

# FOUNDATION CALCULATION SHEET

## One-Stop Solution for Foundation



| TITLE                  |      | DESCRIPTION                        |        |       |        |        |
|------------------------|------|------------------------------------|--------|-------|--------|--------|
| PROJECT/JOB NO.        |      | Revise F6-F6                       |        |       |        |        |
| PROJECT/JOB NAME       |      | 7.5 MW. Power Plant Stream Turbine |        |       |        |        |
| CLIENT NAME            |      | SAHAGREEN FOREST                   |        |       |        |        |
| SITE NAME              |      | KAMPANGPET                         |        |       |        |        |
| DOCUMENT NO.           |      |                                    |        |       |        |        |
| REFERENCE NO.          |      |                                    |        |       |        |        |
| STRUCTURE NAME         |      | Revise F6-F6                       |        |       |        |        |
| LOAD COMBINATION GROUP |      |                                    |        |       |        |        |
| REV                    | DATE | DESCRIPTION                        | PREP'D | CHK'D | APPR'D | APPR'D |
|                        |      |                                    |        |       |        |        |
|                        |      |                                    |        |       |        |        |
|                        |      |                                    |        |       |        |        |
|                        |      |                                    |        |       |        |        |
|                        |      |                                    |        |       |        |        |
|                        |      |                                    |        |       |        |        |
|                        |      |                                    |        |       |        |        |
|                        |      |                                    |        |       |        |        |

## Project Na. : 7.5 MW. Power Plant Stream..

Client : SAHAGREEN F...

## FOUNDATION LISTS

[illegible]



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

Client : SAHAGREEN F...

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## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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### 1. GENERAL

#### 1.1 CODE & STANDARD

| Items                        | Description  |
|------------------------------|--|
| Design Code                  | American Concrete Institute (ACI 318) [Metric]         |
| Horizontal Force for Wind    | UNIFORM BUILDING CODE (UBC-1997)                       |
| Horizontal Force for Seismic | UNIFORM BUILDING CODE [UBC-1997]                       |
| Unit System                  | Input : MKS, Output : MKS, Calculation Unit : IMPERIAL |

#### 1.2 MATERIALS & UNIT WEIGHT

| Items                                       | Value                                       |
|---|---|
| Concrete (f'c : compressive strength)       | 280.000 kgf/cm <sup>2</sup>                 |
| Lean Concrete (Lf'c : compressive strength) | 240.000 kgf/cm <sup>2</sup>                 |
| Reinforcement (#3 ~ #5 , yield strength)    | 4000.000 kgf/cm <sup>2</sup>                |
| Reinforcement (#6 ~ , yield strength)       | 2400.000 kgf/cm <sup>2</sup>                |
| Rs (Soil unit weight)                       | 1.700 ton/m <sup>3</sup>                    |
| Rc (Concrete unit weight)                   | 2.400 ton/m <sup>3</sup>                    |
| Es (Steel Modulus of Elasticity)            | 2.040 × 10 <sup>6</sup> kgf/cm <sup>2</sup> |
| Ec (Concrete Modulus of Elasticity)         | 252976.800 kgf/cm <sup>2</sup>              |

#### - Pile Capacity

| Items                     | Value            |
|---------------------------|------------------|
| Pile Name                 | PHC-12           |
| Footing List              | F-61, F-62       |
| Diameter                  | 300 mm           |
| Length                    | 14 m             |
| Thick                     | 10 mm            |
| Shape                     | Square           |
| Capacity ( Ha , Ua , Va ) | 2 , 15 , 30 tonf |

#### 1.3 SUBSOIL CONDITION & SAFETY FACTORS

| Items   | Description |
|---|-------------|
| Allowable Increase of Soil (Wind)               | 33.33 %     |
| Allowable Increase of Soil (Seismic)            | 33.33 %     |
| Allowable Increase of Soil (Test)               | 20 %        |
| Allowable Increase of Pile Horizontal (Wind)    | 33.33 %     |
| Allowable Increase of Pile Horizontal (Seismic) | 33.33 %     |
| Allowable Increase of Pile Horizontal (Test)    | 20 %        |
| Allowable Increase of Pile Vertical (Wind)      | 33.33 %     |
| Allowable Increase of Pile Vertical (Seismic)   | 33.33 %     |
| Allowable Increase of Pile Vertical (Test)      | 20 %        |
| Allowable Increase of Pile Uplift (Wind)        | 0 %         |
| Allowable Increase of Pile Uplift (Seismic)     | 0 %         |
| Allowable Increase of Pile Uplift (Test)        | 0 %         |



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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|   |     |
|---|-----|
| Safety factor against overturning for OVM1(FO1) | 1.5 |
| Safety factor against overturning for OVM2(FO2) | 1.5 |
| Safety factor against overturning for OVM3(FO3) | 1.5 |
| Safety factor against overturning for OVM4(FO4) | 1.9 |
| Safety factor against sliding for the SL1(FS1)  | 1.5 |
| Safety factor against sliding for the SL2(FS2)  | 1.8 |
| Safety factor against sliding for the SL3(FS3)  | 1.5 |
| Safety factor against sliding for the SL4(FS4)  | 1.5 |
| Friction factor ( $\mu$ )                       | .35 |

### 1.4 LOAD COMBINATION

| Index | Load Case Name | Load Case Description |
|-------|----------------|-----------------------|
| 1     | SW             | SELF WEIGHT           |
| 2     | DL             | DEAD LOAD             |

#### 1.4.1 Group - F-61

Footing List = F-61

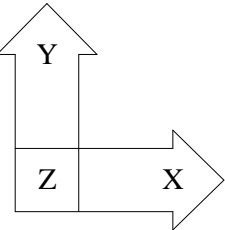
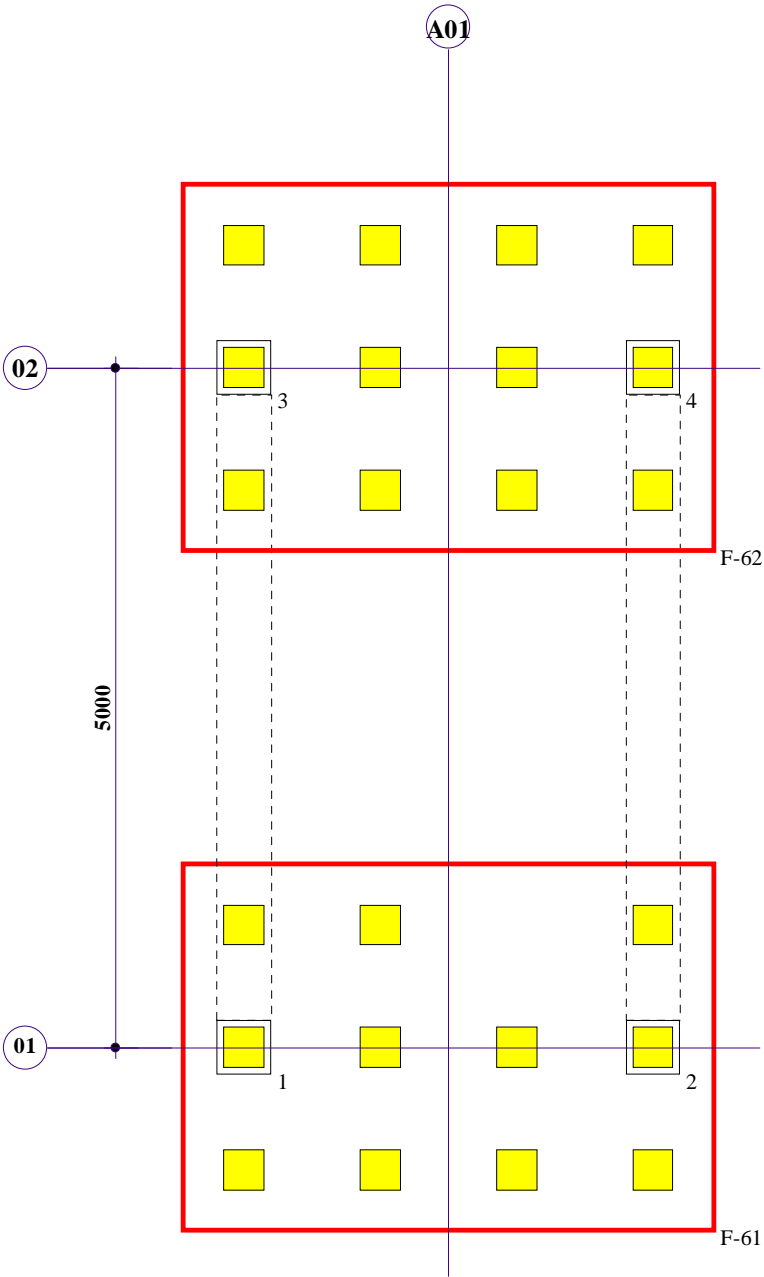
| Comb . ID | Load Combination for Reinforcement |
|-----------|------------------------------------|
| 1         | 1.0 SW + 1.0 DL                    |

#### 1.4.2 Group - F-62

Footing List = F-62

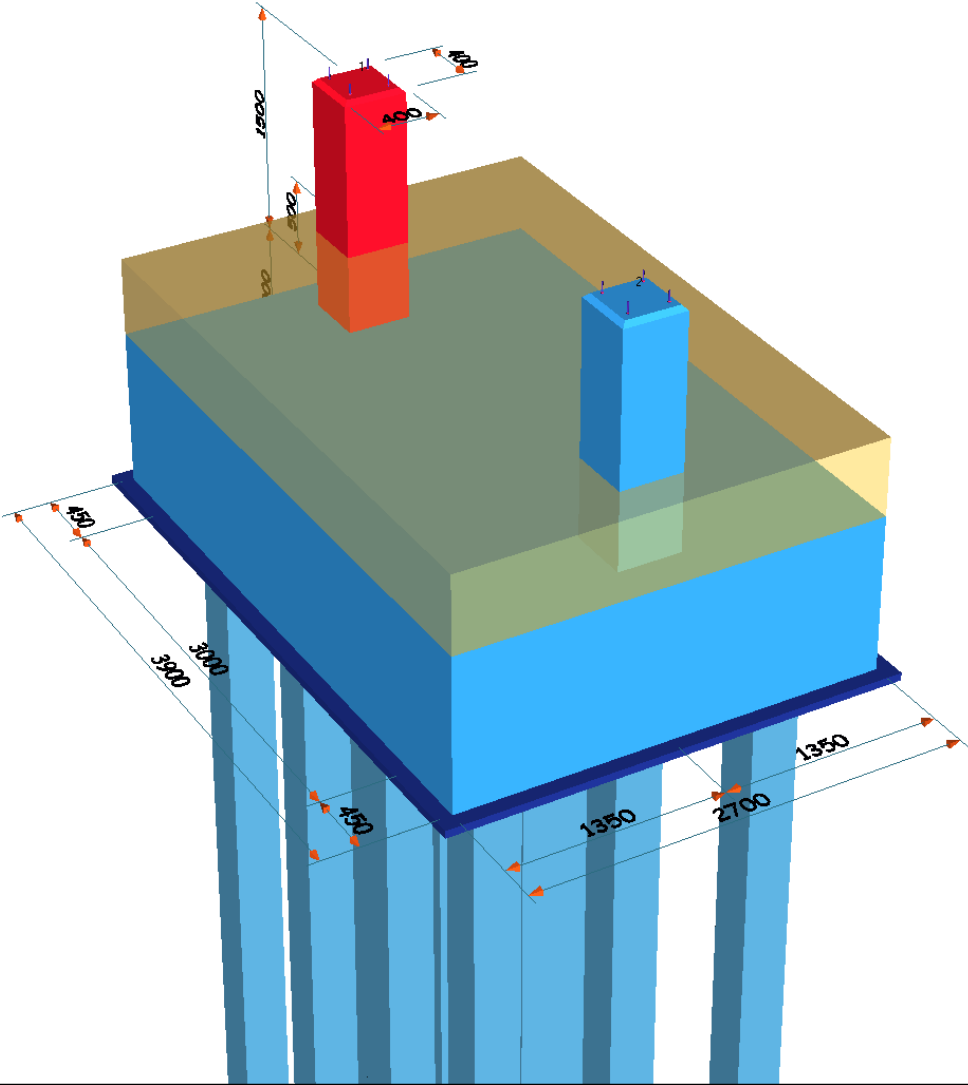
| Comb . ID | Load Combination for Reinforcement |
|-----------|------------------------------------|
| 1         | 1.0 SW + 1.0 DL                    |

2. DRAWING

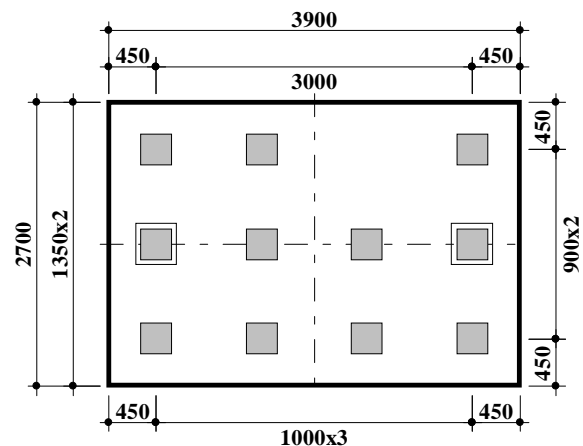


| REFERENCE DWGS                             |         |              |         |               |       |       |
|--|---------|--------------|---------|---------------|-------|-------|
| NO.  | DWG NO. |              |         | DWG TITLE     |       |       |
|  |         |              |         |               |       |       |
|  |         |              |         |               |       |       |
|  |         |              |         |               |       |       |
|  |         |              |         |               |       |       |
|  |         |              |         |               |       |       |
|  |         |              |         |               |       |       |
|  |         |              |         |               |       |       |
|  |         |              |         |               |       |       |
| NOTES                                      |         |              |         |               |       |       |
| * OUTPUT UNIT : mm                         |         |              |         |               |       |       |
| 7.5 MW. Power Plant Stream Turbine PROJECT |         |              |         |               |       |       |
| FOUNDATION LOCATION PLAN<br>Revise F6-F6   |         |              |         |               |       |       |
| SQUAD CHECK                                |         |              |         |               |       |       |
|  |         |              |         |               |       |       |
|  |         |              |         |               |       |       |
|  |         |              |         |               |       |       |
|  | PROCESS | PIPING       | VESSELS | STRUCT.       | ELEC. | INST. |
|  |         |              |         |               |       |       |
| SCALE                                      |         | JOB NO.      |         | MICROFILM NO. |       |       |
| AS SHOWN                                   |         | Revise F6-F6 |         |               |       |       |

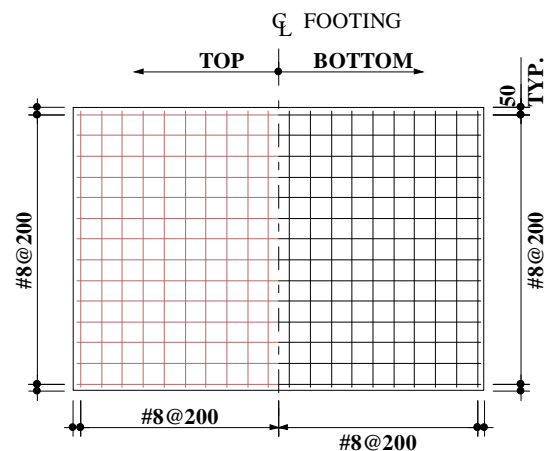
2.2 DETAIL SKETCH



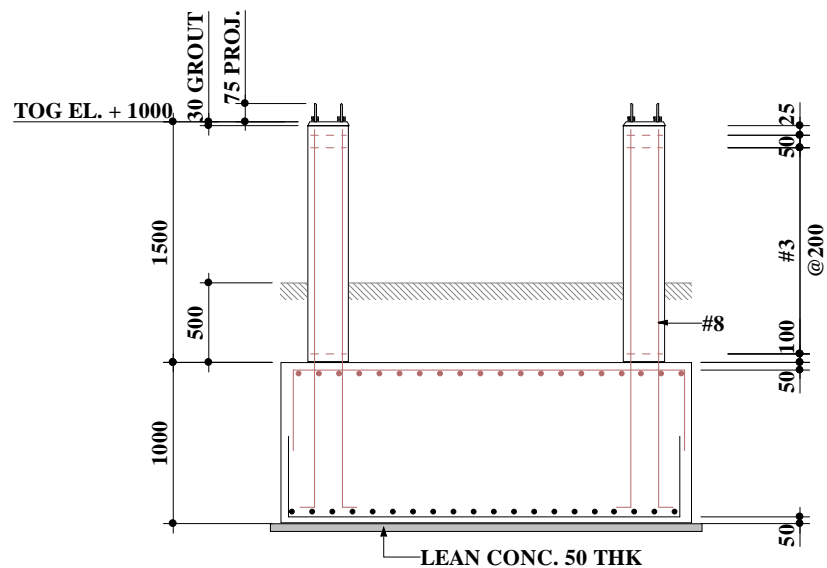
OUTPUT UNIT : mm



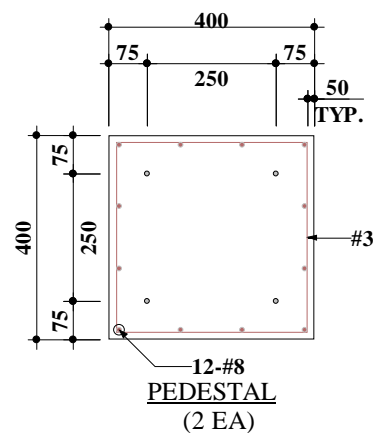
## FOUNDATION PLAN



FOOTING REINF. PLAN



## SECTION

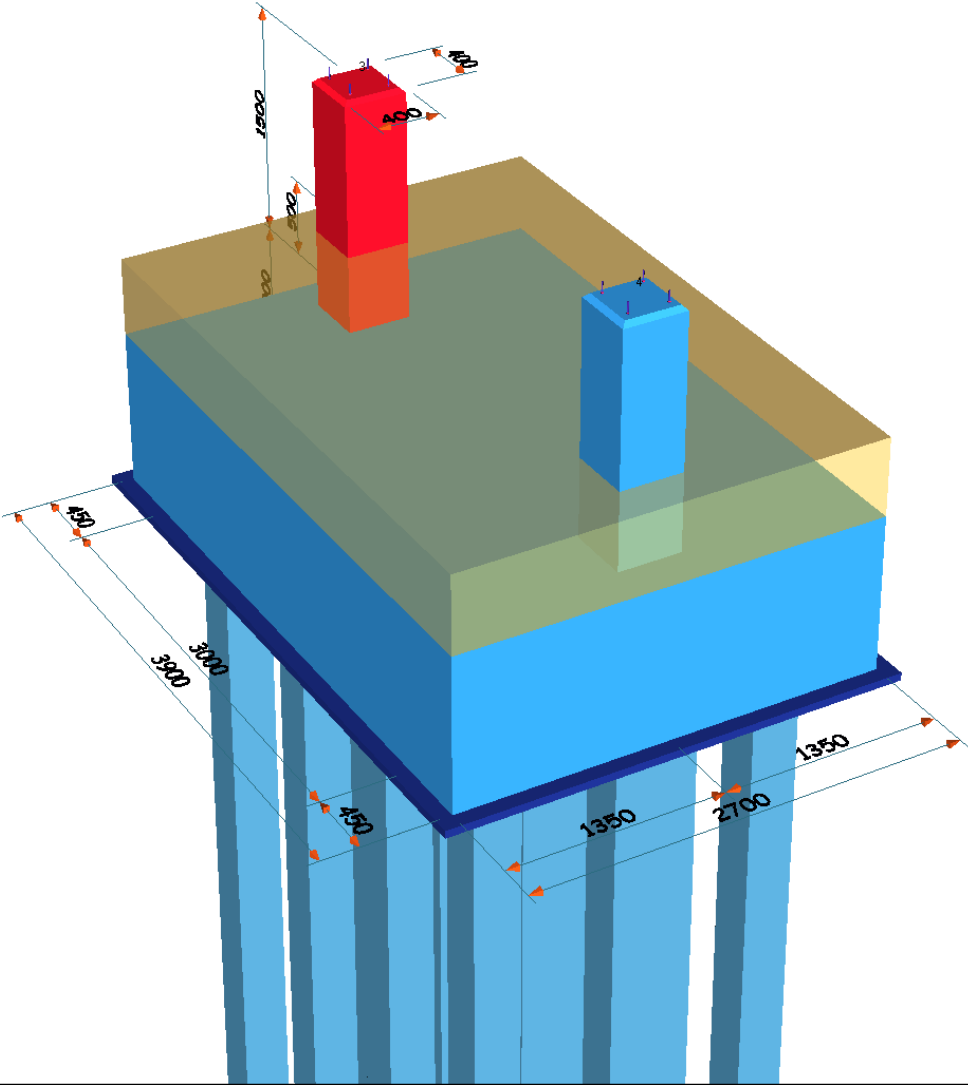


PEDESTAL  
(2 EA)

