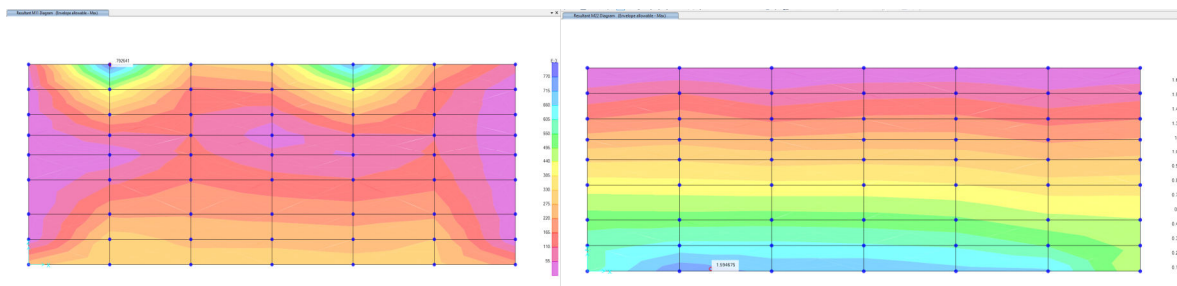


FIG 14 - -Graphical output of M(1-1),(2-2)max Sleeper Type A(ton-m)

|                                                                                            |                                                                                                                     |           |            |         |      |          |       |                                                                                     |      |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------|------------|---------|------|----------|-------|-------------------------------------------------------------------------------------|------|
| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p> |           |            |         |      |          |       |  |      |
| شماره پیمان:                                                                               | Calculation Note for Utility Area Sleepers                                                                          |           |            |         |      |          |       | شماره صفحه : 21 از 29                                                               |      |
| 053 – 073 – 9184                                                                           | پروژه                                                                                                               | بسته کاری | صادر کننده | تسهیلات | رشته | نوع مدرک | سریال |                                                                                     | نسخه |
|                                                                                            | BK                                                                                                                  | GCS       | PEDCO      | 120     | ST   | CN       | 0024  |                                                                                     | D02  |

| As     |           |       |        |                          |                         |            |
|--------|-----------|-------|--------|--------------------------|-------------------------|------------|
| INPUT  | Mu(ton.m) | b(cm) | d(cm)  | Fy (kg/cm <sup>2</sup> ) | fc(kg/cm <sup>2</sup> ) | phi        |
|        | 0.7       | 100   | 45     | 4000                     | 300                     | 0.9        |
| OUTPUT | Mn        | Rn1   | m1     | $\rho_{req}$             | As(req)                 | SELECT PHI |
|        | 77777.778 | 0.384 | 15.686 | 0.000096                 | 0.432                   | 16.00      |

According to above output max Moment is about 77777 kg-cm  
 $=0.432 \text{ cm}^2 \ll : \text{uses } \varnothing 16@200 \quad A_s=10.05\text{cm}^2 \quad ok A_{s(req)} = \rho_{req} \cdot b \cdot d$

| As     |            |       |        |                          |                         |            |
|--------|------------|-------|--------|--------------------------|-------------------------|------------|
| INPUT  | Mu(ton.m)  | b(cm) | d(cm)  | Fy (kg/cm <sup>2</sup> ) | fc(kg/cm <sup>2</sup> ) | phi        |
|        | 1.6        | 100   | 45     | 4000                     | 300                     | 0.9        |
| OUTPUT | Mn         | Rn1   | m1     | $\rho_{req}$             | As(req)                 | SELECT PHI |
|        | 177777.778 | 0.878 | 15.686 | 0.000220                 | 0.989                   | 16.00      |

According to above output max Moment is about 177777 kg-cm  
 $=0.989 \text{ cm}^2 \ll : \text{uses } \varnothing 16@200 \quad A_s=10.05\text{cm}^2 \quad ok A_{s(req)} = \rho_{req} \cdot b \cdot d$

