Tender Technical Specification

Technical Specification for Development of Parametric Programs for customization and Optimization of Various Coal Handling Plant (CHP) structures

Short Description of tender

“Development of Design Automation Tools for Customization of Analysis and Optimization of various Structural components in Coal Handling Plant (CHP) like Conveyor Galleries, Trestles and Transfer Towers considering various loads and their combinations as per Indian Standard Codes using FEMAP API for parametric modeling and interfacing such tool with the available softwares such as PROKON and STAAD Pro, with auto execution for modeling, analysis including design optimization with technical reports and BOM as per Technical Specification provided by BHEL”.

CHP structures consists of various types of conveyor galleries and trestles along with junction houses and other structural sub systems

As there are huge number of variants in the types of galleries, trestles and transfer towers with various requirements such as lengths load carrying capacities, single/double galleries etc, it is proposed to develop a parametric program to develop the mathematical model and interface with analytical packages and relevant design codes as per Indian Standards.
The total system of automated program is basically dividend into following sections

1) General Guidelines
2) Basic types of galleries, trestles and transfer towers.
3) Development of parametric mathematical model of galleries, trestles and transfer towers
4) Generation of 3D Mathematical model and 3D frame from the above
5) Imposition of loads calculated as per relevant codes and constraints for various conditions
6) Development of interfaces with existing software for the above program
7) After execution of program in analysis package, retrieval of properties, analysis data, forces and moments
8) Development of program to read these values into a separately developed code as per Indian Standards and cross checking for strength and stability using these codes
9) Prepare model with revised properties for optimization
10) Rechecking results for system safety and further optimization and calculation of sectional properties
11) Preparation of bill of material and cutting diagrams and calculation of raw material weights etc
12) Preparation of dxf file from analysis model suitable for plotting in AutoCad.
The tender is invited for carrying out developmental work which would result into a customized Design and Analysis Tool for the specified components of Coal Handling Plant (CHP). The brief technical scope is as under.

1. Components Considered are Conveyor Galleries, Trestles and Transfer Towers.
2. Basic initial geometry is to be arrived at based on physical requirements of space, size and capacity.
3. Development of parametric programs to convert the physical configuration into finite element models using FEMAP with parameters and constraints.
4. Finite element analysis of the component under the loading as per Indian standard Codes. This is to be done by linking the FE models to analysis packages, STAAD PRO and with PROKON.
5. Interpretation of results according to Indian standard codes
6. Iterative optimization (repetition of steps 2to5) to get acceptable design (Stress and deflections) from consideration of weight.
7. Converts the final configuration into drawings, BOM, and auto generation of design report.

The Scope mentioned above is detailed with some more intermediate steps as mentioned below.
**General guidelines for customization for development of Parametric program**

1) For customization of codes and input of frames in program - a continuous interaction with BHEL and developer is required for proper guidance from the Indenting department.

2) Initially, after placement of order, the Developer has to work with the indenting Department at BHEL R&D Hyderabad to formulate the design procedure and procedure to be followed and work should be carried out jointly during the first phase of development. Developer has to visit R&D and stay at his own expenses and BHEL will not pay any expenses towards travel, boarding and lodging or any other charges.

3) The logic and guidance given for customization are only indicative to quantify the amount of work involved. The logic of preparing the frames may change during the course of development, if needed. There may be changes in configuration of structures during the course of development, which needs to be considered.

4) The software logic prepared will be the property of BHEL and the supplier or developer will not have any rights on the programs developed and will be copywrited / patented by BHEL.

5) The Developer should maintain strict confidentiality of the joint work being carried out and should sign the confidentiality agreement before starting the work.

6) It is the developer's responsibility to test the software and customization prepared for typical CHP structures of earlier jobs as given by the indenting department.

7) The developer should provide operating manual and other procedures to be followed for executing the structural analysis jobs.

8) The initial models and parametric programs must be developed using the preprocessor and API program capability of FEMAP for checking at BHEL. The programs must interface with PROKON and STAAD Pro softwares, which are available at BHEL and have to be tested at Indenting department. The customization and modeling data has to be carried on the existing softwares. However, the supplier is free to develop the programs on any other platform suitable to him and the same software along with the full program code is to be
supplied along with the developed codes, but final interfacing must be done with the above available softwares at BHEL (FEMAP, PROKON and STAAD Pro).