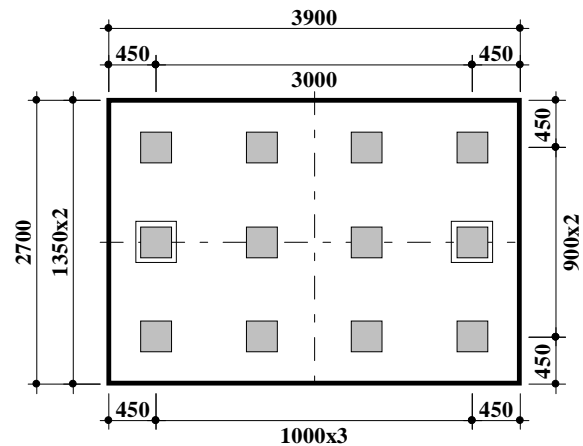
| REFERENCE DWGS   |          |        |              |           |               |       |
|--|----------|--------|--------------|-----------|---------------|-------|
| NO.  | DWG NO.  |        |              | DWG TITLE |               |       |
|  |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
| <b>NOTES</b>   |          |        |              |           |               |       |
| * PILE<br>11-??300 PHC-12<br>* ANCHOR BOLT<br>2X4-M12 ANC. BOLTS (TYPE TYPE L)<br><br>* OUTPUT UNIT : mm |          |        |              |           |               |       |
| 7.5 MW. Power Plant Stream Turbine PROJECT   |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
| <b>FOUNDATION DETAIL FOR</b>   |          |        |              |           |               |       |
| <b>F-61</b>  |          |        |              |           |               |       |
| <b>SQUAD CHECK</b>   |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
|  |          |        |              |           |               |       |
|  | PROCESS  | PIPING | VESSELS      | STRUCT.   | ELEC.         | INST. |
|  |          |        |              |           |               |       |
|  | SCALE    |        | JOB NO.      |           | MICROFILM NO. |       |
| PD   | AS SHOWN |        | Revise F6-F6 |           |               |       |



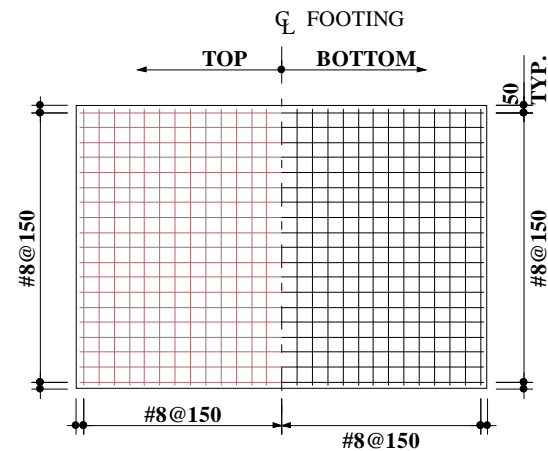
2.2 DETAIL SKETCH



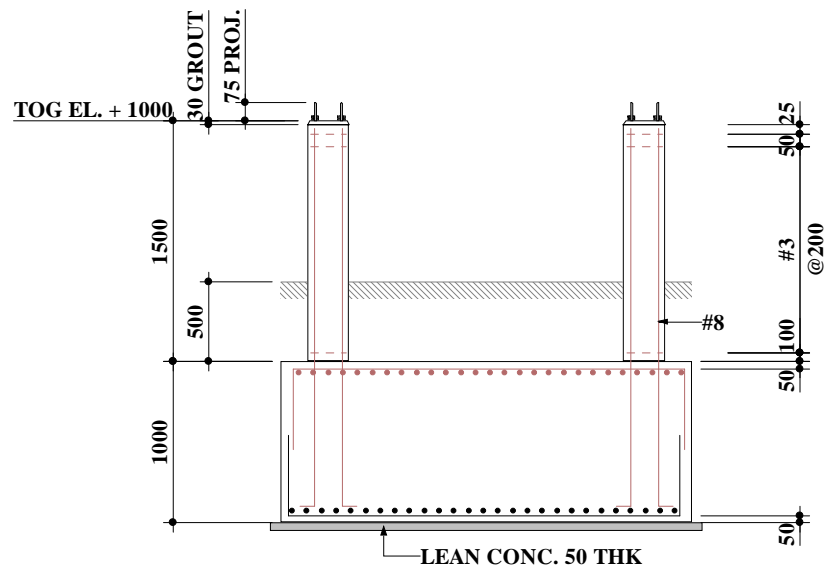
OUTPUT UNIT : mm



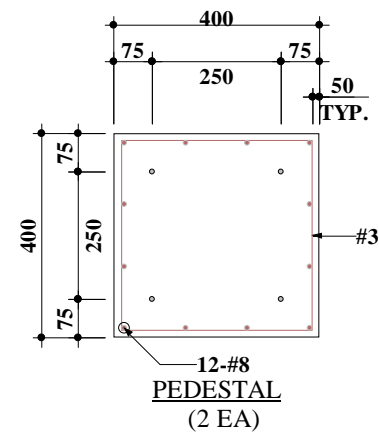
## FOUNDATION PLAN



FOOTING REINF. PLAN



## SECTION



PEDESTAL  
(2 EA)

| REFERENCE DWGS   |          |        |              |           |               |       |  |
|--|----------|--------|--------------|-----------|---------------|-------|--|
| NO.  | DWG NO.  |        |              | DWG TITLE |               |       |  |
|  |          |        |              |           |               |       |  |
|  |          |        |              |           |               |       |  |
|  |          |        |              |           |               |       |  |
|  |          |        |              |           |               |       |  |
|  |          |        |              |           |               |       |  |
|  |          |        |              |           |               |       |  |
|  |          |        |              |           |               |       |  |
|  |          |        |              |           |               |       |  |
| NOTES  |          |        |              |           |               |       |  |
| * PILE<br>12-??300 PHC-12<br>* ANCHOR BOLT<br>2X4-M12 ANC. BOLTS (TYPE TYPE L)<br><br>* OUTPUT UNIT : mm |          |        |              |           |               |       |  |
| 7.5 MW. Power Plant Stream Turbine PROJECT   |          |        |              |           |               |       |  |
|  |          |        |              |           |               |       |  |
| FOUNDATION DETAIL FOR<br><br>F-62  |          |        |              |           |               |       |  |
| SQUAD CHECK  |          |        |              |           |               |       |  |
|  |          |        |              |           |               |       |  |
|  |          |        |              |           |               |       |  |
|  |          |        |              |           |               |       |  |
|  | PROCESS  | PIPING | VESSLS       | STRUCT.   | ELEC.         | INST. |  |
|  |          |        |              |           |               |       |  |
|  | SCALE    |        | JOB NO.      |           | MICROFILM NO. |       |  |
| PD   | AS SHOWN |        | Revise F6-F6 |           |               |       |  |



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

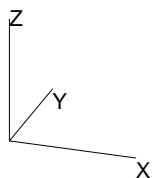
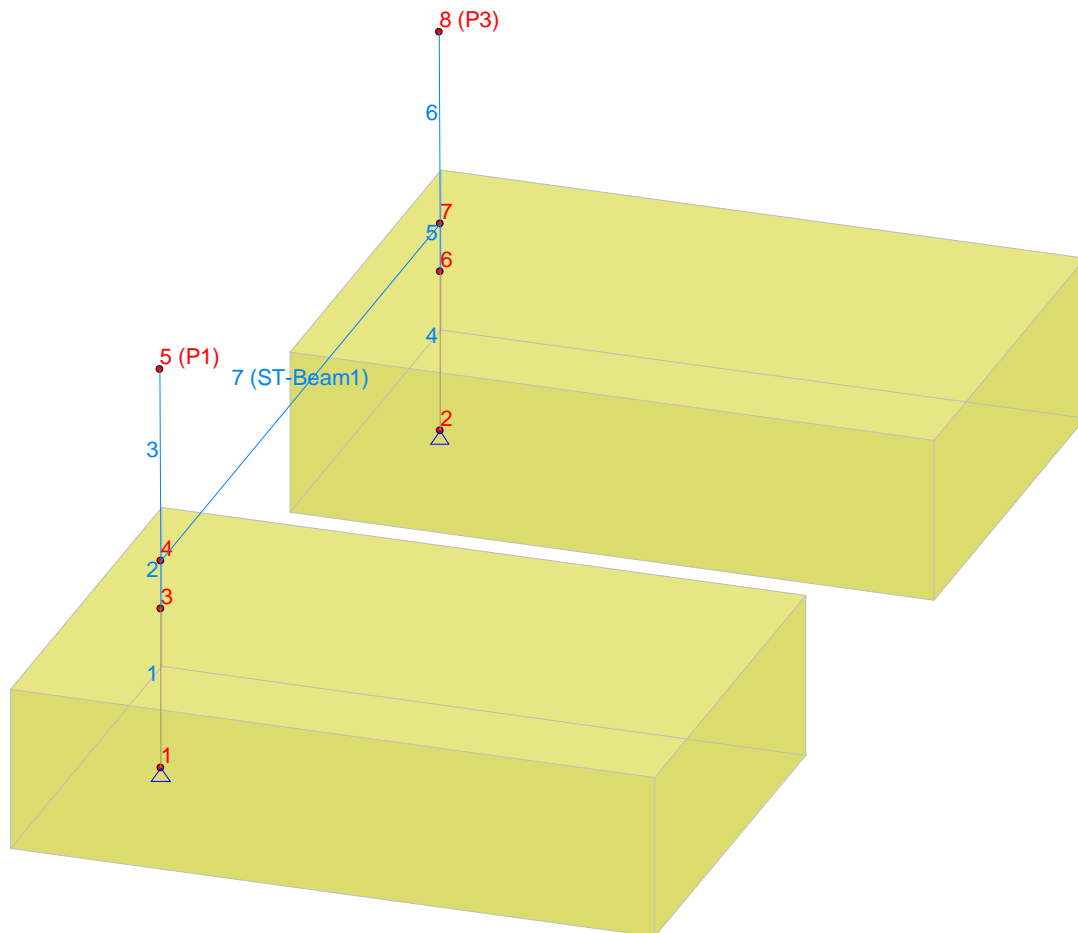
Client : SAHAGREEN F...

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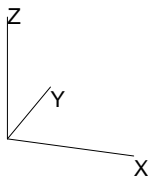
### 3. FRAME ANALYSIS

#### 3.1 FRAME DRAWING

Sturcture 1



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## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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### 3.2 FRAME ANALYSIS DATA

#### 3.2.1 Structure 1

► Member and Force

Unit ( tonf,tonf-m )

| Member | LC# |   | Axial  | Shear-Y | Shear-Z | Torsion | Moment-Y | Moment-Z |
|--------|-----|---|--------|---------|---------|---------|----------|----------|
| 1      | 1   | i | -183.5 | 0       | -.573   | 0       | 0        | 0        |
|        |     | j | -183.5 | 0       | -.573   | 0       | .573     | 0        |
| 2      | 1   | i | -183   | 0       | -.573   | 0       | .573     | 0        |
|        |     | j | -183   | 0       | -.573   | 0       | .744     | 0        |
| 3      | 1   | i | -181.5 | 0       | 0       | 0       | 0        | 0        |
|        |     | j | -181.5 | 0       | 0       | 0       | 0        | 0        |
| 4      | 1   | i | -183.5 | 0       | .573    | 0       | 0        | 0        |
|        |     | j | -183.5 | 0       | .573    | 0       | -.573    | 0        |
| 5      | 1   | i | -183   | 0       | .573    | 0       | -.573    | 0        |
|        |     | j | -183   | 0       | .573    | 0       | -.744    | 0        |
| 6      | 1   | i | -181.5 | 0       | 0       | 0       | 0        | 0        |
|        |     | j | -181.5 | 0       | 0       | 0       | 0        | 0        |
| 7      | 1   | i | -.573  | -1.44   | 0       | 0       | 0        | -.744    |
|        |     | j | -.573  | 1.44    | 0       | 0       | 0        | -.744    |

► Support Reactions

Unit ( tonf,tonf-m )

| Joint | LC# | Force-X | Force-Y | Force-Z | Moment-X | Moment-Y | Moment-Z |
|-------|-----|---------|---------|---------|----------|----------|----------|
| 1     | 1   | 0       | .573    | 183.55  | 0        | 0        | 0        |
| 2     | 1   | 0       | -.573   | 183.55  | 0        | 0        | 0        |

#### 3.2.2 Structure 2

► Member and Force

Unit ( tonf,tonf-m )

| Member | LC# |   | Axial  | Shear-Y | Shear-Z | Torsion | Moment-Y | Moment-Z |
|--------|-----|---|--------|---------|---------|---------|----------|----------|
| 1      | 1   | i | -191.4 | 0       | -.573   | 0       | 0        | 0        |
|        |     | j | -191.4 | 0       | -.573   | 0       | .573     | 0        |
| 2      | 1   | i | -190.9 | 0       | -.573   | 0       | .573     | 0        |
|        |     | j | -190.9 | 0       | -.573   | 0       | .744     | 0        |
| 3      | 1   | i | -189.4 | 0       | 0       | 0       | 0        | 0        |
|        |     | j | -189.4 | 0       | 0       | 0       | 0        | 0        |
| 4      | 1   | i | -191.4 | 0       | .573    | 0       | 0        | 0        |
|        |     | j | -191.4 | 0       | .573    | 0       | -.573    | 0        |
| 5      | 1   | i | -190.9 | 0       | .573    | 0       | -.573    | 0        |
|        |     | j | -190.9 | 0       | .573    | 0       | -.744    | 0        |
| 6      | 1   | i | -189.4 | 0       | 0       | 0       | 0        | 0        |
|        |     | j | -189.4 | 0       | 0       | 0       | 0        | 0        |
| 7      | 1   | i | -.573  | -1.44   | 0       | 0       | 0        | -.744    |
|        |     | j | -.573  | 1.44    | 0       | 0       | 0        | -.744    |

► Support Reactions

Unit ( tonf,tonf-m )

| Joint | LC# | Force-X | Force-Y | Force-Z | Moment-X | Moment-Y | Moment-Z |
|-------|-----|---------|---------|---------|----------|----------|----------|
| 1     | 1   | 0       | .573    | 191.44  | 0        | 0        | 0        |



**Calculation Sheet  
of  
Foundation**

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

Client : SAHAGREEN F...

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|   |   |   |      |        |   |   |   |
|---|---|---|------|--------|---|---|---|
| 2 | 1 | 0 | -573 | 191.44 | 0 | 0 | 0 |
|---|---|---|------|--------|---|---|---|



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

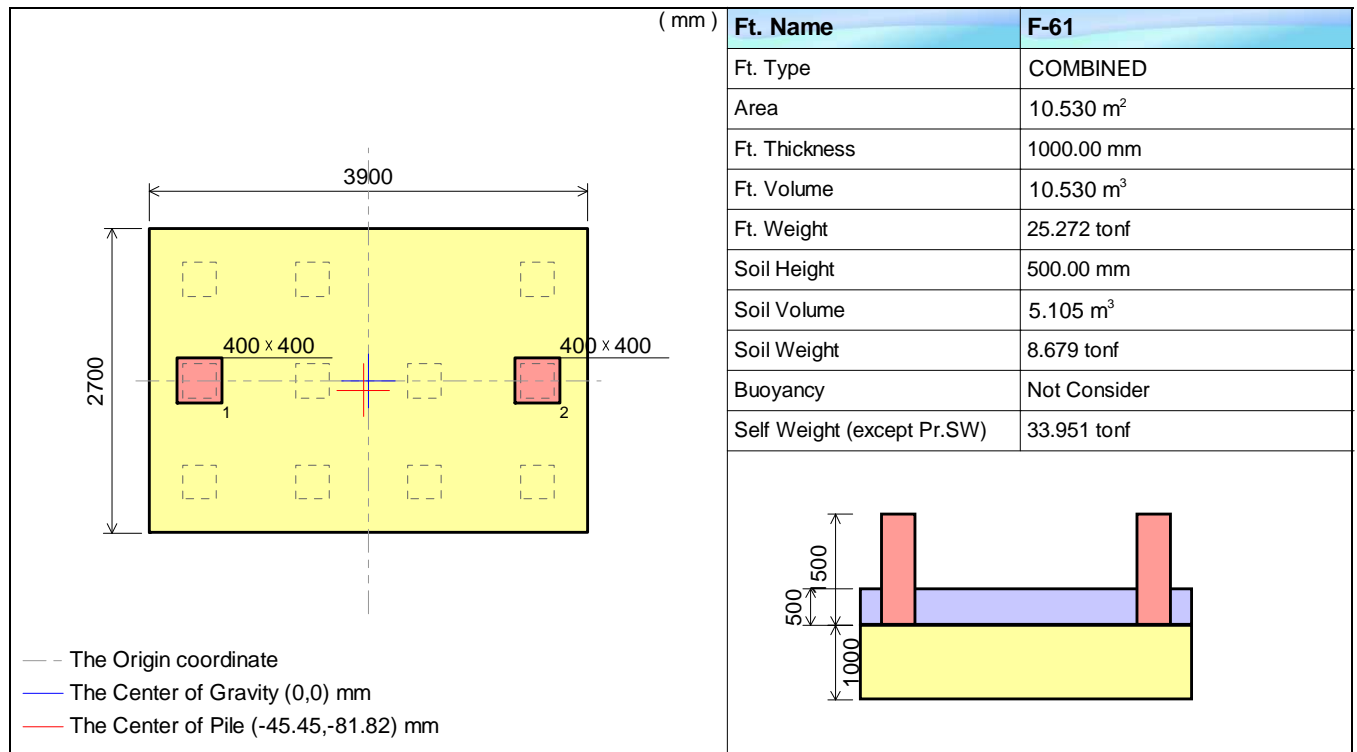
Project No. : Revise F6-F6

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### 4. FOUNDATION DATA

#### 4.1 FOOTING AND SECTION DATA



#### » Section Data

| <p>( mm )</p> | Ft.Name  | Direction             | Ft. Volume            | Soil Volume          | Pier Wt      |
|---------------|----------|-----------------------|-----------------------|----------------------|--------------|
|               | F-61     | X Direct              | 10.530 m <sup>3</sup> | 5.105 m <sup>3</sup> | 1.152 tonf   |
|               | Sec.Name | Section Area          | Ft. Weight            | Soil Weight          | Total Weight |
|               | S1       | 10.530 m <sup>2</sup> | 25.272 tonf           | 8.679 tonf           | 35.103 tonf  |

| <p>( mm )</p> | Ft.Name  | Direction            | Ft. Volume           | Soil Volume          | Pier Wt      |
|---------------|----------|----------------------|----------------------|----------------------|--------------|
|               | F-61     | Y Direct             | 5.265 m <sup>3</sup> | 2.553 m <sup>3</sup> | 0.576 tonf   |
|               | Sec.Name | Section Area         | Ft. Weight           | Soil Weight          | Total Weight |
|               | S2       | 5.265 m <sup>2</sup> | 12.636 tonf          | 4.340 tonf           | 17.552 tonf  |

| <p>( mm )</p> | Ft.Name  | Direction            | Ft. Volume           | Soil Volume          | Pier Wt      |
|---------------|----------|----------------------|----------------------|----------------------|--------------|
|               | F-61     | Y Direct             | 5.265 m <sup>3</sup> | 2.553 m <sup>3</sup> | 0.576 tonf   |
|               | Sec.Name | Section Area         | Ft. Weight           | Soil Weight          | Total Weight |
|               | S3       | 5.265 m <sup>2</sup> | 12.636 tonf          | 4.340 tonf           | 17.552 tonf  |



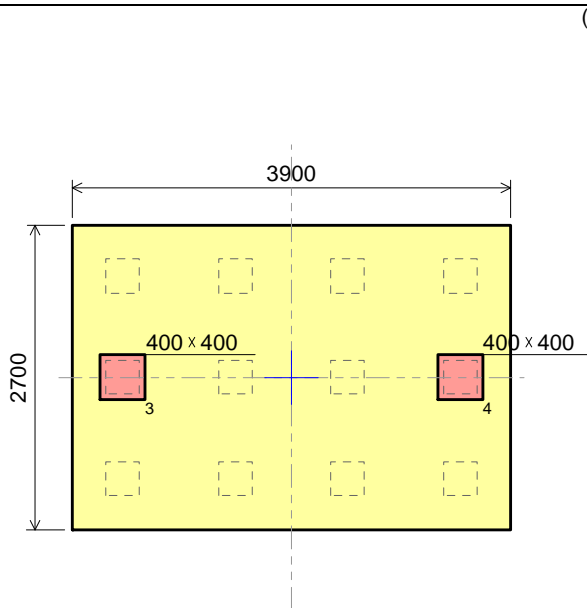
## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

Client : SAHAGREEN F...