### 10.3.CHECK OF STRESS & SETTLEMENT FOR FOUNDATION (TYPE A:300X130X40 TYPE B:300X90X40)

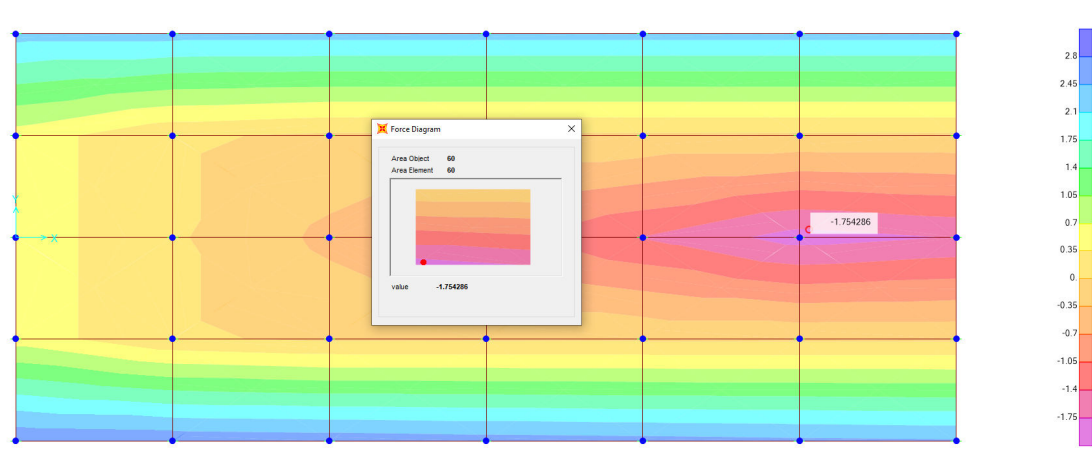


FIG 15 - stress diagram for foundation (Sleeper Type A)

|                                                                                            |                                                                                                                                                                                                                                                                                                                |                                                                                     |           |           |          |       |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------|-----------|----------|-------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                            |  |           |           |          |       |          |       |      |    |     |       |     |    |    |      |     |                       |
| شماره پیمان:<br>053-073-9184                                                               | <p>Calculation Note for Utility Area Sleepers</p> <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادرکننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | پروژه                                                                               | بسته کاری | صادرکننده | تسهیلات  | رشته  | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 22 از 29 |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                      | صادرکننده                                                                           | تسهیلات   | رشته      | نوع مدرک | سریال | نسخه     |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                            | PEDCO                                                                               | 120       | ST        | CN       | 0024  | D02      |       |      |    |     |       |     |    |    |      |     |                       |

According to Sap results, the maximum soil stress under the foundation in combination ENV-

Allowable is:

max. stress under foundation:  $1.8 \times 0.7 = 1.26 \text{ kg/cm}^2 < 2.40 \text{ kg/cm}^2$  ok.

Foundation joints displacement under load combinations is as below:

| TABLE: Joint Displacements |                    |             |          |        |
|----------------------------|--------------------|-------------|----------|--------|
| Joint                      | OutputCase         | CaseType    | StepType | U3     |
| Text                       | Text               | Text        | Text     | cm     |
| 35                         | Envelope allowable | Combination | Max      | 0.068  |
| 35                         | Envelope allowable | Combination | Min      | -0.526 |
| 36                         | Envelope allowable | Combination | Max      | -0.217 |
| 36                         | Envelope allowable | Combination | Min      | -0.727 |
| 39                         | Envelope allowable | Combination | Max      | 0.007  |
| 39                         | Envelope allowable | Combination | Min      | -0.512 |
| 47                         | Envelope allowable | Combination | Max      | -0.054 |
| 47                         | Envelope allowable | Combination | Min      | -0.504 |
| 52                         | Envelope allowable | Combination | Max      | -0.116 |
| 52                         | Envelope allowable | Combination | Min      | -0.512 |
| 57                         | Envelope allowable | Combination | Max      | -0.177 |
| 57                         | Envelope allowable | Combination | Min      | -0.583 |
| 62                         | Envelope allowable | Combination | Max      | -0.238 |
| 62                         | Envelope allowable | Combination | Min      | -0.655 |
| 70                         | Envelope allowable | Combination | Max      | 0.345  |
| 70                         | Envelope allowable | Combination | Min      | -0.875 |
| 71                         | Envelope allowable | Combination | Max      | 0.311  |
| 71                         | Envelope allowable | Combination | Min      | -0.875 |
| 72                         | Envelope allowable | Combination | Max      | 0.281  |
| 72                         | Envelope allowable | Combination | Min      | -1.310 |
| 73                         | Envelope allowable | Combination | Max      | 0.281  |
| 73                         | Envelope allowable | Combination | Min      | -1.277 |
| 74                         | Envelope allowable | Combination | Max      | 0.339  |
| 74                         | Envelope allowable | Combination | Min      | -0.875 |
| 75                         | Envelope allowable | Combination | Max      | 0.007  |
| 75                         | Envelope allowable | Combination | Min      | -0.586 |
| 76                         | Envelope allowable | Combination | Max      | 0.068  |
| 76                         | Envelope allowable | Combination | Min      | -0.586 |
| 77                         | Envelope allowable | Combination | Max      | 0.007  |
| 77                         | Envelope allowable | Combination | Min      | -0.877 |