9) The supplier may send samples of such developed code for any other product/structure in above formats for assessing the technical suitability, if available.

10) The design must comply with Indian Standard codes like IS 800 both working stress and limit state designs and the codes should be incorporated in the analytical engine for automatic design checks.

11) The loadings should follow the required Indian codes as per IS875 and IS1893 (latest Versions)

12) The developer has to test each phase of program before proceeding to the next phase

13) The required effective length calculations, K factor determination, optimization routines with different load combinations as per Indian codes must be incorporated and interfaced with the above mentioned analytical tools.

14) The Information contained in Tender Documents is confidential and should not be used for any other purpose other than for quoting/executing for this envisaged work.
**Technical specification**

General Introduction of CHP Structures:

The coal Handling Plant (CHP) structures consists of various conveyor galleries carrying coal from coal yards to the bunkers in the boiler area of a thermal power plant. These galleries run from ground level to bunker level which is approximately 50 to 60 metres high. Typical Layout of a plant is as shown below:

Typical Layout of a Power plant
Typical Conveyor system:

The conveyor system designed to carry coal is generally inclined conveyor system with single or double conveyors on a single gallery. The length of each gallery segment varies between 8m to 30m in length and widths from 4 to 10m. They are supported by vertical supporting structure called trestles. These may be two legged trestles or 4 legged trestles. Typical Galleries running in a coal plant are as shown below:
As seen from the above figures the galleries are of different lengths and inclinations and these run from ground to bunker height with various types supporting Trestles in-between. The location of trestles depend on site condition such as layout of roads, piping and location of other equipment.
**Types of Galleries:**

In order to standardize the number and types of galleries, it is proposed to standardize based on the typical lengths for various single/ double galleries.

The will be basically TWO types of galleries - galleries carrying one belt conveyor or Gallery carrying two conveyor belts as shown below:

The cross sectional details of Single conveyor Gallery is as shown below:

The cross sectional details of a Double conveyor Gallery is as shown below:
Lengths of Conveyor Galleries:

It is proposed to standardize 4 lengths of galleries such as 12m, 18m, 24m and 30m for the purpose of optimization and development of tool.

The typical arrangement of single conveyor gallery is as shown below:
Similarly typical Double Conveyor galleries are shown below:
Design Guidelines

The overhead gallery girder consists of two vertical latticed girder connected with two end portal. Cross beams supporting walkway runner & conveyor stringer made of plate girder connecting the bottom chords of the vertical girder. The roof trusses supporting the purlins are connecting the top chord of the vertical girder. The top & bottom plan of the gallery girder are horizontally braced with “V” bracings. A space frame model is required to be prepared on the above basis for analysis.

Conveyor gallery girders are to be designed as a pair of girders, braced at top and bottom levels.

A gallery consists of two girders of depth approx 2.8m, braced at top and bottom chord levels to transmit loads to end portals which in turn connected to trestles. Roof truss is provided at upper end points @ 3 m c/c to form an enclosure. Cross beams at bottom chord level spanning between the two girders is provided to support walkway and conveyor supporting structures.

Typical arrangement is as shown in above figures.

Development Tool Requirement:

The design Optimization GUI based development tool to be prepared for each type of gallery, trestle and transfer tower. Initial Model to be prepared using FEMAP API for checking and interfacing.

The parameterized mathematical model has to be developed using the FEMAP API program only. Other modes of development are not acceptable. The model has to be developed for different optimum configurations of various types of structures. For example there API programs of a 12m gallery of a single conveyor system will be different to that of a 12m gallery structure for double conveyor system.

The mathematical model developed by the tool has to be integrated with analytical softwares PROKON and STAAD Pro for analysis, design and Optimization automatically without user intervention.

The Details Are:

1) For Single Conveyor and Double Conveyor Systems

The program has to be developed for each of the Gallery lengths

a) 12m in length

b) 18m in Length
c) 24m in length. and

d) 30m length

The mathematical models prepared will also depend on the type of material to be carried. The structure may differ for carrying coal from that to carry Lignite etc (For Lignite carrying gallery the cables etc are to be placed outside the conveyor structure).