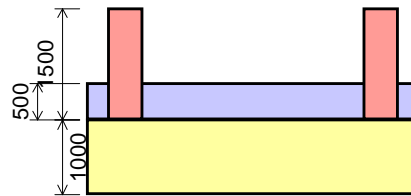
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— The Origin coordinate

— The Center of Gravity &amp; Pile (0,0) mm

| Ft. Name                   | F-62                  |
|----------------------------|-----------------------|
| Ft. Type                   | COMBINED              |
| Area                       | 10.530 m <sup>2</sup> |
| Ft. Thickness              | 1000.00 mm            |
| Ft. Volume                 | 10.530 m <sup>3</sup> |
| Ft. Weight                 | 25.272 tonf           |
| Soil Height                | 500.00 mm             |
| Soil Volume                | 5.105 m <sup>3</sup>  |
| Soil Weight                | 8.679 tonf            |
| Buoyancy                   | Not Consider          |
| Self Weight (except Pr.SW) | 33.951 tonf           |



### » Section Data

|  | Ft.Name  | Direction             | Ft. Volume            | Soil Volume          | Pier Wt      |
|--|----------|-----------------------|-----------------------|----------------------|--------------|
|  | F-62     | X Direct              | 10.530 m <sup>3</sup> | 5.105 m <sup>3</sup> | 1.152 tonf   |
|  | Sec.Name | Section Area          | Ft. Weight            | Soil Weight          | Total Weight |
|  | S1       | 10.530 m <sup>2</sup> | 25.272 tonf           | 8.679 tonf           | 33.951 tonf  |
|  | Ft.Name  | Direction             | Ft. Volume            | Soil Volume          | Pier Wt      |
|  | F-62     | Y Direct              | 5.265 m <sup>3</sup>  | 2.553 m <sup>3</sup> | 0.576 tonf   |
|  | Sec.Name | Section Area          | Ft. Weight            | Soil Weight          | Total Weight |
|  | S2       | 5.265 m <sup>2</sup>  | 12.636 tonf           | 4.340 tonf           | 17.552 tonf  |
|  | Ft.Name  | Direction             | Ft. Volume            | Soil Volume          | Pier Wt      |
|  | F-62     | Y Direct              | 5.265 m <sup>3</sup>  | 2.553 m <sup>3</sup> | 0.576 tonf   |
|  | Sec.Name | Section Area          | Ft. Weight            | Soil Weight          | Total Weight |
|  | S3       | 5.265 m <sup>2</sup>  | 12.636 tonf           | 4.340 tonf           | 17.552 tonf  |

## 4.2 PIER DATA

Off X , Off Y is offset position from the Center of the footing

If Pier Shape is Circle or Circle wall, PI is a Diameter. and Pw is a Inner Diameter

Area is pier concrete area

Weight is pier and inner soil weight in case circle wall except Tank1 Type(Circle Ring Footing Shape)

Unit( Length : mm , Weight : tonf , Area : m<sup>2</sup> )

| Ft.Name | Pr.Name | Shape     | PI      | Pw      | Ph       | Area  | Weight | Off X     | Off Y |
|---------|---------|-----------|---------|---------|----------|-------|--------|-----------|-------|
| F-61    | 1       | Rectangle | 400.000 | 400.000 | 1500.000 | 0.160 | 0.576  | -1500.000 | 0.000 |
|         | 2       | Rectangle | 400.000 | 400.000 | 1500.000 | 0.160 | 0.576  | 1500.000  | 0.000 |
| F-62    | 3       | Rectangle | 400.000 | 400.000 | 1500.000 | 0.160 | 0.576  | -1500.000 | 0.000 |





## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

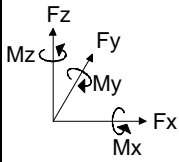
Project No. : Revise F6-F6

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|  |   |           |         |         |          |       |       |          |       |
|--|---|-----------|---------|---------|----------|-------|-------|----------|-------|
|  | 4 | Rectangle | 400.000 | 400.000 | 1500.000 | 0.160 | 0.576 | 1500.000 | 0.000 |
|--|---|-----------|---------|---------|----------|-------|-------|----------|-------|

### 4.3 LOAD CASE



Input the point loads in the global coordinate system direction. Positive directions of moments (shown in the sketch) are based on the right hand rule.

| Index | Load Case Name | Load Case Description |
|-------|----------------|-----------------------|
| 1     | SW             | SELF WEIGHT           |
| 2     | DL             | DEAD LOAD             |

Unit( tonf , tonf-m )

| Ft.Name | Pr.Name | Load Case  | Fx    | Fy    | Fz      | Mx    | My    |
|---------|---------|------------|-------|-------|---------|-------|-------|
| F-61    | 1       | 1          | 0     | 0     | -58     | 0     | 0     |
|         |         | 2          | 0     | 0     | -181.53 | 0     | 0     |
|         | 2       | 1          | 0     | 0     | -58     | 0     | 0     |
|         |         | 2          | 0     | 0     | -189.42 | 0     | 0     |
|         |         | Footing SW | 0.000 | 0.000 | -33.951 | 0.000 | 0.000 |
| F-62    | 3       | 1          | 0     | 0     | -58     | 0     | 0     |
|         |         | 2          | 0     | 0     | -181.53 | 0     | 0     |
|         | 4       | 1          | 0     | 0     | -58     | 0     | 0     |
|         |         | 2          | 0     | 0     | -189.42 | 0     | 0     |
|         |         | Footing SW | 0.000 | 0.000 | -33.951 | 0.000 | 0.000 |

### 4.4 LOAD COMBINATION

|  |   |  |
|--|---|--|
| <p>In Pier Top<br/>without Self Weight</p> | <p>In Footing Bottom<br/>with Pier Self Weight,<br/>But without Footing Self Weight,<br/>(Frame Analysis)</p> | <p>In Footing Bottom Center<br/>with Pier &amp; Footing Self Weight &amp; Soil Weight,<br/>Case PileType<br/>in centroid of Pile Group<br/>Case NonPileType<br/>in centroid of Footing</p> |
|--|---|--|

#### 4.4.1 Load Combination in Pier Top (Without SW)

» Group 1 - F-61

Unit( tonf , tonf-m )

| Ft.Name | Pr.Name | L.Comb. | ΣFx   | ΣFy   | ΣFz      | ΣMx   | ΣMy   |
|---------|---------|---------|-------|-------|----------|-------|-------|
| F-61    | 1       | 1       | 0.000 | 0.000 | -181.530 | 0.000 | 0.000 |
|         | 2       | 1       | 0.000 | 0.000 | -189.420 | 0.000 | 0.000 |

» Group 2 - F-62

Unit( tonf , tonf-m )

| Ft.Name | Pr.Name | L.Comb. | ΣFx   | ΣFy   | ΣFz      | ΣMx   | ΣMy   |
|---------|---------|---------|-------|-------|----------|-------|-------|
| F-62    | 3       | 1       | 0.000 | 0.000 | -181.530 | 0.000 | 0.000 |
|         | 4       | 1       | 0.000 | 0.000 | -189.420 | 0.000 | 0.000 |



## Calculation Sheet of Foundation

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### 4.4.2 Load Combination in Footing Bottom (With Pier SW)

#### » Group 1 - F-61

Unit( tonf , tonf-m )

| Ft.Name | Pr.Name | L.Comb. | $\Sigma F_x$ | $\Sigma F_y$ | $\Sigma F_z$ | $\Sigma M_x$ | $\Sigma M_y$ |
|---------|---------|---------|--------------|--------------|--------------|--------------|--------------|
| F-61    | 1       | 1       | 0.000        | -0.573       | -183.550     | 0.000        | 0.000        |
|         | 2       | 1       | 0.000        | -0.573       | -191.440     | 0.000        | 0.000        |

#### » Group 2 - F-62

Unit( tonf , tonf-m )

| Ft.Name | Pr.Name | L.Comb. | $\Sigma F_x$ | $\Sigma F_y$ | $\Sigma F_z$ | $\Sigma M_x$ | $\Sigma M_y$ |
|---------|---------|---------|--------------|--------------|--------------|--------------|--------------|
| F-62    | 3       | 1       | 0.000        | 0.573        | -183.550     | 0.000        | 0.000        |
|         | 4       | 1       | 0.000        | 0.573        | -191.440     | 0.000        | 0.000        |

### 4.4.3 Load Combination in Footing Bottom Center (With Pier & Footing SW)

#### » Load Combination of Elastic Condition

There is no Load Combination

#### » Load Combination of Ultimate Condition

Ⓢ : PileType

#### Group 1 - F-61

- C.G. of Load is coordinate from left bottom. Unit : mm

Unit( tonf , tonf-m )

| Ft.Name | Sec.Nam | L.Comb. | $\Sigma F_x$ | $\Sigma F_y$ | $\Sigma F_z$ | $\Sigma M_x$ | $\Sigma M_y$ | C.G. of Loads   |
|---------|---------|---------|--------------|--------------|--------------|--------------|--------------|-----------------|
| F-61 Ⓢ  | S1      | 1       | 0.000        | -1.145       | -408.940     | -33.452      | 30.440       | 1978.9 , 1350.0 |
|         | S2      | 1       | 0.000        | -0.573       | -200.526     | 0.000        | -91.351      | 1978.9 , 1350.0 |
|         | S3      | 1       | 0.000        | -0.573       | -208.416     | -37.515      | 74.454       | 1978.9 , 1350.0 |

#### Group 2 - F-62

- C.G. of Load is coordinate from left bottom. Unit : mm

Unit( tonf , tonf-m )

| Ft.Name | Sec.Nam | L.Comb. | $\Sigma F_x$ | $\Sigma F_y$ | $\Sigma F_z$ | $\Sigma M_x$ | $\Sigma M_y$ | C.G. of Loads   |
|---------|---------|---------|--------------|--------------|--------------|--------------|--------------|-----------------|
| F-62 Ⓢ  | S1      | 1       | 0.000        | 1.145        | -408.940     | 0.000        | 11.835       | 1978.9 , 1350.0 |
|         | S2      | 1       | 0.000        | 0.573        | -200.526     | 0.000        | -91.351      | 1978.9 , 1350.0 |
|         | S3      | 1       | 0.000        | 0.573        | -208.416     | 0.000        | 95.296       | 1978.9 , 1350.0 |



## Calculation Sheet of Foundation

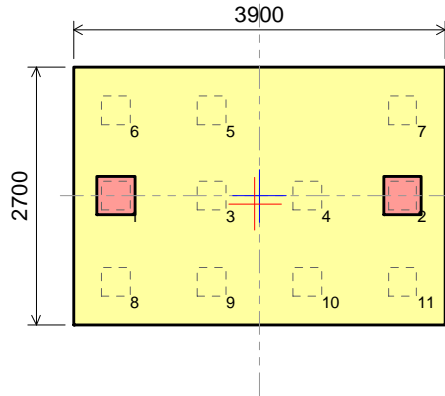
Project No. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

Client : SAHAGREEN F...

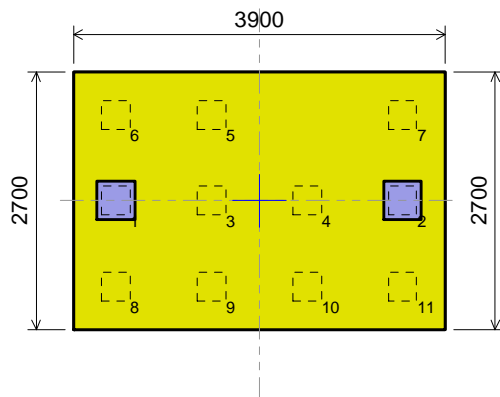
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### 4.4.4 Pile Reaction Table



| Footing Name  | F-61      |
|---------------|-----------|
| Section Name  | -         |
| Pile Name     | PHC-12    |
| Pile Shape    | Square    |
| Pile Number   | 11 EA     |
| Pile Diameter | 300 mm    |
| LC Type       | Stability |

--- Origin Point (0,0) mm  
 --- The Center of Gravity (0,0) mm  
 --- The Center of Pile (-45.45,-81.82) mm



| Footing Name  | F-61      |
|---------------|-----------|
| Section Name  | S1        |
| Pile Name     | PHC-12    |
| Pile Shape    | Square    |
| Pile Number   | 11 EA     |
| Pile Diameter | 300 mm    |
| LC Type       | Reinforce |

--- Origin Point (0,0) mm  
 --- The Center of Gravity (0,0) mm  
 --- The Center of Pile (-45.45,-81.82) mm

· LC : 1, ( 1.0 SW + 1.0 DL )

Unit (mm,tonf)

| No. | Name   | Pile Geometry |      | Bi-Axial | Shear (Hor) | Ra | Ua | Ha |
|-----|--------|---------------|------|----------|-------------|----|----|----|
|     |        | X             | Y    | XY-Dir.  | XY-Dir.     |    |    |    |
| 1   | PHC-12 | -1500         | 0    | 34.66    | .1          | 30 | 15 | 2  |
| 2   | PHC-12 | 1500          | 0    | 40.86    | .1          | 30 | 15 | 2  |
| 3   | PHC-12 | -500          | 0    | 36.73    | .1          | 30 | 15 | 2  |
| 4   | PHC-12 | 500           | 0    | 38.79    | .1          | 30 | 15 | 2  |
| 5   | PHC-12 | -500          | 900  | 42.11    | .1          | 30 | 15 | 2  |
| 6   | PHC-12 | -1500         | 900  | 40.04    | .1          | 30 | 15 | 2  |
| 7   | PHC-12 | 1500          | 900  | 46.24    | .1          | 30 | 15 | 2  |
| 8   | PHC-12 | -1500         | -900 | 29.28    | .1          | 30 | 15 | 2  |
| 9   | PHC-12 | -500          | -900 | 31.35    | .1          | 30 | 15 | 2  |



## Calculation Sheet of Foundation

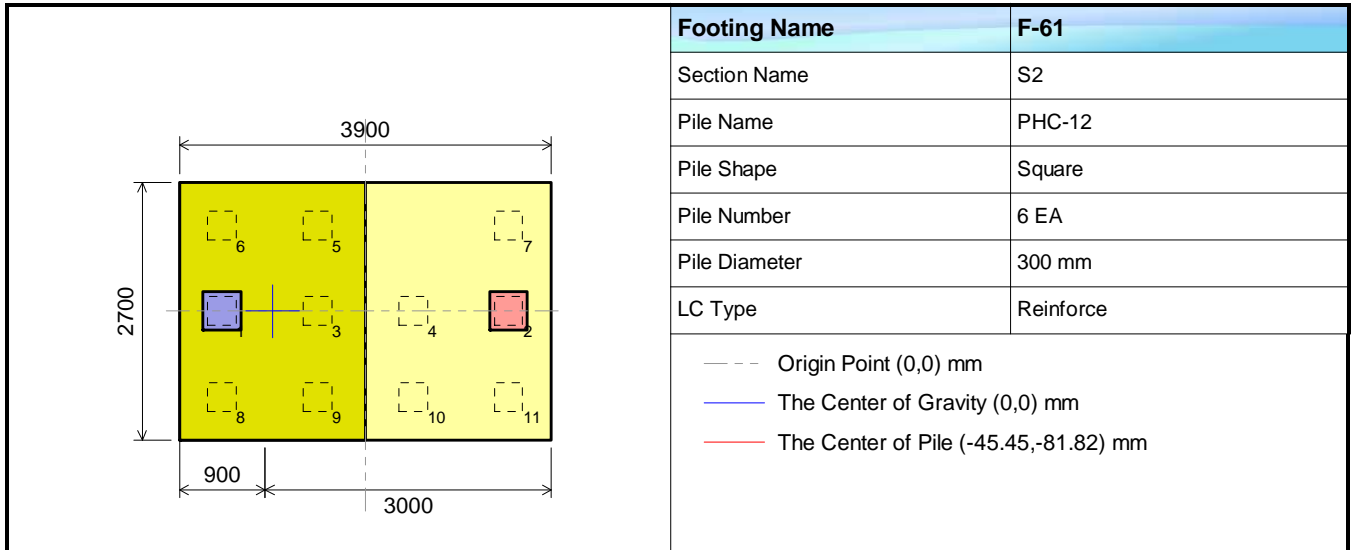
Project Na. : 7.5 MW. Power Plant Stream..