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                  |  |         |      |          |       |      |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|------|----------|-------|------|--|--|-------|-----------|-----------|---------|------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادرکننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |         |      |          |       |      |  |  | پروژه | بسته کاری | صادرکننده | تسهیلات | رشته | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 23 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                      |                                                                                     |         |      |          |       |      |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                            | صادرکننده                                                                           | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                  | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |

| TABLE: Joint Displacements |                    |             |          |        |
|----------------------------|--------------------|-------------|----------|--------|
| Joint                      | OutputCase         | CaseType    | StepType | U3     |
| Text                       | Text               | Text        | Text     | cm     |
| 78                         | Envelope allowable | Combination | Max      | 0.068  |
| 78                         | Envelope allowable | Combination | Min      | -0.871 |
| 79                         | Envelope allowable | Combination | Max      | 0.281  |
| 79                         | Envelope allowable | Combination | Min      | -1.282 |
| 80                         | Envelope allowable | Combination | Max      | 0.334  |
| 80                         | Envelope allowable | Combination | Min      | -0.875 |
| 81                         | Envelope allowable | Combination | Max      | -0.008 |
| 81                         | Envelope allowable | Combination | Min      | -0.586 |
| 82                         | Envelope allowable | Combination | Max      | -0.008 |
| 82                         | Envelope allowable | Combination | Min      | -0.883 |
| 83                         | Envelope allowable | Combination | Max      | 0.281  |
| 83                         | Envelope allowable | Combination | Min      | -1.288 |
| 84                         | Envelope allowable | Combination | Max      | 0.328  |
| 84                         | Envelope allowable | Combination | Min      | -0.875 |
| 85                         | Envelope allowable | Combination | Max      | -0.008 |
| 85                         | Envelope allowable | Combination | Min      | -0.586 |
| 86                         | Envelope allowable | Combination | Max      | -0.008 |
| 86                         | Envelope allowable | Combination | Min      | -0.888 |
| 87                         | Envelope allowable | Combination | Max      | 0.281  |
| 87                         | Envelope allowable | Combination | Min      | -1.293 |
| 88                         | Envelope allowable | Combination | Max      | 0.322  |
| 88                         | Envelope allowable | Combination | Min      | -0.875 |
| 89                         | Envelope allowable | Combination | Max      | -0.008 |
| 89                         | Envelope allowable | Combination | Min      | -0.586 |
| 90                         | Envelope allowable | Combination | Max      | -0.008 |
| 90                         | Envelope allowable | Combination | Min      | -0.894 |
| 91                         | Envelope allowable | Combination | Max      | 0.281  |
| 91                         | Envelope allowable | Combination | Min      | -1.299 |
| 92                         | Envelope allowable | Combination | Max      | 0.317  |
| 92                         | Envelope allowable | Combination | Min      | -0.875 |
| 93                         | Envelope allowable | Combination | Max      | -0.008 |
| 93                         | Envelope allowable | Combination | Min      | -0.586 |
| 94                         | Envelope allowable | Combination | Max      | -0.008 |
| 94                         | Envelope allowable | Combination | Min      | -0.906 |
| 95                         | Envelope allowable | Combination | Max      | 0.281  |
| 95                         | Envelope allowable | Combination | Min      | -1.305 |

|                                                                                            |                                                                                                                     |           |            |         |      |          |       |                                                                                     |      |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------|------------|---------|------|----------|-------|-------------------------------------------------------------------------------------|------|
| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p> |           |            |         |      |          |       |  |      |
| شماره پیمان:<br>053-073-9184                                                               | Calculation Note for Utility Area Sleepers                                                                          |           |            |         |      |          |       | شماره صفحه : 24 از 29                                                               |      |
|                                                                                            | پروژه                                                                                                               | بسته کاری | صادر کننده | تسهیلات | رشته | نوع مدرک | سریال |                                                                                     | نسخه |
|                                                                                            | BK                                                                                                                  | GCS       | PEDCO      | 120     | ST   | CN       | 0024  |                                                                                     | D02  |

| TABLE: Joint Displacements |                    |             |          |        |
|----------------------------|--------------------|-------------|----------|--------|
| Joint                      | OutputCase         | CaseType    | StepType | U3     |
| Text                       | Text               | Text        | Text     | cm     |
| 96                         | Envelope allowable | Combination | Max      | -0.008 |
| 96                         | Envelope allowable | Combination | Min      | -0.586 |
| 97                         | Envelope allowable | Combination | Max      | -0.008 |
| 97                         | Envelope allowable | Combination | Min      | -0.978 |
|                            |                    |             | max      | 0.345  |
|                            |                    |             | min      | -1.310 |

According to above sap 2000 results, the maximum soil displacement under the foundation in combination ENV-COMB is:

*max. displacement under foundation : 1.310 cm < 2 cm ok.*

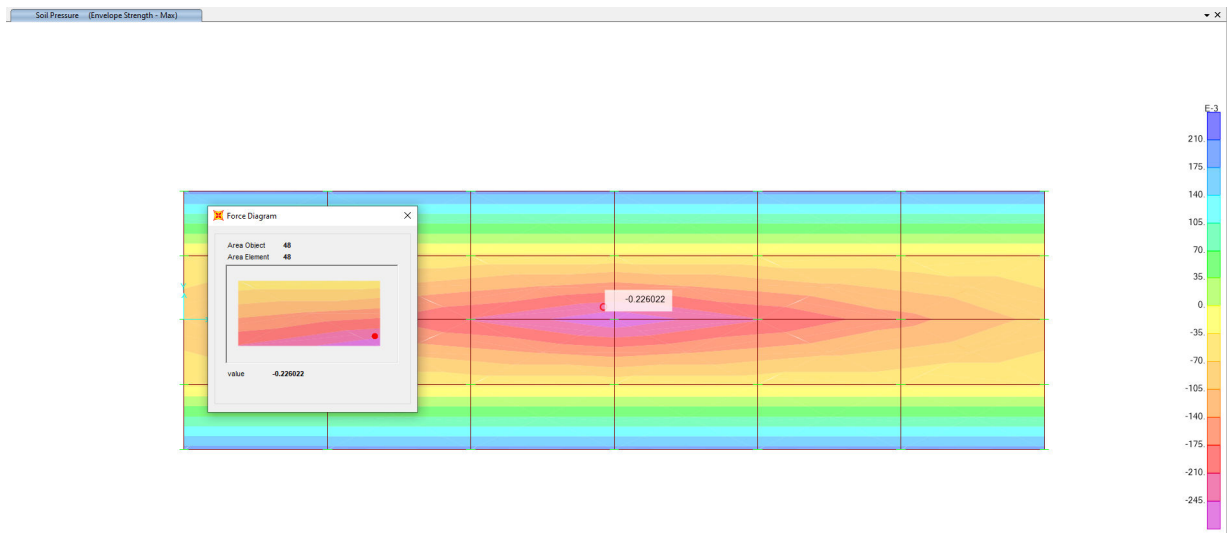


FIG 16 - stress diagram for foundation (Sleeper Type B)

According to Sap results, the maximum soil stress under the foundation in combination ENV-Allowable is:

*max. stress under foundation:  $.022 \times 0.9 = 0.198 \text{ kg/cm}^2 < 2.40 \text{ kg/cm}^2$  ok.*

#### 10.4. FOUNDATION REINFORCING CONTROL

for foundation :  $A_{smin} = 0.0018 bh = 0.0018 \times 100 \times 45 = 8.1 \text{ cm}^2$

$A_{s \text{ used}} = \phi 16 @ 200 = 10.05 \text{ cm}^2$  OK

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                  |  |         |      |          |       |      |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|------|----------|-------|------|--|--|-------|-----------|-----------|---------|------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادرکننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |         |      |          |       |      |  |  | پروژه | بسته کاری | صادرکننده | تسهیلات | رشته | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 25 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                      |                                                                                     |         |      |          |       |      |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                            | صادرکننده                                                                           | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                  | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |           |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |