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|    |        |      |      |       |    |    |    |   |
|----|--------|------|------|-------|----|----|----|---|
| 10 | PHC-12 | 500  | -900 | 33.41 | .1 | 30 | 15 | 2 |
| 11 | PHC-12 | 1500 | -900 | 35.48 | .1 | 30 | 15 | 2 |



• LC : 1, ( 1.0 SW + 1.0 DL )

Unit (mm,tonf)

| No. | Name   | Pile Geometry |      | Bi-Axial | Shear (Hor) | Ra | Ua | Ha |
|-----|--------|---------------|------|----------|-------------|----|----|----|
|     |        | X             | Y    | XY-Dir.  | XY-Dir.     |    |    |    |
| 1   | PHC-12 | -1500         | 0    | 63.87    | .1          | 30 | 15 | 2  |
| 3   | PHC-12 | -500          | 0    | 2.97     | .1          | 30 | 15 | 2  |
| 5   | PHC-12 | -500          | 900  | 2.97     | .1          | 30 | 15 | 2  |
| 6   | PHC-12 | -1500         | 900  | 63.87    | .1          | 30 | 15 | 2  |
| 8   | PHC-12 | -1500         | -900 | 63.87    | .1          | 30 | 15 | 2  |
| 9   | PHC-12 | -500          | -900 | 2.97     | .1          | 30 | 15 | 2  |



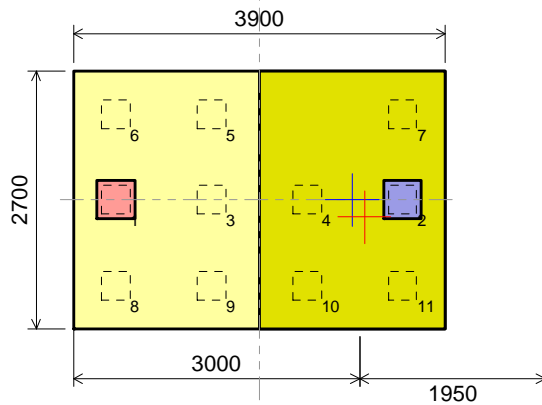
## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

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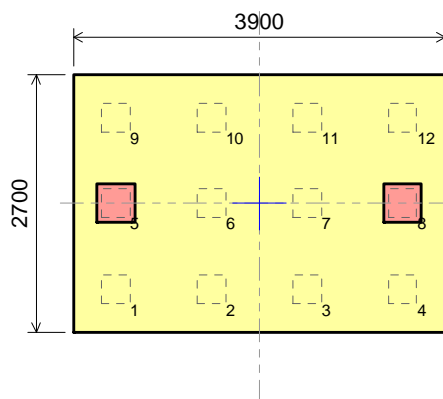


| Footing Name  | F-61      |
|---|-----------|
| Section Name  | S3        |
| Pile Name   | PHC-12    |
| Pile Shape  | Square    |
| Pile Number   | 5 EA      |
| Pile Diameter   | 300 mm    |
| LC Type   | Reinforce |
| <p>--- Origin Point (0,0) mm</p> <p>--- The Center of Gravity (0,0) mm</p> <p>--- The Center of Pile (-45.45,-81.82) mm</p> |           |

· LC : 1, ( 1.0 SW + 1.0 DL )

Unit (mm,tonf)

| No. | Name   | Pile Geometry |      | Bi-Axial | Shear (Hor) | Ra | Ua | Ha |
|-----|--------|---------------|------|----------|-------------|----|----|----|
|     |        | X             | Y    | XY-Dir.  | XY-Dir.     |    |    |    |
| 2   | PHC-12 | 1500          | 0    | 69.48    | .11         | 30 | 15 | 2  |
| 4   | PHC-12 | 500           | 0    | 7.43     | .11         | 30 | 15 | 2  |
| 7   | PHC-12 | 1500          | 900  | 84.37    | .11         | 30 | 15 | 2  |
| 10  | PHC-12 | 500           | -900 | -7.45    | .11         | 30 | 15 | 2  |
| 11  | PHC-12 | 1500          | -900 | 54.59    | .11         | 30 | 15 | 2  |



| Footing Name  | F-62      |
|---|-----------|
| Section Name  | -         |
| Pile Name   | PHC-12    |
| Pile Shape  | Square    |
| Pile Number   | 12 EA     |
| Pile Diameter   | 300 mm    |
| LC Type   | Stability |
| <p>--- Origin Point (0,0) mm</p> <p>--- The Center of Gravity &amp; Pile (0,0) mm</p> |           |



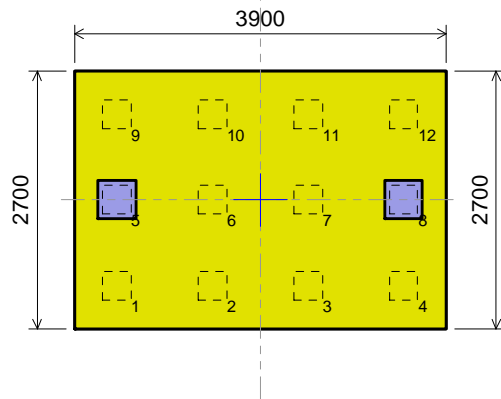
## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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| Footing Name  | F-62      |
|---------------|-----------|
| Section Name  | S1        |
| Pile Name     | PHC-12    |
| Pile Shape    | Square    |
| Pile Number   | 12 EA     |
| Pile Diameter | 300 mm    |
| LC Type       | Reinforce |

--- Origin Point (0,0) mm

— The Center of Gravity &amp; Pile (0,0) mm

· LC : 1, ( 1.0 SW + 1.0 DL )

Unit (mm,tonf)

| No. | Name   | Pile Geometry |      | Bi-Axial | Shear (Hor) | Ra | Ua | Ha |
|-----|--------|---------------|------|----------|-------------|----|----|----|
|     |        | X             | Y    | XY-Dir.  | XY-Dir.     |    |    |    |
| 1   | PHC-12 | -1500         | -900 | 32.89    | .1          | 30 | 15 | 2  |
| 2   | PHC-12 | -500          | -900 | 33.68    | .1          | 30 | 15 | 2  |
| 3   | PHC-12 | 500           | -900 | 34.47    | .1          | 30 | 15 | 2  |
| 4   | PHC-12 | 1500          | -900 | 35.26    | .1          | 30 | 15 | 2  |
| 5   | PHC-12 | -1500         | 0    | 32.89    | .1          | 30 | 15 | 2  |
| 6   | PHC-12 | -500          | 0    | 33.68    | .1          | 30 | 15 | 2  |
| 7   | PHC-12 | 500           | 0    | 34.47    | .1          | 30 | 15 | 2  |
| 8   | PHC-12 | 1500          | 0    | 35.26    | .1          | 30 | 15 | 2  |
| 9   | PHC-12 | -1500         | 900  | 32.89    | .1          | 30 | 15 | 2  |
| 10  | PHC-12 | -500          | 900  | 33.68    | .1          | 30 | 15 | 2  |
| 11  | PHC-12 | 500           | 900  | 34.47    | .1          | 30 | 15 | 2  |
| 12  | PHC-12 | 1500          | 900  | 35.26    | .1          | 30 | 15 | 2  |



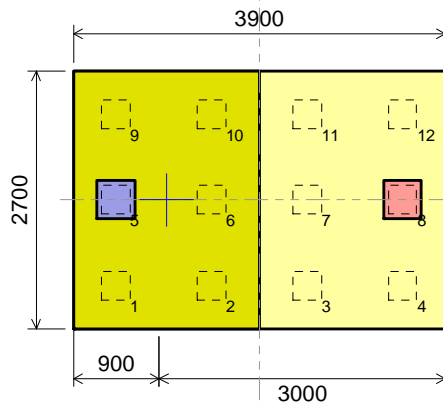
## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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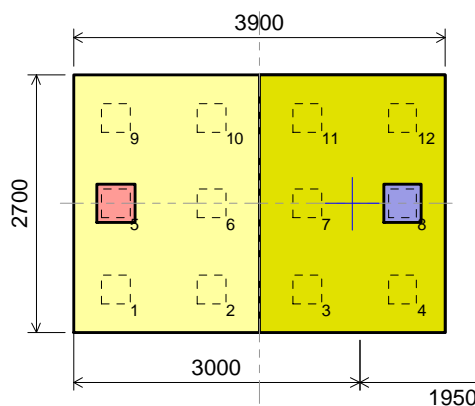


| Footing Name  | F-62      |
|---|-----------|
| Section Name  | S2        |
| Pile Name   | PHC-12    |
| Pile Shape  | Square    |
| Pile Number   | 6 EA      |
| Pile Diameter   | 300 mm    |
| LC Type   | Reinforce |
| <p>--- Origin Point (0,0) mm</p> <p>--- The Center of Gravity &amp; Pile (0,0) mm</p> |           |

· LC : 1, ( 1.0 SW + 1.0 DL )

Unit (mm,tonf)

| No. | Name   | Pile Geometry |      | Bi-Axial<br>XY-Dir. | Shear (Hor)<br>XY-Dir. | Ra | Ua | Ha |
|-----|--------|---------------|------|---------------------|------------------------|----|----|----|
|     |        | X             | Y    |                     |                        |    |    |    |
| 1   | PHC-12 | -1500         | -900 | 63.87               | .1                     | 30 | 15 | 2  |
| 2   | PHC-12 | -500          | -900 | 2.97                | .1                     | 30 | 15 | 2  |
| 5   | PHC-12 | -1500         | 0    | 63.87               | .1                     | 30 | 15 | 2  |
| 6   | PHC-12 | -500          | 0    | 2.97                | .1                     | 30 | 15 | 2  |
| 9   | PHC-12 | -1500         | 900  | 63.87               | .1                     | 30 | 15 | 2  |
| 10  | PHC-12 | -500          | 900  | 2.97                | .1                     | 30 | 15 | 2  |



| Footing Name  | F-62      |
|---|-----------|
| Section Name  | S3        |
| Pile Name   | PHC-12    |
| Pile Shape  | Square    |
| Pile Number   | 6 EA      |
| Pile Diameter   | 300 mm    |
| LC Type   | Reinforce |
| <p>--- Origin Point (0,0) mm</p> <p>--- The Center of Gravity &amp; Pile (0,0) mm</p> |           |

· LC : 1, ( 1.0 SW + 1.0 DL )

Unit (mm,tonf)

| No. | Name   | Pile Geometry |      | Bi-Axial<br>XY-Dir. | Shear (Hor)<br>XY-Dir. | Ra | Ua | Ha |
|-----|--------|---------------|------|---------------------|------------------------|----|----|----|
|     |        | X             | Y    |                     |                        |    |    |    |
| 3   | PHC-12 | 500           | -900 | 2.97                | .1                     | 30 | 15 | 2  |



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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|    |        |      |      |      |    |    |    |   |
|----|--------|------|------|------|----|----|----|---|
| 4  | PHC-12 | 1500 | -900 | 66.5 | .1 | 30 | 15 | 2 |
| 7  | PHC-12 | 500  | 0    | 2.97 | .1 | 30 | 15 | 2 |
| 8  | PHC-12 | 1500 | 0    | 66.5 | .1 | 30 | 15 | 2 |
| 11 | PHC-12 | 500  | 900  | 2.97 | .1 | 30 | 15 | 2 |
| 12 | PHC-12 | 1500 | 900  | 66.5 | .1 | 30 | 15 | 2 |





**Calculation Sheet  
of  
Foundation**

Project Na. : 7.5 MW. Power Plant Stream..

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## 5. CHECK OF STABILITY

There is no Static LoadCombination



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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## 6. DESIGN OF FOOTING

### 6.1 DESIGN MOMENT AND SHEAR FORCE

Footing design is in accordance with ultimate strength method at footing bottom.

Calculated total pier load as

$$\Sigma Q = \Sigma F_z - \text{Self Weight Factor} \times (\text{Soil Weight} + \text{Footing Weight})$$

Ft.Name : Footing Name , Sec.Name : Strip Name for Footing Reinforcement Design

Dir. : Direction , L.Comb. : Load Combination Index , Sl or Sw : Strip X or Y width

#### 6.1.1 Data

##### Group 1 - F-61

Unit( mm , tonf , tonf-m )

| Ft.Name | Sec.Nam | Dir. | L.Comb. | Fl or Fw | Sl or Sw | $\Sigma F_z$ | $\Sigma M$ | $\Sigma Q$ |
|---------|---------|------|---------|----------|----------|--------------|------------|------------|
| F-61 ♂  | S1      | X    | 1       | 3900.00  | 2700.00  | 408.940      | 30.44      | 374.990    |
|         | S2      | Y    | 1       | 2700.00  | 1950.00  | 200.526      | 0.000      | 183.550    |
|         | S3      | Y    | 1       | 2700.00  | 1950.00  | 208.416      | -37.515    | 191.440    |

##### Group 2 - F-62

Unit( mm , tonf , tonf-m )

| Ft.Name | Sec.Nam | Dir. | L.Comb. | Fl or Fw | Sl or Sw | $\Sigma F_z$ | $\Sigma M$ | $\Sigma Q$ |
|---------|---------|------|---------|----------|----------|--------------|------------|------------|
| F-62 ♂  | S1      | X    | 1       | 3900.00  | 2700.00  | 408.940      | 11.84      | 374.990    |
|         | S2      | Y    | 1       | 2700.00  | 1950.00  | 200.526      | 0.000      | 183.550    |
|         | S3      | Y    | 1       | 2700.00  | 1950.00  | 208.416      | 0.000      | 191.440    |

#### 6.1.2 Design Parameters

Yield Strength - #3 ~ #5 :  $f_y1$  , #6 ~ :  $f_y2$

$f_{cl}$  : Clear Cover for edge of footing reinforcement

$f_{clt}$  : Clear Cover for top of footing reinforcement

$f_{pcb}$  : Clear Cover for bottom of footing reinforcement (Pile Foundation)

Loc. : Location of Critical Point from left side of footing

Unit(kgf/cm<sup>2</sup>,mm)

| $\phi$ (Flexure) | $\phi$ (Shear) | $f'c$  | $f_y1$  | $f_y2$  | $f_{cl}$ | $f_{clt}$ | $f_{pcb}$ |
|------------------|----------------|--------|---------|---------|----------|-----------|-----------|
| .85              | .8             | 280.00 | 4000.00 | 2400.00 | 50.0     | 50.0      | 50.0      |



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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### 6.2 REQUIRED REINFORCEMENT

#### 6.2.1 Reinforcement Formula

- Shrinkage and temperature reinforcement ---- ACI CODE 7.12.2

$A_s \geq = \text{fac} \cdot b \cdot h$  , fac = following

Area of shrinkage and temperature reinforcement shall provide at least the following ratio of reinforcement area to gross concrete area, but not less than 0.0014

- (a) Slabs where Grade 40 or 50 deformed bars are used .....0.0020  
 (b) Slabs where Grade 60 deformed bars or welded wire reinforcement are used.....0.0018  
 (c) Slabs where reinforcement with yield stress exceeding 60,000 psi measured at a yield strain of 0.35 percent is used .....  $\frac{0.0018 \times 60,000}{f_y}$

- Required Reinforcement by Analysis

$$A_s \geq A_{s2}$$

- At every section of flexural members where tensile reinforcement is required

$$A_s \geq A_{s5} \geq A_{s4} \quad \text{---- ACI Eq (10-3)}$$

- The requirements of Eq (10-3) need not be applied, if every section  $A_s$  provided is at least one -third greater then that required by analysis ---- ACI CODE 10.5.3

$$A_{s2} = \rho_{\text{req}} \cdot b \cdot d$$

$$A_{s3} = 1.333 \rho_{\text{req}} \cdot b \cdot d$$

$$A_{s4} = \frac{200}{f_y} \cdot b \cdot d$$

$$A_{s5} = \frac{3 \sqrt{f_{ck}}}{f_y} \cdot b \cdot d$$

$$A_{s\text{max}} = 0.75 \rho_b \cdot b \cdot d$$

$$\rho_b = 0.85 \times \beta_1 \times \frac{f_{ck}}{f_y} \times \frac{0.003 \times E_s}{0.003 \times E_s + f_y}$$

$$\text{Selected } A_s = \text{Max} ( A_{s1} , A_{s2} , \text{Min} ( A_{s3} , \text{Max} ( A_{s4} , A_{s5} ) ) )$$

**If Selected  $A_s < \text{Using } A_s < A_{s\text{max}}$  , then OK!!**

Note : The reinforcement is calculated bases on the maximum moment under the foundation in each direction.

But, the 'ISO', 'OCT', 'HEX', 'COMB', 'TANK1' foundations are calaulated as face pier

Where,

$$R_n = \frac{M_u}{\phi b d^2} , \phi = .85 , \rho_{\text{req}} = \frac{0.85 \cdot f_{ck}}{f_y} \times \left( 1 - \sqrt{1 - \frac{2 R_n}{0.85 f_{ck}}} \right)$$

#### 6.2.2 Check of Footing Reinforcement

##### Group 1 - F-61

☉ Footing Name : F-61 GroupType : Combined

- X direction (All Width)

| Sec.Name | L.Comb. | Using Bar (mm) | Loc. (m) | Width b (m) | d (cm) | $A_s$ (cm <sup>2</sup> ) |
|----------|---------|----------------|----------|-------------|--------|--------------------------|
| S1       | 1 top   | 14 - #8 @ 200  | 1.581    | 2.700       | 93.730 | 70.939                   |
|          | 1 botom | 14 - #8 @ 200  | 3.450    | 2.700       | 93.730 | 70.939                   |

| Sec.Name | L.Comb.  | Mu (tonf-m) | Rn    | $\rho$ -Req |
|----------|----------|-------------|-------|-------------|
| S1       | 1 top    | 96.405      | 4.782 | 0.0020      |
|          | 1 bottom | 4.542       | 0.225 | 0.0001      |

| Sec.Name | L.Comb.  | $A_{s1}$ (cm <sup>2</sup> ) | $A_{s2}$ (cm <sup>2</sup> ) | $A_{s3}$ (cm <sup>2</sup> ) | $A_{s4}$ (cm <sup>2</sup> ) | $A_{s5}$ (cm <sup>2</sup> ) | $A_{s\text{max}}$ (cm <sup>2</sup> ) |
|----------|----------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|--------------------------------------|
| S1       | 1 top    | 27.000                      | 50.936                      | 67.898                      | 148.272                     | 140.356                     | 1149.212                             |
|          | 1 bottom | 27.000                      | 2.377                       | 3.168                       | 148.272                     | 140.356                     | 1149.212                             |



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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| Sec.Name | L.Comb. |        | Using As(cm <sup>2</sup> ) | Select As(cm <sup>2</sup> ) | Result |
|----------|---------|--------|----------------------------|-----------------------------|--------|
| S1       | 1       | top    | 70.939                     | 67.898                      | OK     |
|          | 1       | bottom | 70.939                     | 27.000                      | OK     |

- Y direction (All Width)

| Sec.Name | L.Comb. |        | Using Bar (mm) | Loc. (m) | Width b (m) | d (cm) | As (cm <sup>2</sup> ) |
|----------|---------|--------|----------------|----------|-------------|--------|-----------------------|
| S2       | 1       | top    | 11 - #8 @ 200  | 1.350    | 1.950       | 91.190 | 55.738                |
|          | 1       | bottom | 11 - #8 @ 200  | 1.550    | 1.950       | 91.190 | 55.738                |
| S3       | 1       | top    | 11 - #8 @ 200  | 1.350    | 1.950       | 91.190 | 55.738                |
|          | 1       | bottom | 11 - #8 @ 200  | 1.550    | 1.950       | 91.190 | 55.738                |

| Sec.Name | L.Comb. |        | Mu (tonf-m) | Rn    | ρ-Req  |  |  |
|----------|---------|--------|-------------|-------|--------|--|--|
| S2       | 1       | top    | -           | -     | -      |  |  |
|          | 1       | bottom | 46.789      | 3.395 | 0.0014 |  |  |
| S3       | 1       | top    | -           | -     | -      |  |  |
|          | 1       | bottom | 41.683      | 3.024 | 0.0013 |  |  |

| Sec.Name | L.Comb. |        | As <sub>1</sub> (cm <sup>2</sup> ) | As <sub>2</sub> (cm <sup>2</sup> ) | As <sub>3</sub> (cm <sup>2</sup> ) | As <sub>4</sub> (cm <sup>2</sup> ) | As <sub>5</sub> (cm <sup>2</sup> ) | As <sub>max</sub> (cm <sup>2</sup> ) |
|----------|---------|--------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|--------------------------------------|
| S2       | 1       | top    | 19.500                             | -                                  | -                                  | 104.183                            | 98.621                             | 807.494                              |
|          | 1       | bottom | 19.500                             | 25.334                             | 33.770                             | 104.183                            | 98.621                             | 807.494                              |
| S3       | 1       | top    | 19.500                             | -                                  | -                                  | 104.183                            | 98.621                             | 807.494                              |
|          | 1       | bottom | 19.500                             | 22.551                             | 30.061                             | 104.183                            | 98.621                             | 807.494                              |

| Sec.Name | L.Comb. |        | Using As(cm <sup>2</sup> ) | Select As(cm <sup>2</sup> ) | Result |
|----------|---------|--------|----------------------------|-----------------------------|--------|
| S2       | 1       | top    | 55.738                     | 19.500                      | OK     |
|          | 1       | bottom | 55.738                     | 33.770                      | OK     |
| S3       | 1       | top    | 55.738                     | 19.500                      | OK     |
|          | 1       | bottom | 55.738                     | 30.061                      | OK     |