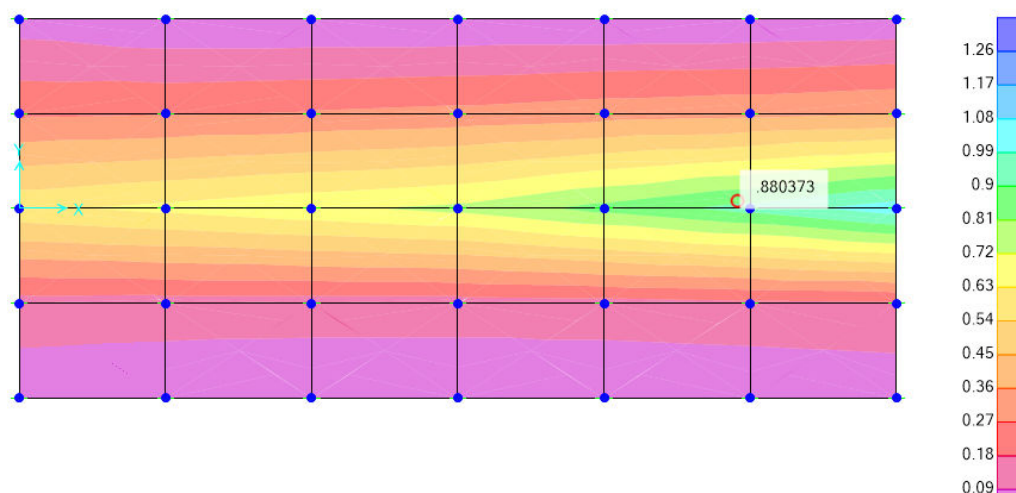


FIG 17 - stress diagram for Sleeper Type A Foundation

| As     |           |       |        |                          |                         |         |
|--------|-----------|-------|--------|--------------------------|-------------------------|---------|
| INPUT  | Mu(ton.m) | b(cm) | d(cm)  | Fy (kg/cm <sup>2</sup> ) | fc(kg/cm <sup>2</sup> ) | phi     |
|        | 0.880373  | 100   | 35     | 4000                     | 300                     | 0.9     |
| OUTPUT | Mn        | Rn1   | m1     | $\rho_{req}$             | As(req)                 | use phi |
|        | 97819.222 | 0.799 | 15.686 | 0.000200                 | 0.700                   | 16.000  |

$$Mu_1 = 880373 \text{ kg.cm}$$

$$b = 100 \text{ cm}$$

$$f_c = 300$$

$$f_y = 4000$$

$$d = 35 \text{ cm}$$

$$\phi = 0.9$$

$$M_n = \frac{M_u}{\phi} = 97819.222 \text{ kg.cm}$$

$$R_{n1} = \frac{M_{n1}}{b \cdot d^2} = 0.799$$

$$m_1 = \frac{f_y}{0.85 f_c} = 15.686$$

$$\rho_{req} = \frac{1}{m_1} \left( 1 - \sqrt{1 - \frac{2m_1 R_{n1}}{f_y}} \right) = 0.000200$$

$$= 0.7 \text{ cm}^2 \ll : \text{ uses } \phi 16 @ 200 \quad A_s = 10.05 \text{ cm}^2 \quad \text{ok } A_{s(req)} = \rho_{req} \cdot b \cdot d$$

|  | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                   |  |      |         |            |           |       |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|---------|------------|-----------|-------|--|--|------|-------|----------|------|---------|------------|-----------|-------|-----|------|----|----|-----|-------|-----|----|-----------------------|
| شماره پیمان:<br>053 – 073 – 9184                                                  | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D02</td><td>0024</td><td>CN</td><td>ST</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |      |         |            |           |       |  |  | نسخه | سریال | نوع مدرک | رشته | تسهیلات | صادر کننده | بسته کاری | پروژه | D02 | 0024 | CN | ST | 120 | PEDCO | GCS | BK | شماره صفحه : 26 از 29 |
| Calculation Note for Utility Area Sleepers                                        |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |      |         |            |           |       |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
| نسخه                                                                              | سریال                                                                                                                                                                                                                                                                                                                                 | نوع مدرک                                                                            | رشته | تسهیلات | صادر کننده | بسته کاری | پروژه |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |
| D02                                                                               | 0024                                                                                                                                                                                                                                                                                                                                  | CN                                                                                  | ST   | 120     | PEDCO      | GCS       | BK    |  |  |      |       |          |      |         |            |           |       |     |      |    |    |     |       |     |    |                       |

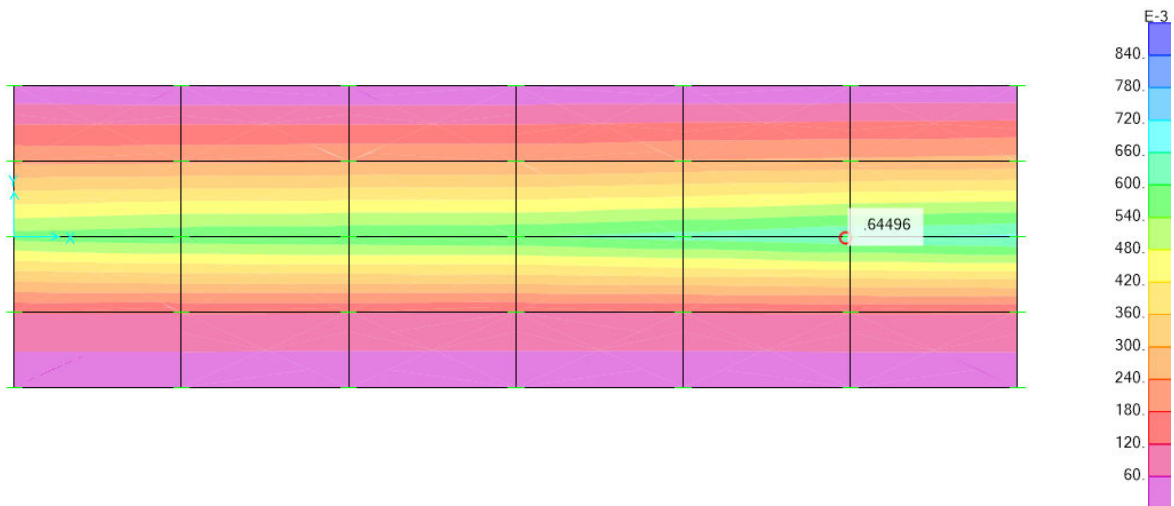


FIG 18 - stress diagram for Sleeper Type B Foundation

| As     |           |       |        |              |             |         |
|--------|-----------|-------|--------|--------------|-------------|---------|
| INPUT  | Mu(ton.m) | b(cm) | d(cm)  | Fy (kg/cm^2) | fc(kg/cm^2) | phi     |
|        | 0.64496   | 100   | 35     | 4000         | 300         | 0.9     |
| OUTPUT | Mn        | Rn1   | m1     | $\rho_{req}$ | As(req)     | use phi |
|        | 71662.222 | 0.585 | 15.686 | 0.000146     | 0.512       | 16.000  |

$$\begin{aligned}
 Mu_1 &= 644960 \text{ kg.cm} \\
 b &= 100 \text{ cm} \\
 f_c &= 300 \\
 f_y &= 4000 \\
 d &= 35 \text{ cm} \\
 \phi &= 0.9 \\
 M_n &= \frac{Mu}{\phi} = 71662.22 \text{ kg.cm} \\
 R_{n1} &= \frac{M_{n1}}{b \cdot d^2} = 0.585 \\
 m_1 &= \frac{f_y}{0.85 f_c} = 15.686 \\
 \rho_{req} &= \frac{1}{m_1} \left( 1 - \sqrt{1 - \frac{2m_1 R_{n1}}{f_y}} \right) = 0.000146 \\
 &= 0.512 \text{ cm}^2 \ll : \text{ uses } \phi 16 @ 200 \quad As = 10.05 \text{ cm}^2 \quad \text{ok } A_{s(req)} = \rho_{req} \cdot b \cdot d
 \end{aligned}$$

## 10.5. OVERTURNING AND SLIDING CONTROL CALCULATION

### 10.5.1. Anchor Sleeper TYPE A:

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                   |  |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|------|----------|-------|------|--|--|-------|-----------|------------|---------|------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادر کننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |         |      |          |       |      |  |  | پروژه | بسته کاری | صادر کننده | تسهیلات | رشته | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 27 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                             | صادر کننده                                                                          | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                   | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |

#### 10.5.1.1. SLIDING CONTROL CALCULATION:

$L=3\text{ m}$  ,  $B=1.3\text{m}$  ,  $t=0.4\text{m}$  ,  $H=1.1\text{m}$  (1 m soil height & 0.5m above ground)

For pipe 10 inch weight per meter is about 25kg/ m .