**Group 2 - F-62**
☒ Footing Name : F-62    GroupType : Combined

- X direction (All Width)

| Sec.Name | L.Comb. |        | Using Bar (mm) | Loc. (m) | Width b (m) | d (cm) | As (cm <sup>2</sup> ) |
|----------|---------|--------|----------------|----------|-------------|--------|-----------------------|
| S1       | 1       | top    | 19 - #8 @ 150  | 2.283    | 2.700       | 93.730 | 96.274                |
|          | 1       | bottom | 19 - #8 @ 150  | 3.450    | 2.700       | 93.730 | 96.274                |

| Sec.Name | L.Comb. |        | Mu (tonf-m) | Rn    | ρ-Req  |  |  |
|----------|---------|--------|-------------|-------|--------|--|--|
| S1       | 1       | top    | 102.498     | 5.084 | 0.0021 |  |  |
|          | 1       | bottom | 3.967       | 0.197 | 0.0001 |  |  |

| Sec.Name | L.Comb. |        | As <sub>1</sub> (cm <sup>2</sup> ) | As <sub>2</sub> (cm <sup>2</sup> ) | As <sub>3</sub> (cm <sup>2</sup> ) | As <sub>4</sub> (cm <sup>2</sup> ) | As <sub>5</sub> (cm <sup>2</sup> ) | As <sub>max</sub> (cm <sup>2</sup> ) |
|----------|---------|--------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|--------------------------------------|
| S1       | 1       | top    | 27.000                             | 54.191                             | 72.237                             | 148.272                            | 140.356                            | 1149.212                             |
|          | 1       | bottom | 27.000                             | 2.076                              | 2.767                              | 148.272                            | 140.356                            | 1149.212                             |

| Sec.Name | L.Comb. |        | Using As(cm <sup>2</sup> ) | Select As(cm <sup>2</sup> ) | Result |
|----------|---------|--------|----------------------------|-----------------------------|--------|
| S1       | 1       | top    | 96.274                     | 72.237                      | OK     |
|          | 1       | bottom | 96.274                     | 27.000                      | OK     |



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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- Y direction (All Width)

| Sec.Name | L.Comb. |        | Using Bar (mm) | Loc. (m) | Width b (m) | d (cm) | As (cm <sup>2</sup> ) |
|----------|---------|--------|----------------|----------|-------------|--------|-----------------------|
| S2       | 1       | top    | 14 - #8 @ 150  | 1.350    | 1.950       | 91.190 | 70.939                |
|          | 1       | bottom | 14 - #8 @ 150  | 1.550    | 1.950       | 91.190 | 70.939                |
| S3       | 1       | top    | 14 - #8 @ 150  | 1.350    | 1.950       | 91.190 | 70.939                |
|          | 1       | bottom | 14 - #8 @ 150  | 1.550    | 1.950       | 91.190 | 70.939                |

| Sec.Name | L.Comb. |        | Mu (tonf-m) | Rn    | p-Req  |
|----------|---------|--------|-------------|-------|--------|
| S2       | 1       | top    | -           | -     | -      |
|          | 1       | bottom | 46.789      | 3.395 | 0.0014 |
| S3       | 1       | top    | -           | -     | -      |
|          | 1       | bottom | 48.631      | 3.528 | 0.0015 |

| Sec.Name | L.Comb. |        | As <sub>1</sub> (cm <sup>2</sup> ) | As <sub>2</sub> (cm <sup>2</sup> ) | As <sub>3</sub> (cm <sup>2</sup> ) | As <sub>4</sub> (cm <sup>2</sup> ) | As <sub>5</sub> (cm <sup>2</sup> ) | As <sub>max</sub> (cm <sup>2</sup> ) |
|----------|---------|--------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|--------------------------------------|
| S2       | 1       | top    | 19.500                             | -                                  | -                                  | 104.183                            | 98.621                             | 807.494                              |
|          | 1       | bottom | 19.500                             | 25.334                             | 33.770                             | 104.183                            | 98.621                             | 807.494                              |
| S3       | 1       | top    | 19.500                             | -                                  | -                                  | 104.183                            | 98.621                             | 807.494                              |
|          | 1       | bottom | 19.500                             | 26.339                             | 35.110                             | 104.183                            | 98.621                             | 807.494                              |

| Sec.Name | L.Comb. |        | Using As(cm <sup>2</sup> ) | Select As(cm <sup>2</sup> ) | Result |
|----------|---------|--------|----------------------------|-----------------------------|--------|
| S2       | 1       | top    | 70.939                     | 19.500                      | OK     |
|          | 1       | bottom | 70.939                     | 33.770                      | OK     |
| S3       | 1       | top    | 70.939                     | 19.500                      | OK     |
|          | 1       | bottom | 70.939                     | 35.110                      | OK     |



# Calculation Sheet of Foundation

Project No. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

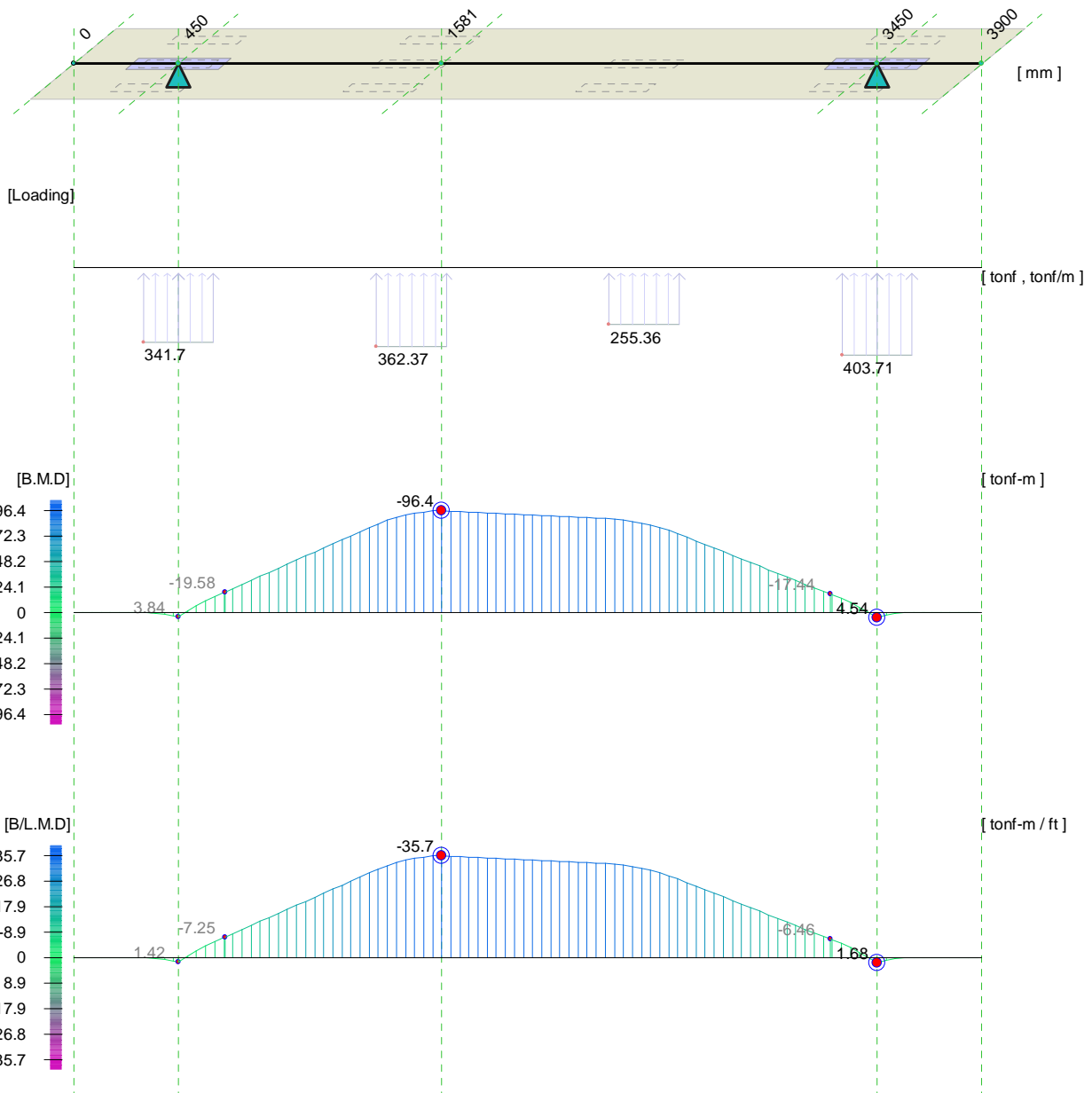
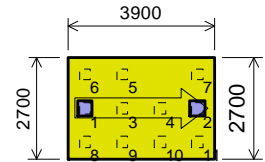
Client : SAHAGREEN F...

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Title

## Bending Moment Diagram

|  |      |                       |              |           |               |                       |                        |
|--|------|-----------------------|--------------|-----------|---------------|-----------------------|------------------------|
| Foundation name  | F-61 | Section name          | S1           | Direction | X             | L/C ID                | 1                      |
| Analysis Method<br>Conventional Rigid Method with reaction (Method 1)                      |      |                       |              |           |               |                       |                        |
| ΣFz  |      | -408.940 tonf         | ΣMy          |           | 30.440 tonf-m | Moment inertia        | 13.3468 m <sup>4</sup> |
| Area   |      | 10.530 m <sup>2</sup> | Contact Area |           |               | Critical Point Method | Maximum Point          |
| Critical Value<br>Mu <sub>bottom</sub> = 4.542 tonf-m , Mu <sub>top</sub> = -96.405 tonf-m |      |                       |              |           |               |                       |                        |





## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

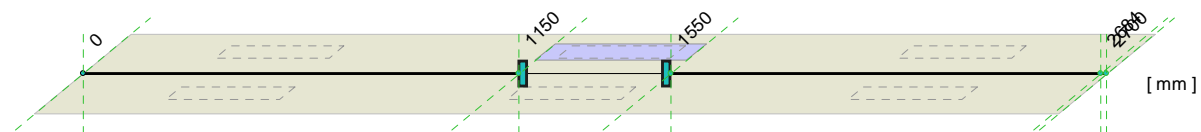
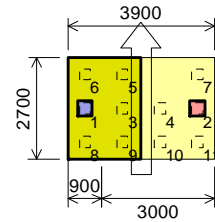
Client : SAHAGREEN F...

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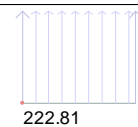
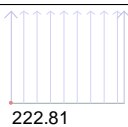
Title

# Bending Moment Diagram

|   |      |                      |    |              |   |                       |   |                |                       |
|---|------|----------------------|----|--------------|---|-----------------------|---|----------------|-----------------------|
| Foundation name   | F-61 | Section name         | S2 | Direction    | Y | L/C ID                | 1 |                |                       |
| Analysis Method<br>Conventional Rigid Method with reaction (Method 1)                 |      |                      |    |              |   |                       |   |                |                       |
| ΣFz   |      | -200.526 tonf        |    | ΣMx          |   | 0.000 tonf-m          |   | Moment inertia | 3.1985 m <sup>4</sup> |
| Area  |      | 5.265 m <sup>2</sup> |    | Contact Area |   | Critical Point Method |   |                | Maximum Point         |
| Critical Value<br>Mu <sub>bottom</sub> = 46.789 tonf-m , Mu <sub>top</sub> = 0 tonf-m |      |                      |    |              |   |                       |   |                |                       |



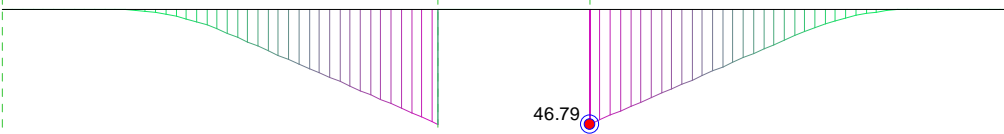
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[tonf , tonf/m ]

[B.M.D]

-46.8  
-35.1  
-23.4  
-11.7  
0  
11.7  
23.4  
35.1  
46.8



[tonf-m ]

[B/L.M.D]

-24  
-18  
-12  
-6  
0  
6  
12  
18  
24



[tonf-m / ft ]



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

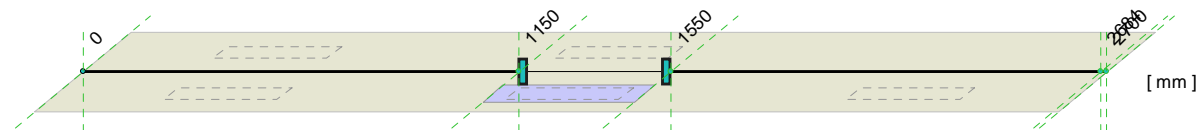
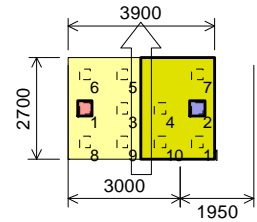
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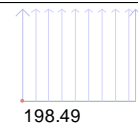
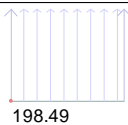
Title

# Bending Moment Diagram

|   |                      |              |                |                       |   |                       |   |
|---|----------------------|--------------|----------------|-----------------------|---|-----------------------|---|
| Foundation name   | F-61                 | Section name | S3             | Direction             | Y | L/C ID                | 1 |
| Analysis Method<br>Conventional Rigid Method with reaction (Method 1)                 |                      |              |                |                       |   |                       |   |
| ΣFz   | -208.416 tonf        | ΣMx          | -37.515 tonf-m | Moment inertia        |   | 3.1985 m <sup>4</sup> |   |
| Area  | 5.265 m <sup>2</sup> | Contact Area |                | Critical Point Method |   | Maximum Point         |   |
| Critical Value<br>Mu <sub>bottom</sub> = 41.683 tonf-m , Mu <sub>top</sub> = 0 tonf-m |                      |              |                |                       |   |                       |   |



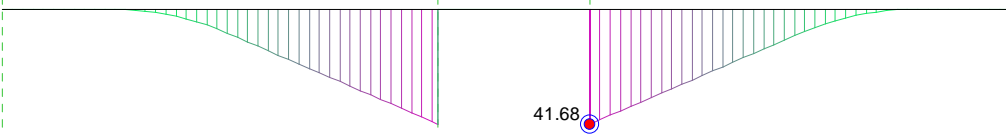
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[tonf , tonf/m ]

[B.M.D]

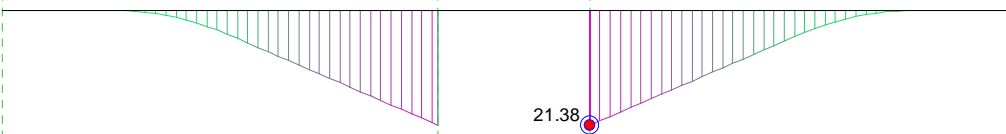
-41.7  
-31.3  
-20.8  
-10.4  
0  
10.4  
20.8  
31.3  
41.7



[tonf-m ]

[B/L.M.D]

-21.4  
-16  
-10.7  
-5.3  
0  
5.3  
10.7  
16  
21.4



[tonf-m / ft ]





## Calculation Sheet of Foundation

Project No. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

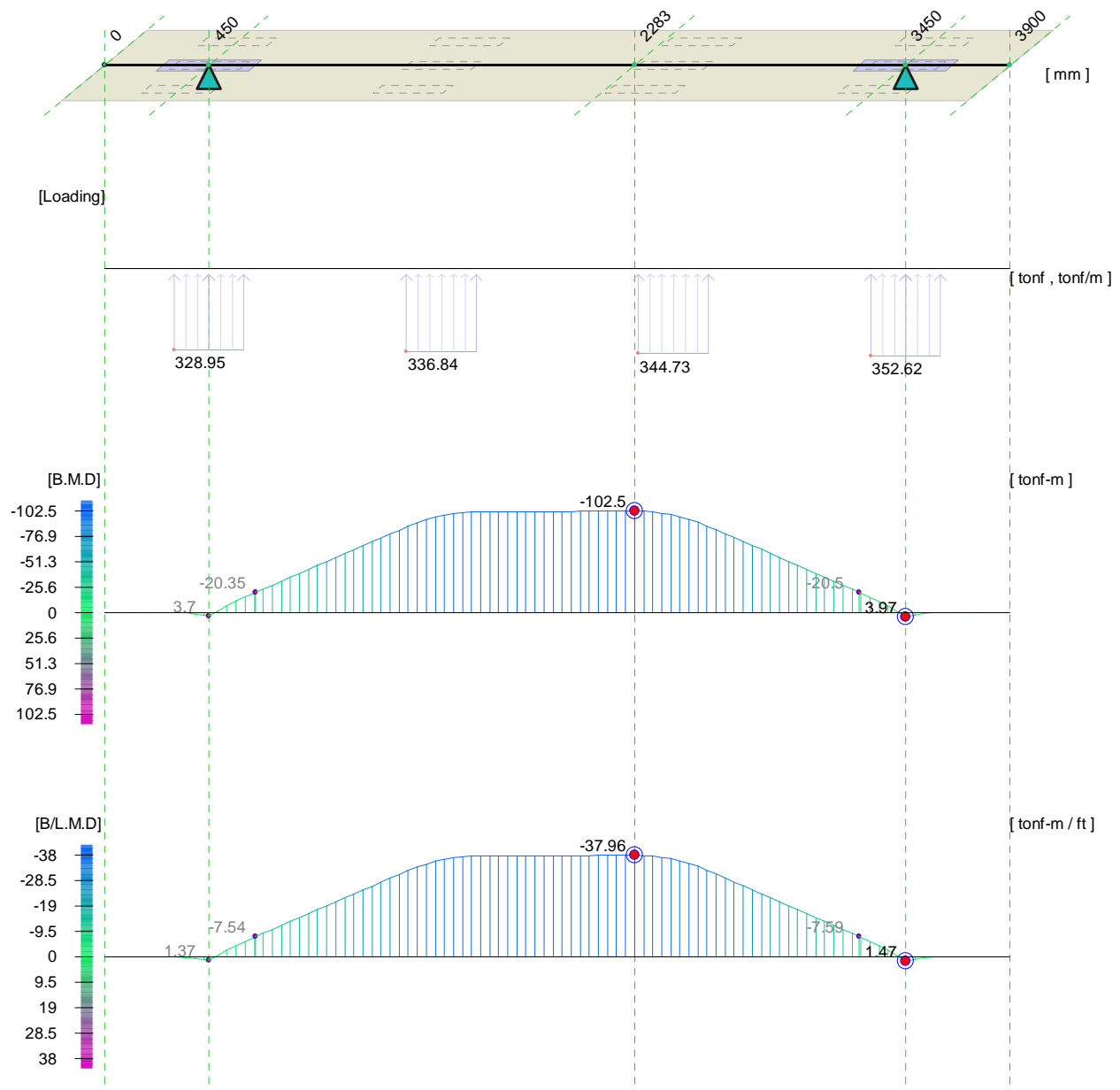
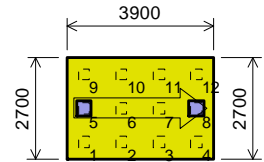
Client : SAHAGREEN F...