$$\gamma_{SOIL} = 1850\text{ kg/m}^3$$

$$\gamma_{concrete} = 2500\text{ kg/m}^3$$

$$W_F = 3 \times 1.3 \times 0.4 \times 2.5 = 3.9\text{ ton}$$

$$W_{wall} = 3 \times 0.5 \times 1.1 \times 2.5 = 4.125\text{ ton}$$

$$W_{soil} = 1.85 \times (1 \times 0.8 \times 3) = 4.44\text{ ton}$$

$$W_{pipe} = 3.7\text{ ton}$$

$$Mr = (3.9 + 4.125 + 4.44 + 3.7) \times 0.65 = 10.50\text{ ton.m}$$

$$Mo = 205 \times 7 \times 1.5 = 2.1525\text{ ton.m}$$

$$SF = \frac{M_r}{M_o} = \frac{10.50}{2.1525} = 4.88 > 1.5\text{ OK}$$

#### 10.5.1.2. SLIDING CONTROL CALCULATION:

According to design criteria the resisting force against sliding shall be calculated with the value whichever is greater of the followings:

(100 % friction force between soil and foundation) + (50%soil passive resistance)

(50% friction force between soil and foundation) + (100%soil passive resistance)

$$\mu = \tan(0.67^\circ) = 0.4$$

$$V_{eqy} = 1.435\text{ ton}$$

$$K_p = 3$$

$$\gamma = 1.85 \frac{\text{gr}}{\text{cm}^3}$$

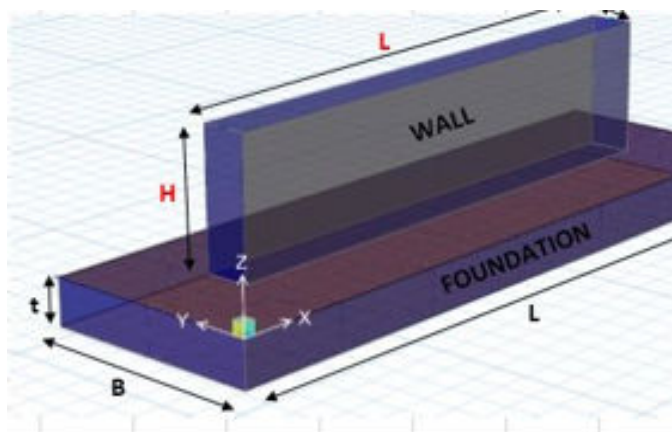
$$R_{sliding} = 0.5 \times \mu \times W_R + 0.5K_p\gamma H^2 L = 0.5 \times 0.4 \times (3.9 + 4.125 + 4.44 + 3.7) + 0.5 \times 3 \times 1.85 \times 1^2 \times 3 = 11.55\text{ ton}$$

$$R_{sliding} = \mu \times W_R + 0.5 \times 0.5K_p\gamma H^2 L = 0.4 \times (3.9 + 4.125 + 4.44 + 3.7) + 0.5 \times 0.5 \times 3 \times 1.85 \times 1^2 \times 3 = 10.62\text{ ton}$$

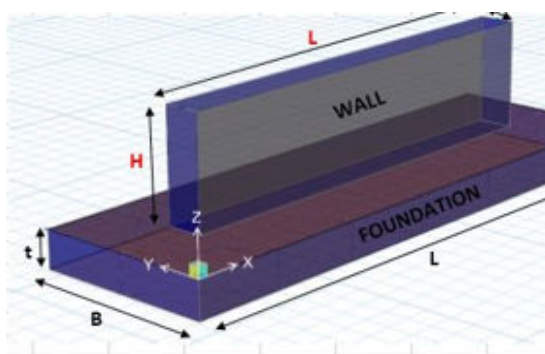
$$R_{sliding} = \min(11.55, 10.62)$$

$$SF = \frac{R_{sliding}}{V_{eqy}} = \frac{9.90}{1.435} = 7.40 \geq 1.00\text{ OK}$$

|  | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                  |  |      |         |           |           |       |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                       |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|---------|-----------|-----------|-------|--|--|------|-------|----------|------|---------|-----------|-----------|-------|-----|------|----|----|-----|-------|-----|----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                      | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادرکننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D02</td><td>0024</td><td>CN</td><td>ST</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |      |         |           |           |       |  |  | نسخه | سریال | نوع مدرک | رشته | تسهیلات | صادرکننده | بسته کاری | پروژه | D02 | 0024 | CN | ST | 120 | PEDCO | GCS | BK | شماره صفحه : 28 از 29 |
| Calculation Note for Utility Area Sleepers                                        |                                                                                                                                                                                                                                                                                                                                      |                                                                                     |      |         |           |           |       |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                       |
| نسخه                                                                              | سریال                                                                                                                                                                                                                                                                                                                                | نوع مدرک                                                                            | رشته | تسهیلات | صادرکننده | بسته کاری | پروژه |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                       |
| D02                                                                               | 0024                                                                                                                                                                                                                                                                                                                                 | CN                                                                                  | ST   | 120     | PEDCO     | GCS       | BK    |  |  |      |       |          |      |         |           |           |       |     |      |    |    |     |       |     |    |                       |



#### 10.5.1.Anchor Sleeper TYPE B:



#### 10.5.2.1. SLIDING CONTROL CALCULATION:

$L=3 \text{ m}$  ,  $B=0.9$  ,  $t=0.4\text{m}$  ,  $H=1.1\text{m}$  (1m soil height & 0.5m above ground)

For pipe 10 inch weight per meter is about 25kg/ m.

$$\gamma_{SOIL} = 1850 \text{ kg/m}^3$$

$$\gamma_{concrete} = 2500 \text{ kg/m}^3$$

$$W_F = 3 \times 0.9 \times 0.4 \times 2.5 = 2.7 \text{ ton}$$

$$W_{wall} = 3 \times 0.5 \times 1.1 \times 2.5 = 4.125 \text{ ton}$$

$$W_{soil} = 1.85 \times (1 \times 0.4 \times 3) = 2.22 \text{ ton}$$

| <br>NISOC | <p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>                                                                                                                                                                                                                   |  |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|------|----------|-------|------|--|--|-------|-----------|------------|---------|------|----------|-------|------|----|-----|-------|-----|----|----|------|-----|-----------------------|
| شماره پیمان:<br>053-073-9184                                                               | <table><tr><th colspan="8">Calculation Note for Utility Area Sleepers</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادر کننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>ST</td><td>CN</td><td>0024</td><td>D02</td></tr></table> | Calculation Note for Utility Area Sleepers                                          |         |      |          |       |      |  |  | پروژه | بسته کاری | صادر کننده | تسهیلات | رشته | نوع مدرک | سریال | نسخه | BK | GCS | PEDCO | 120 | ST | CN | 0024 | D02 | شماره صفحه : 29 از 29 |
| Calculation Note for Utility Area Sleepers                                                 |                                                                                                                                                                                                                                                                                                                                       |                                                                                     |         |      |          |       |      |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| پروژه                                                                                      | بسته کاری                                                                                                                                                                                                                                                                                                                             | صادر کننده                                                                          | تسهیلات | رشته | نوع مدرک | سریال | نسخه |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |
| BK                                                                                         | GCS                                                                                                                                                                                                                                                                                                                                   | PEDCO                                                                               | 120     | ST   | CN       | 0024  | D02  |  |  |       |           |            |         |      |          |       |      |    |     |       |     |    |    |      |     |                       |

$$W_{pipe} = 3.7 \text{ ton}$$

$$Mr = (2.7 + 4.125 + 2.22 + 3.7) \times 0.45 = 5.73 \text{ ton.m}$$

$$Mo = 1440 \times 1.5 = 2.16 \text{ ton.m}$$

$$SF = \frac{M_r}{M_o} = \frac{5.73}{2.16} = 2.65 > 1.5 \text{ OK}$$

#### 10.5.2.2. SLIDING CONTROL CALCULATION:

According to design criteria the resisting force against sliding shall be calculated with the value whichever is greater of the followings:

(100 % friction force between soil and foundation) + (50%soil passive resistance)

(50% friction force between soil and foundation) + (100%soil passive resistance)

$$\mu = \tan(0.67\phi) = 0.4$$

$$V_{eqy} = 1.44 \text{ ton}$$

$$K_p = 3$$

$$\gamma = 1.85 \frac{gr}{cm^3}$$

$$R_{sliding} = 0.5 \times \mu \times W_R + 0.5K_p\gamma H^2L = 0.5 \times 0.4 \times (2.7 + 4.125 + 2.22 + 3.7) + 0.5 \times 3 \times 1.85 \times 1^2 \times 3 = 10.87 \text{ ton}$$

$$R_{sliding} = \mu \times W_R + 0.5 \times 0.5K_p\gamma H^2L = 0.4 \times (2.7 + 4.125 + 2.22 + 3.7) + 0.5 \times 0.5 \times 3 \times 1.85 \times 1^2 \times 3 = 9.26 \text{ ton}$$

$$R_{sliding} = \min(10.87, 9.26)$$

$$SF = \frac{R_{sliding}}{V_{eqy}} = \frac{9.26}{1.435} = 6.45 \geq 1.00 \text{ OK}$$