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Title

# Bending Moment Diagram

|   |                       |              |               |                       |   |                        |   |
|---|-----------------------|--------------|---------------|-----------------------|---|------------------------|---|
| Foundation name   | F-62                  | Section name | S1            | Direction             | X | L/C ID                 | 1 |
| Analysis Method<br>Conventional Rigid Method with reaction (Method 1)                       |                       |              |               |                       |   |                        |   |
| $\Sigma F_z$  | -408.940 tonf         | $\Sigma M_y$ | 11.835 tonf-m | Moment inertia        |   | 13.3468 m <sup>4</sup> |   |
| Area  | 10.530 m <sup>2</sup> | Contact Area |               | Critical Point Method |   | Maximum Point          |   |
| Critical Value<br>Mu <sub>bottom</sub> = 3.967 tonf-m , Mu <sub>top</sub> = -102.498 tonf-m |                       |              |               |                       |   |                        |   |





## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

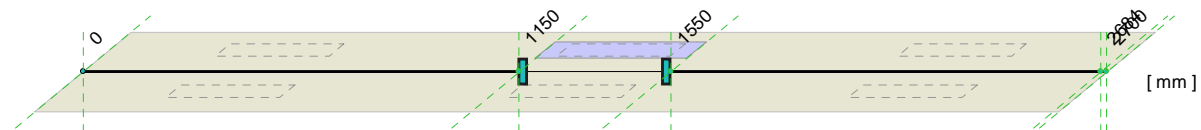
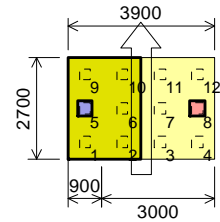
Client : SAHAGREEN F...

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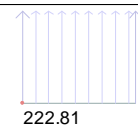
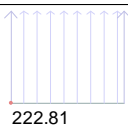
Title

# Bending Moment Diagram

|   |   |              |              |                       |                       |        |   |
|---|---|--------------|--------------|-----------------------|-----------------------|--------|---|
| Foundation name   | F-62  | Section name | S2           | Direction             | Y                     | L/C ID | 1 |
| Analysis Method<br>Conventional Rigid Method with reaction (Method 1) |   |              |              |                       |                       |        |   |
| $\Sigma F_z$  | -200.526 tonf   | $\Sigma M_x$ | 0.000 tonf-m | Moment inertia        | 3.1985 m <sup>4</sup> |        |   |
| Area  | 5.265 m <sup>2</sup>  | Contact Area |              | Critical Point Method | Maximum Point         |        |   |
| Critical Value  | Mu <sub>bottom</sub> = 46.789 tonf-m , Mu <sub>top</sub> = 0 tonf-m |              |              |                       |                       |        |   |



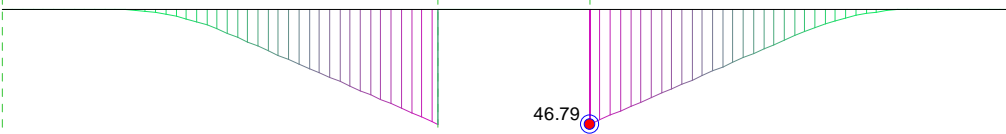
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[tonf , tonf/m ]

[B.M.D]

-46.8  
-35.1  
-23.4  
-11.7  
0  
11.7  
23.4  
35.1  
46.8



[tonf-m ]

[B/L.M.D]

-24  
-18  
-12  
-6  
0  
6  
12  
18  
24



[tonf-m / ft ]



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

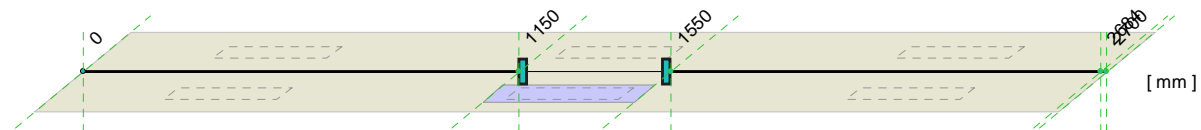
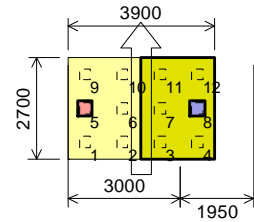
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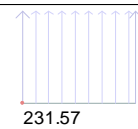
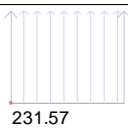
Title

# Bending Moment Diagram

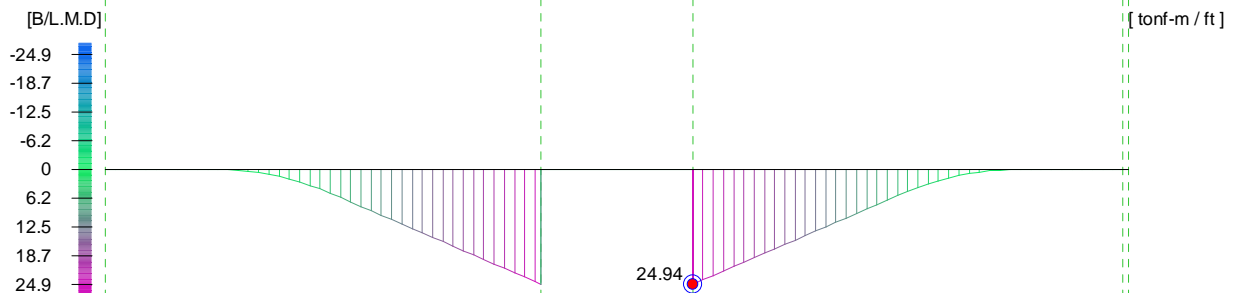
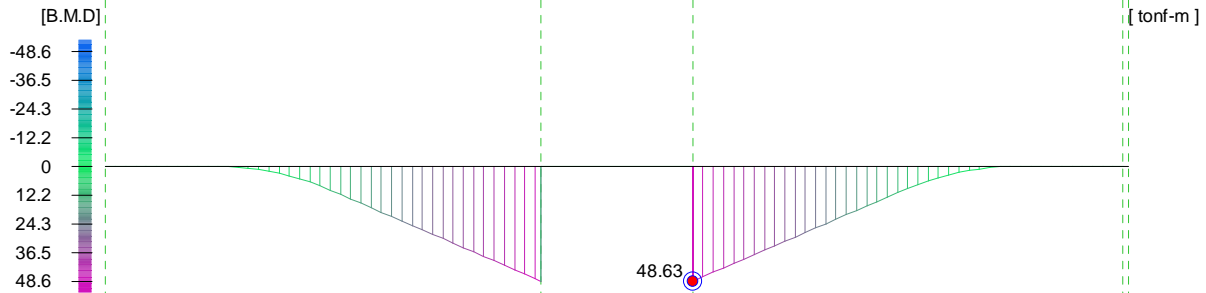
|   |                      |              |              |                       |   |                       |   |
|---|----------------------|--------------|--------------|-----------------------|---|-----------------------|---|
| Foundation name   | F-62                 | Section name | S3           | Direction             | Y | L/C ID                | 1 |
| Analysis Method<br>Conventional Rigid Method with reaction (Method 1)                 |                      |              |              |                       |   |                       |   |
| ΣFz   | -208.416 tonf        | ΣMx          | 0.000 tonf-m | Moment inertia        |   | 3.1985 m <sup>4</sup> |   |
| Area  | 5.265 m <sup>2</sup> | Contact Area |              | Critical Point Method |   | Maximum Point         |   |
| Critical Value<br>Mu <sub>bottom</sub> = 48.631 tonf-m , Mu <sub>top</sub> = 0 tonf-m |                      |              |              |                       |   |                       |   |



[Loading]



[tonf , tonf/m ]





## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

Client : SAHAGREEN F...

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### 6.3 ONE WAY SHEAR FORCE

#### 6.3.1 One-Way Shear Formula

ACI 318-05 CODE 11.3.1.1

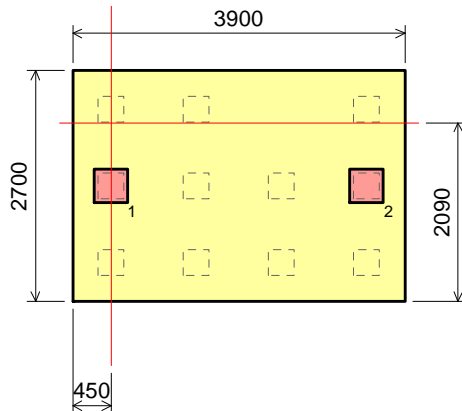
- For members subject to shear and flexure only.
- $\phi V_c = .8 \cdot 2 \sqrt{f_{ck}} B'w d$  (eq 11-3)
- $V_u \leq \phi V_c$ , then OK!!

#### 6.3.2 Check of One-Way Shear

##### Group 1 - F-61

● Footing Name : F-61    GroupType : Combined    PileType : True

Unit : mm



- X direction One-Way Shear (All Width)

| Sec.Name | L.Comb. | Loc. (mm) | d (mm) | Bw (mm) | $\phi V_c$ (tonf) | $V_u$ (tonf) | Result |
|----------|---------|-----------|--------|---------|-------------------|--------------|--------|
| S1       | 1       | 450       | 937.3  | 2700    | 179.653           | 149.265      | OK     |

- Y direction One-Way Shear (All Width)

| Sec.Name | L.Comb. | Loc. (mm) | d (mm) | Bw (mm) | $\phi V_c$ (tonf) | $V_u$ (tonf) | Result |
|----------|---------|-----------|--------|---------|-------------------|--------------|--------|
| S2       | 1       | 2090      | 911.9  | 1950    | 126.233           | 66.842       | OK     |
| S3       | 1       | 2090      | 911.9  | 1950    | 126.233           | 59.548       | OK     |



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

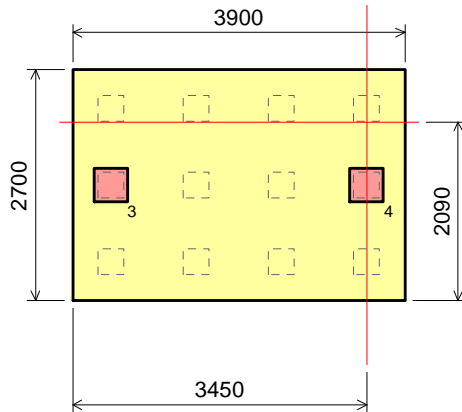
Client : SAHAGREEN F...

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**Group 2 - F-62**

● Footing Name : F-62    GroupType : Combined    PileType : True

Unit : mm



- X direction One-Way Shear (All Width)

| Sec.Name | L.Comb. | Loc. (mm) | d (mm) | Bw (mm) | $\phi V_c$ (tonf) | $V_u$ (tonf) | Result |
|----------|---------|-----------|--------|---------|-------------------|--------------|--------|
| S1       | 1       | 3450      | 937.3  | 2700    | 179.653           | 155.523      | OK     |

- Y direction One-Way Shear (All Width)

| Sec.Name | L.Comb. | Loc. (mm) | d (mm) | Bw (mm) | $\phi V_c$ (tonf) | $V_u$ (tonf) | Result |
|----------|---------|-----------|--------|---------|-------------------|--------------|--------|
| S2       | 1       | 2090      | 911.9  | 1950    | 126.233           | 66.842       | OK     |
| S3       | 1       | 2090      | 911.9  | 1950    | 126.233           | 69.472       | OK     |



# Calculation Sheet of Foundation

Project No. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

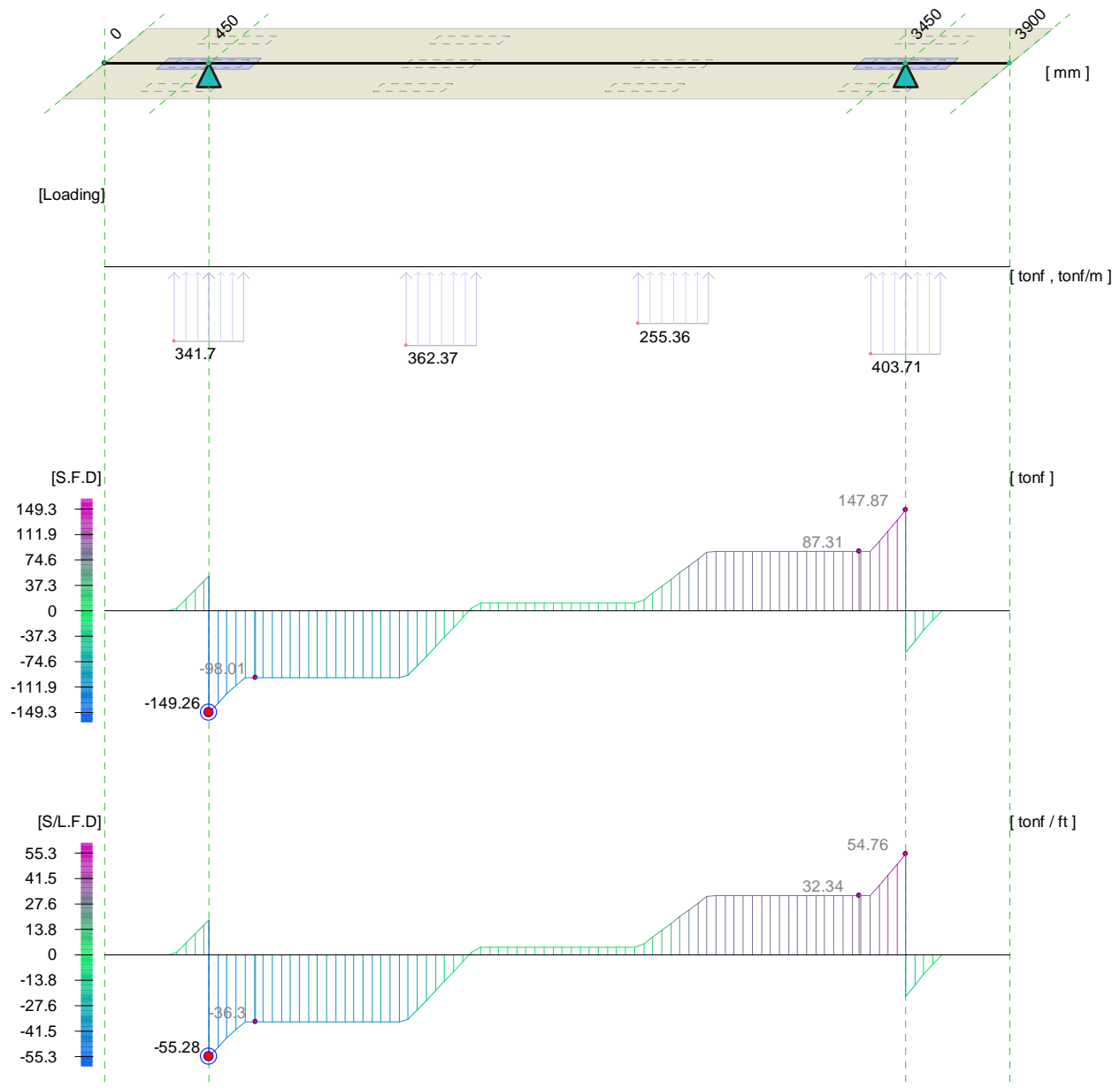
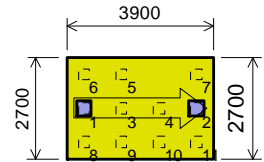
Client : SAHAGREEN F...

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Title

## Shear Force Diagram

|   |                       |              |               |                       |   |                        |   |
|---|-----------------------|--------------|---------------|-----------------------|---|------------------------|---|
| Foundation name   | F-61                  | Section name | S1            | Direction             | X | L/C ID                 | 1 |
| Analysis Method<br>Conventional Rigid Method with reaction (Method 1) |                       |              |               |                       |   |                        |   |
| ΣFz   | -408.940 tonf         | ΣMy          | 30.440 tonf-m | Moment inertia        |   | 13.3468 m <sup>4</sup> |   |
| Area  | 10.530 m <sup>2</sup> | Contact Area |               | Critical Point Method |   | Maximum Point          |   |
| Critical Value<br>Vu = -149.265 tonf                                  |                       |              |               |                       |   |                        |   |





# Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

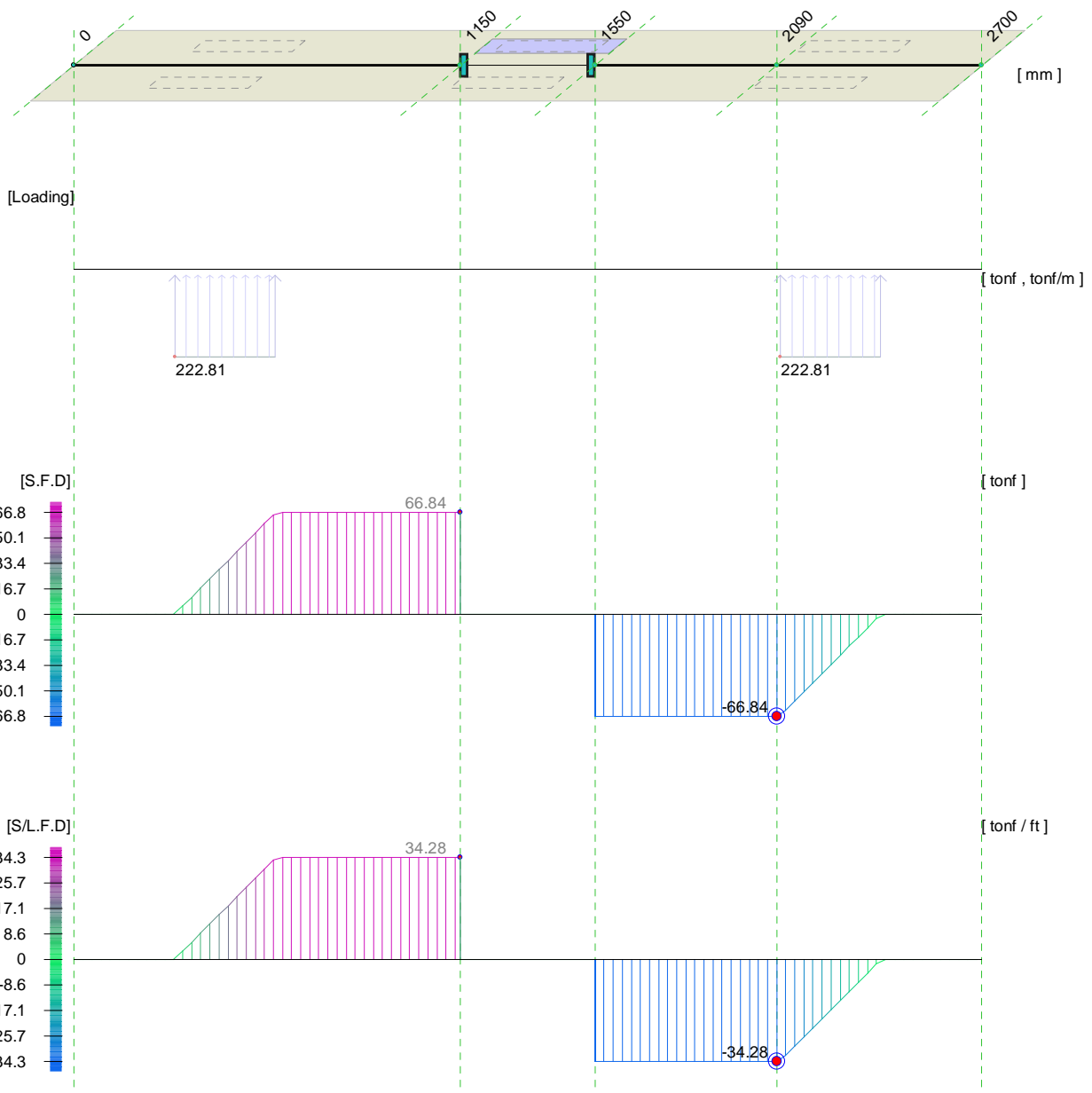
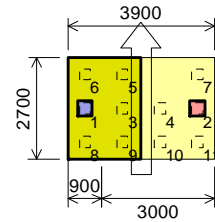
Client : SAHAGREEN F...

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## Shear Force Diagram

|                 |  |              |                       |                |                       |        |   |
|-----------------|--|--------------|-----------------------|----------------|-----------------------|--------|---|
| Foundation name | F-61   | Section name | S2                    | Direction      | Y                     | L/C ID | 1 |
| Analysis Method | Conventional Rigid Method with reaction (Method 1) |              |                       |                |                       |        |   |
| $\Sigma F_z$    | -200.526 tonf                                      | $\Sigma M_x$ | 0.000 tonf-m          | Moment inertia | 3.1985 m <sup>4</sup> |        |   |
| Area            | 5.265 m <sup>2</sup>                               | Contact Area | Critical Point Method |                | Maximum Point         |        |   |
| Critical Value  | Vu = -66.842 tonf                                  |              |                       |                |                       |        |   |





## Calculation Sheet of Foundation

Project No. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

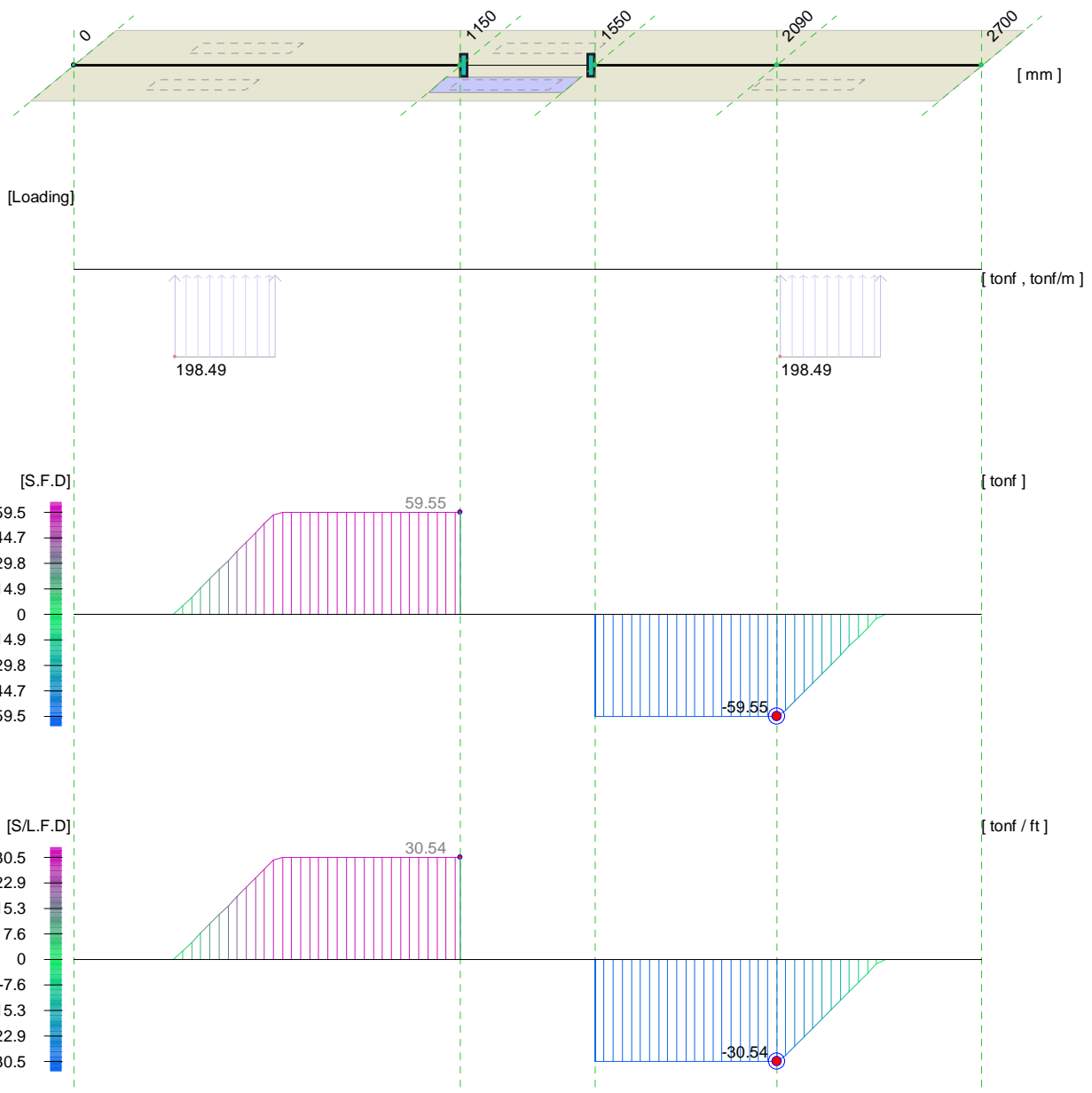
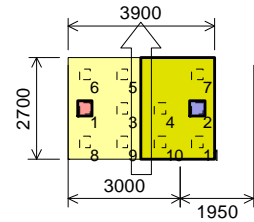
Client : SAHAGREEN F...

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Title

# Shear Force Diagram

|   |                      |              |                |                       |   |                       |   |
|---|----------------------|--------------|----------------|-----------------------|---|-----------------------|---|
| Foundation name   | F-61                 | Section name | S3             | Direction             | Y | L/C ID                | 1 |
| Analysis Method<br>Conventional Rigid Method with reaction (Method 1) |                      |              |                |                       |   |                       |   |
| ΣFz   | -208.416 tonf        | ΣMx          | -37.515 tonf-m | Moment inertia        |   | 3.1985 m <sup>4</sup> |   |
| Area  | 5.265 m <sup>2</sup> | Contact Area |                | Critical Point Method |   | Maximum Point         |   |
| Critical Value  | Vu = -59.548 tonf    |              |                |                       |   |                       |   |







# Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

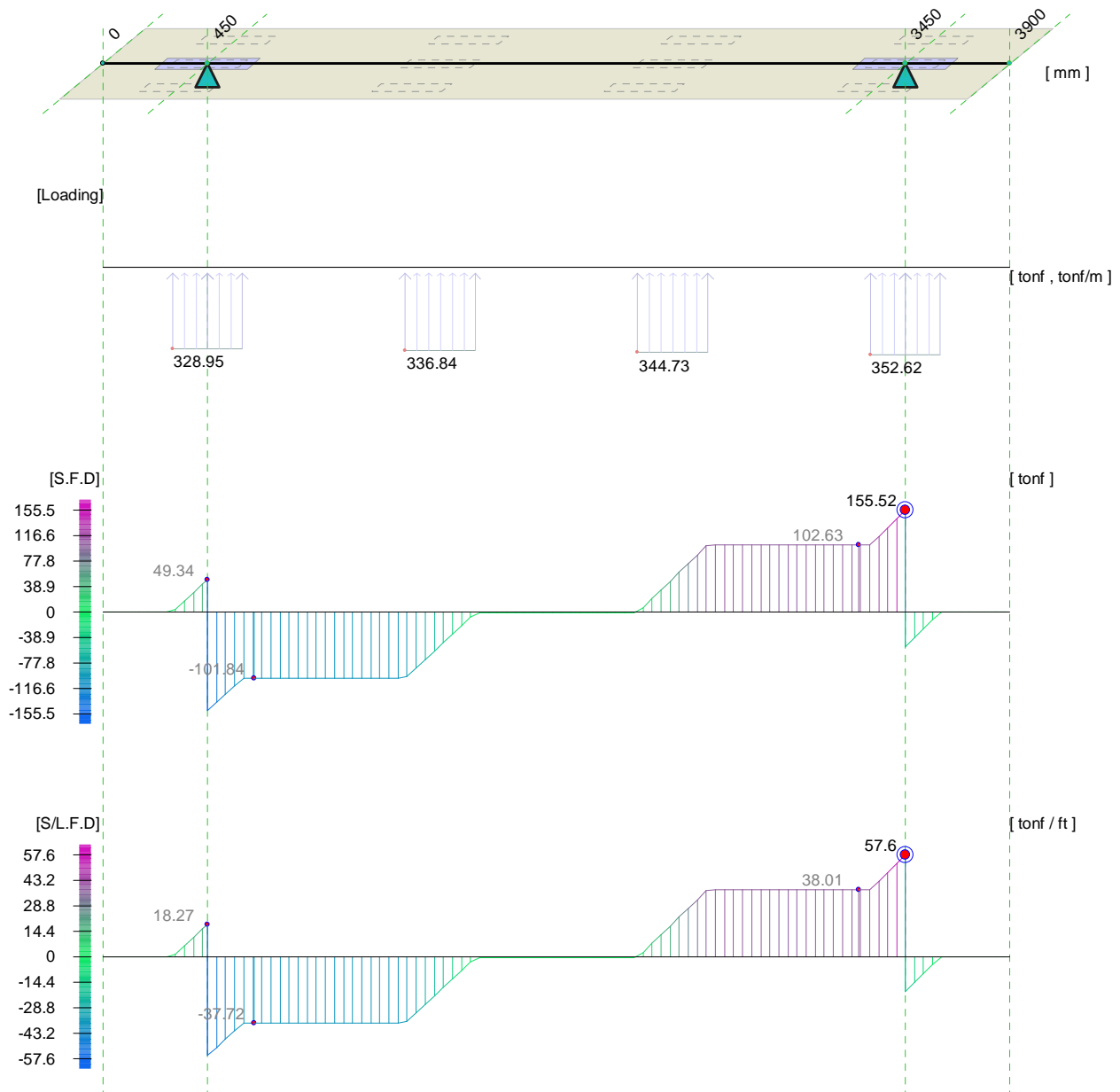
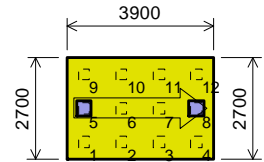
Client : SAHAGREEN F...

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## Shear Force Diagram

|   |      |                       |              |           |  |                |                        |
|---|------|-----------------------|--------------|-----------|--|----------------|------------------------|
| Foundation name   | F-62 | Section name          | S1           | Direction | X                                      | L/C ID         | 1                      |
| Analysis Method<br>Conventional Rigid Meth with reaction (Method 1) |      |                       |              |           |  |                |                        |
| $\Sigma F_z$  |      | -408.940 tonf         | $\Sigma My$  |           | 11.835 tonf-m                          | Moment inertia | 13.3468 m <sup>4</sup> |
| Area  |      | 10.530 m <sup>2</sup> | Contact Area |           | Critical Point Method<br>Maximum Point |                |                        |
| Critical Value<br>Vu = 155.523 tonf                                 |      |                       |              |           |  |                |                        |





# Calculation Sheet of Foundation

Project No. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

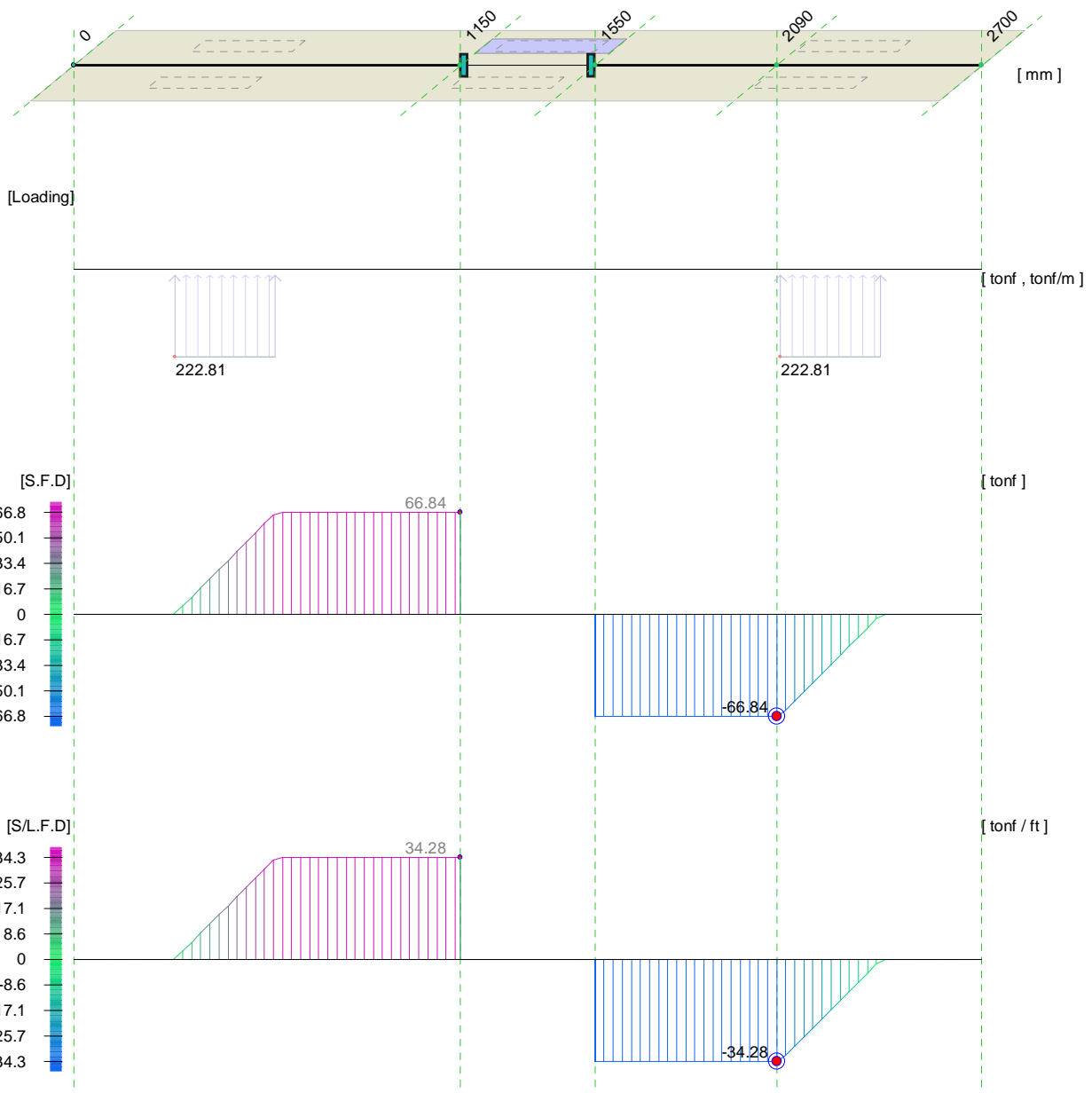
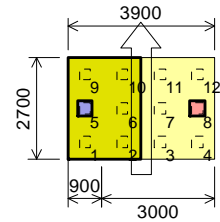
Client : SAHAGREEN F...

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## Shear Force Diagram

|                 |  |              |              |                       |                       |        |   |
|-----------------|--|--------------|--------------|-----------------------|-----------------------|--------|---|
| Foundation name | F-62   | Section name | S2           | Direction             | Y                     | L/C ID | 1 |
| Analysis Method | Conventional Rigid Method with reaction (Method 1) |              |              |                       |                       |        |   |
| $\Sigma F_z$    | -200.526 tonf                                      | $\Sigma M_x$ | 0.000 tonf-m | Moment inertia        | 3.1985 m <sup>4</sup> |        |   |
| Area            | 5.265 m <sup>2</sup>                               | Contact Area |              | Critical Point Method | Maximum Point         |        |   |
| Critical Value  | Vu = -66.842 tonf                                  |              |              |                       |                       |        |   |





# Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

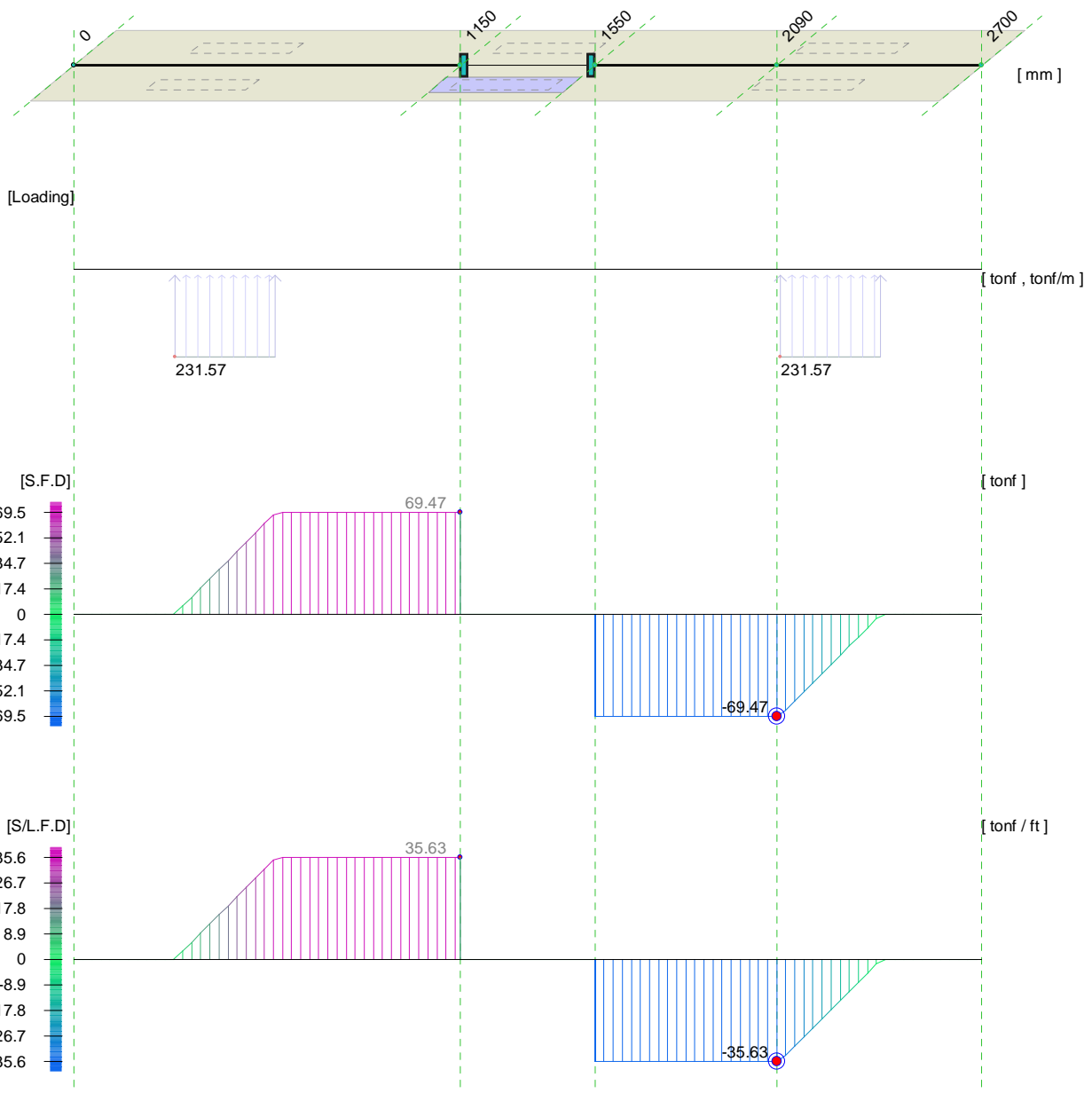
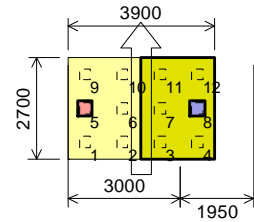
Client : SAHAGREEN F...

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Title

## Shear Force Diagram

|   |      |                      |    |              |   |                       |   |                |                       |
|---|------|----------------------|----|--------------|---|-----------------------|---|----------------|-----------------------|
| Foundation name   | F-62 | Section name         | S3 | Direction    | Y | L/C ID                | 1 |                |                       |
| Analysis Method<br>Conventional Rigid Method with reaction (Method 1) |      |                      |    |              |   |                       |   |                |                       |
| $\Sigma F_z$  |      | -208.416 tonf        |    | $\Sigma M_x$ |   | 0.000 tonf-m          |   | Moment inertia | 3.1985 m <sup>4</sup> |
| Area  |      | 5.265 m <sup>2</sup> |    | Contact Area |   | Critical Point Method |   |                | Maximum Point         |
| Critical Value  |      | Vu = -69.472 tonf    |    |              |   |                       |   |                |                       |





## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

Client : SAHAGREEN F...

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### 6.4 TWO WAY SHEAR FORCE

#### 6.4.1 Two-Way Shear Formula

$$V_u = \Sigma F_z \cdot \text{Shade Ratio}$$

$$(a) \phi V_{c1} = .8 \cdot 2 \cdot (1 + 2/\beta_c) \sqrt{f_{ck}} b_o \cdot d \quad (\text{eq 11-33}) < V_{c1}$$

$$(b) \phi V_{c2} = .8 \cdot 2 \cdot (1 + \alpha_s d / 2 b_o) \sqrt{f_{ck}} b_o \cdot d \quad (\text{eq 11-34}) < V_{c2}$$

$$(c) \phi V_{c3} = .8 \cdot 4 \sqrt{f_{ck}} b_o \cdot d \quad (\text{eq 11-35}) < V_{c3}$$

$$\phi V_c = \text{Min}(\phi V_{c1}, \phi V_{c2}, \phi V_{c3}) \quad \text{ACI 318-05 CODE 11.12.2.1}$$

**$V_u \leq \phi V_c$ , then OK**

where

$\beta$  = ratio of long side to short side of the column, concentrated load or reaction area

$\alpha_s$  = 40 for interior columns

= 30 for edge columns

= 20 for corner columns

$b_o$  = perimeter of critical section

$$\text{Shade Ratio} = \frac{\text{Footing Area} - \text{Punching Area}}{\text{Footing Area}}$$

#### 6.4.2 Check of Two-WayShear

|  |  |                   |                                 |                           |
|--|--|-------------------|---------------------------------|---------------------------|
|  | <b>Ft.Name</b>                         | F-61              | <b>Punching Area</b>            | 14959.700 cm <sup>2</sup> |
|  | <b>Pr.Name</b>                         | 2                 | <b>Pile effect</b>              | 10 / 11                   |
|  | <b>Shape</b>                           | Rectangle         | <b><math>\phi V_{c1}</math></b> | 713.541 tonf              |
|  | <b>L.Comb.</b>                         | 1                 | <b><math>\phi V_{c2}</math></b> | 1173.338 tonf             |
|  | <b>PI</b>                              | 400 mm            | <b><math>\phi V_{c3}</math></b> | 475.694 tonf              |
|  | <b>Pw</b>                              | 400 mm            | <b><math>\phi V_c</math></b>    | 475.694 tonf              |
|  | <b><math>b_o / d</math></b>            | 3574.6 / 937.3 mm | <b><math>V_u</math></b>         | 174.036 tonf              |
|  | <b><math>\beta_c / \alpha_s</math></b> | 1 / 30            | <b>Result</b>                   | <b>OK</b>                 |

|  |  |                   |                                 |                           |
|--|--|-------------------|---------------------------------|---------------------------|
|  | <b>Ft.Name</b>                         | F-62              | <b>Punching Area</b>            | 14959.700 cm <sup>2</sup> |
|  | <b>Pr.Name</b>                         | 4                 | <b>Pile effect</b>              | 11 / 12                   |
|  | <b>Shape</b>                           | Rectangle         | <b><math>\phi V_{c1}</math></b> | 713.541 tonf              |
|  | <b>L.Comb.</b>                         | 1                 | <b><math>\phi V_{c2}</math></b> | 1173.338 tonf             |
|  | <b>PI</b>                              | 400 mm            | <b><math>\phi V_{c3}</math></b> | 475.694 tonf              |
|  | <b>Pw</b>                              | 400 mm            | <b><math>\phi V_c</math></b>    | 475.694 tonf              |
|  | <b><math>b_o / d</math></b>            | 3574.6 / 937.3 mm | <b><math>V_u</math></b>         | 175.487 tonf              |
|  | <b><math>\beta_c / \alpha_s</math></b> | 1 / 30            | <b>Result</b>                   | <b>OK</b>                 |



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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Client : SAHAGREEN F...

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### 6.5 PILE PUNCHING SHEAR FORCE

#### 6.5.1 Pile Punching Shear Formula

 $V_u = \Sigma F_z \cdot \text{Shade Ratio}$ 

 (a)  $\phi V_{c1} = .8 \cdot 2 \cdot (1 + 2/\beta_c) \sqrt{f_{ck}} b_o \cdot d$  (eq 11-33) <  $V_{c1}$ 

 (b)  $\phi V_{c2} = .8 \cdot 2 \cdot (1 + \alpha_s d / 2 b_o) \sqrt{f_{ck}} b_o \cdot d$  (eq 11-34) <  $V_{c2}$ 

 (c)  $\phi V_{c3} = .8 \cdot 4 \sqrt{f_{ck}} b_o \cdot d$  (eq 11-35) <  $V_{c3}$ 
 $\phi V_c = \text{Min}(\phi V_{c1}, \phi V_{c2}, \phi V_{c3})$  ACI 318-05 CODE 11.12.2.1

 $V_u \leq \phi V_c$ , then OK

where

 $\beta$  = ratio of long side to short side of the column, concentrated load or reaction area

 $\alpha_s = 40$  for interior columns

= 30 for edge columns

= 20 for corner columns

 $b_o$  = perimeter of critical section

 $\text{Shade Ratio} = \frac{\text{Footing Area} - \text{Punching Area}}{\text{Footing Area}}$ 

#### 6.5.2 Check of Pile Punching Shear

|  |                 |           |                      |                           |
|--|-----------------|-----------|----------------------|---------------------------|
|  | <b>Ft.Name</b>  | F-61      | <b>Punching Area</b> | 17553.690 cm <sup>2</sup> |
|  | <b>Pile No.</b> | 7         | $\beta_c / \alpha_s$ | 1 / 20                    |
|  | <b>Shape</b>    | Square    | $\phi V_{c1}$        | 528.939 tonf              |
|  | <b>L.Comb.</b>  | 1         | $\phi V_{c2}$        | 799.974 tonf              |
|  | <b>PileName</b> | PHC-12    | $\phi V_{c3}$        | 352.626 tonf              |
|  | <b>Diameter</b> | 300mm     | $\phi V_c$           | 352.626 tonf              |
|  | <b>bo</b>       | 2649.81mm | <b>Vu</b>            | 46.240 tonf               |
|  | <b>d</b>        | 937.3mm   | <b>Result</b>        | <b>OK</b>                 |

|  |                 |           |                      |                           |
|--|-----------------|-----------|----------------------|---------------------------|
|  | <b>Ft.Name</b>  | F-62      | <b>Punching Area</b> | 17553.680 cm <sup>2</sup> |
|  | <b>Pile No.</b> | 4         | $\beta_c / \alpha_s$ | 1 / 20                    |
|  | <b>Shape</b>    | Square    | $\phi V_{c1}$        | 528.939 tonf              |
|  | <b>L.Comb.</b>  | 1         | $\phi V_{c2}$        | 799.974 tonf              |
|  | <b>PileName</b> | PHC-12    | $\phi V_{c3}$        | 352.626 tonf              |
|  | <b>Diameter</b> | 300mm     | $\phi V_c$           | 352.626 tonf              |
|  | <b>bo</b>       | 2649.81mm | <b>Vu</b>            | 35.262 tonf               |
|  | <b>d</b>        | 937.3mm   | <b>Result</b>        | <b>OK</b>                 |



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

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## 7. DESIGN OF TIE-GIRDER

### 7.1 FORMULA

• Moment and Shear

• Reinforcement

- Shrinkage and temperature reinforcement ---- ACI CODE 7.12.2

 $As \geq fac \cdot b \cdot h$  , fac = following

Area of shrinkage and temperature reinforcement shall provide at least the following ratio of reinforcement area to gross concrete area, but not less than 0.0014

0.0018 Slabs where Grade 40 or 50 deformed bars are used .....

0.0018 Slabs where Grade 60 deformed bars or welded wire reinforcement are used.....

(c) Slabs where reinforcement with yield stress exceeding 60,000 psi measured at a yield

strain of 0.35 percent is used .....

- Required Reinforcement by Analysis

 $As \geq As_2$ 

- At every section of flexural members where tensile reinforcement is required

 $As \geq As_5 \geq As_4$  ---- ACI Eq (10-3)

- The requirements of Eq (10-3) need not be applied, if every section  $As$  provided is at least one -third greater than that required by analysis ---- ACI CODE 10.5.3

 $As_2 = \rho_{req} \cdot b \cdot d$  $As_3 = 1.333 \rho_{req} \cdot b \cdot d$  $As_4 = \frac{200}{f_y} \cdot b \cdot d$  $As_5 = \frac{3 \sqrt{f_{ck}}}{f_y} \cdot b \cdot d$  $As_{max} = 0.75 \rho_b \cdot b \cdot d$  $\rho_b = 0.85 \times \beta_1 \times \frac{f_{ck}}{f_y} \times \frac{0.003 \times E_s}{0.003 \times E_s + f_y}$ Selected  $As = \text{Max} ( As_1 , As_2 , \text{Min} ( As_3 , \text{Max} ( As_4 , As_5 ) ) )$ **If Selected  $As < \text{Using } As < As_{max}$  , then OK!!**

Note : The reinforcement is calculated bases on the maximum moment under the foundation in each direction.

But, the 'ISO', 'OCT', 'HEX', 'COMB', 'TANK1' foundations are calculated as face pier

Where,

$$Rn = \frac{Mu}{\phi b d^2} , \phi = .85 , \rho_{req} = \frac{0.85 \cdot f_{ck}}{f_y} \times \left( 1 - \sqrt{1 - \frac{2Rn}{0.85 f_{ck}}} \right)$$

• Shear

$$\phi V_c = \phi 2 \sqrt{f_{ck}} B_w d \quad [\text{ACI CODE 11.3.1.1 (11-3)}]$$

$$\phi V_s = \phi \frac{A_s f_y d}{s} \quad [\text{ACI CODE 11.5.7.2 (11-15)}]$$

$$\phi V_{smax} = \phi 8 \sqrt{f_{ck}} B_w d \quad [\text{ACI CODE 11.5.7.9}]$$

if  $V_u < 0.5 \cdot \phi V_c$  then ,  $Asv_{req} = 0$ 

$$\text{if } V_u \geq 0.5 \cdot \phi V_c \text{ then , } Asv_{req} = \frac{(V_u - \phi V_c) s}{\phi f_y d} \geq 0.75 \sqrt{f_{ck}} \frac{b_w s}{f_y} \geq \frac{50 b_w s}{f_y} \quad [\text{ACI CODE 11.5.6.3 (11-13)}]$$

$$\phi V_n = \phi V_c + \phi V_s \quad [\text{ACI CODE 11.1.1.1 (11-2)}]$$

$$V_u \leq \phi V_n \rightarrow \text{OK} \quad [\text{ACI CODE 11.1.1.1 (11-1)}]$$

## 7.2 GEOMETRY AND MATERIALS

### 7.2.1 General

Unit(kgf/cm<sup>2</sup>,mm)

| $\phi$ (Flexure) | $\phi$ (Shear) | f'c    | fy1     | fy2     |
|------------------|----------------|--------|---------|---------|
| .85              | .8             | 280.00 | 4000.00 | 2400.00 |



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

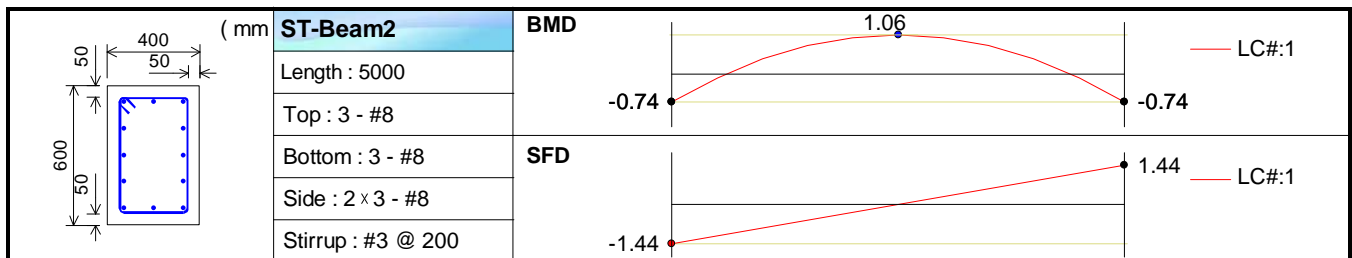
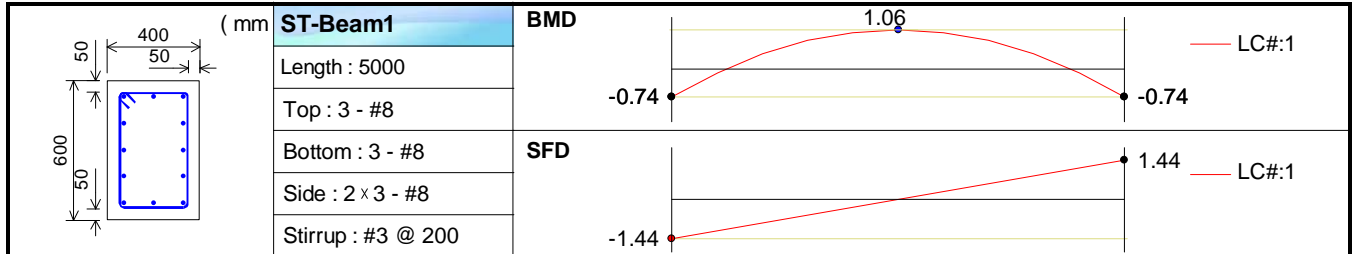
Project No. : Revise F6-F6

Client : SAHAGREEN F...

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### 7.2.2 MATERIAL

Unit (mm , tonf , tonf-m)



### 7.3 MEMBER FORCE

#### » Sturcture 1

- ST-Beam1

Unit (tonf , tonf-m)

| L.Comb. | Ra    | Rb   | Ma     | Mb     | V <sub>max</sub> | M <sub>max(-)</sub> | M <sub>max(+)</sub> |
|---------|-------|------|--------|--------|------------------|---------------------|---------------------|
| 1       | -1.44 | 1.44 | -0.744 | -0.744 | -1.44            | -0.744              | 1.056               |

#### » Sturcture 2

- ST-Beam2

Unit (tonf , tonf-m)

| L.Comb. | Ra    | Rb   | Ma     | Mb     | V <sub>max</sub> | M <sub>max(-)</sub> | M <sub>max(+)</sub> |
|---------|-------|------|--------|--------|------------------|---------------------|---------------------|
| 1       | -1.44 | 1.44 | -0.744 | -0.744 | -1.44            | -0.744              | 1.056               |

### 7.4 REQUIRED REINFORCEMENT

#### » Sturcture 1

- ST-Beam1

( cm<sup>2</sup> )

| L.Comb. |        | As <sub>1</sub> | As <sub>2</sub> | As <sub>3</sub> | As <sub>4</sub> | As <sub>5</sub> | As <sub>select</sub> | As <sub>used</sub> | As <sub>max</sub> | Result |
|---------|--------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------------|--------------------|-------------------|--------|
| 1       | Top    | 2.4             | .7              | .9              | 12.4            | 11.7            | 2.4                  | 15.2               | 95.9              | OK     |
|         | Bottom | 2.4             | 1               | 1.3             | 12.4            | 11.7            | 2.4                  | 15.2               | 95.9              | OK     |

#### » Sturcture 2

- ST-Beam2

( cm<sup>2</sup> )

| L.Comb. |        | As <sub>1</sub> | As <sub>2</sub> | As <sub>3</sub> | As <sub>4</sub> | As <sub>5</sub> | As <sub>select</sub> | As <sub>used</sub> | As <sub>max</sub> | Result |
|---------|--------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------------|--------------------|-------------------|--------|
| 1       | Top    | 2.4             | .7              | .9              | 12.4            | 11.7            | 2.4                  | 15.2               | 95.9              | OK     |
|         | Bottom | 2.4             | 1               | 1.3             | 12.4            | 11.7            | 2.4                  | 15.2               | 95.9              | OK     |



## Calculation Sheet of Foundation

Project Na. : 7.5 MW. Power Plant Stream..

Project No. : Revise F6-F6

Client : SAHAGREEN F...

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### 7.5 ONE WAY SHEAR

#### » Sturcture 1

- ST-Beam1

( tonf , cm<sup>2</sup> )

| L.Comb. | Vu   | $\phi V_c$ | $\phi V_s$ | $\phi V_n$ | $\phi V_{s_{max}}$ | Asv <sub>use</sub> | Asv <sub>req</sub> | Result |
|---------|------|------------|------------|------------|--------------------|--------------------|--------------------|--------|
| 1       | 1.44 | 15.482     | 12.432     | 27.915     | 61.929             | 1.425              | 0                  | OK     |

#### » Sturcture 2

- ST-Beam2

( tonf , cm<sup>2</sup> )

| L.Comb. | Vu   | $\phi V_c$ | $\phi V_s$ | $\phi V_n$ | $\phi V_{s_{max}}$ | Asv <sub>use</sub> | Asv <sub>req</sub> | Result |
|---------|------|------------|------------|------------|--------------------|--------------------|--------------------|--------|
| 1       | 1.44 | 15.482     | 12.432     | 27.915     | 61.929             | 1.425              | 0                  | OK     |

### - Shear Reinforcement Space Check

#### » Sturcture 1

( mm )

| Name     | Using Space | Max Space | Result |
|----------|-------------|-----------|--------|
| ST-Beam1 | 200         | 272.6     | OK     |

#### » Sturcture 2

( mm )

| Name     | Using Space | Max Space | Result |
|----------|-------------|-----------|--------|
| ST-Beam2 | 200         | 272.6     | OK     |