The following variables need to be considered for the development of mathematical model

A) Coal feeding rates - Variables are

   Boiler Specification such as 110MW, 250MW or 500 MW Boiler with feeding rates of 400, 600, 800, 1200, 1400, 1600, 1800 and 2000 Tonnes/Hr (Add 20% Extra Load)

B) Inclination of Conveyor from 0 to 15Deg in steps of 1 degree. (The load on walk way increases for inclinations more than 10 deg due to the presence of steps instead of floor)

C) The end of Portal to be suitably designed for the above inclination

D) Belt speed - Program should input variable belt speed for each gallery.

E) Walk way - following to be considered

   i) Single side walk way

   ii) Walkway on both sides of conveyor (may be of different widths) for single conveyor system and

   iii) For double conveyor system, the walk ways in the middle as well as at end to be considered

The walk ways on both sides may differ in widths (Variable width walk way to be considered)

F) Inclusion of seal plate -- length and weight of coal to be considered

G) Deck Plate to be considered and dust load to be considered

H) Variable wind load as per the height of gallery (Height at which it has to be erected is a parameter)

I) Site Location

J) wind speeds as per IS875

K) Seismic loads as per IS1893

L) Other parameters as required by the site conditions and customer requirement.
Design Codes to be Followed:

IS : 875 (Part – 2) – 1987 – Code of practice of Design Load (Other than earth quake) for Building & structure – Imposed Loads

IS : 875 (Part – 3) – 1987 – Code of practice of Design Load (Other than earth quake) for Building & structure – Wind Loads

IS1893- 2002 Part 1 and IS1893-2005 Part IV for seismic loads

IS : 800 –2007– Code of practice for General Construction of Steel

Both working stress and Limit state design need to be checked

IS : 808 – 1989 – Dimension for Hot Rolled Steel Beams, Column, Channel & Angle Section

IS 11592 -2000 Code of Practice for Selection and design of Belt Conveyors

Load Parameters

The detailed load calculation parameters to be considered are as given below

Data To be considered for Load Calculations

1.A Design Data and Variables

1) Depth of Gallery
2) Width of Panel
3) Roof Slope
4) Belt width
5) Design Capacity
6) Belt Speed
7) Wt. of Belt (Carrying + Return)
8) Wt. of Idler (Carrying + Return)
9) Wt. of Stringer, Short Post, Etc.
10) Wt. of Hand rail (assumed)
11) Wt. of Lighting Arrangements
12) Wt. of Cable Tray
13) Wt. of Fire fighting pipe
14) Wt. of Service water pipe
15) Wt. of DS Water pipe
16) Wt. of potable water pipe
17) Basic Wind Speed

B. Load on Gallery:

1) Wind Load:

Basic wind speed based on site location
Design Wind speed should be calculated for different heights as per factors k1,k2(and varies with Height) and k3 of IS: 875- Part3
Design Wind pressure for different heights to be calculated
Vz for upto 10.0m height
Vz for 10 to 15m height
Vz for 15 to 20 m height
Vz for 20 to 30m height
Vz for 30 to 40 m height
Vz for 40 to 50m height
Vz for 50 to 60m height
Vz for 60 to 70m height
Vz for 70 to 80m height need to be calculated

2) Material Load:

Here Capacity of the conveyor (Tonnes per Hour - TPH) to be considered
Then wt. of material on belt per meter length to be calculated based on the Belt Speed
Other Parameters are Weight of belt and consider 10% extra (as per IS-11592) then compute Total Material weight on belt.

3) Live Load on Walkway:

As per code LL on walkway

4) Live Load on Seal Plate:

Live Load on seal plate

5) Live Load on Deck Plate:

Live Load on deck plate
Width of each deck plate
and LL from each deck plate to be computed
6) **Weight of Pipe:**

- Total weight of service water pipe
- Total weight of DS water pipe
- Total weight of potable water pipe

7) **Load of Cable Tray:**

- Total Weight of Cable Tray on gallery is to be considered
- Then, load on one side gallery-girder due to cable tray is computed
- Then, load on other side (pipe side) gallery-girder is also to be computed

8) **Load on Roof:**

- Here roof slope to be considered
- a) Live Load = As per –IS.875 – Part 2 LL on roof
- b) Dust Load = As per Dust Load
  - Hence UDL on roof is to be computed

9) **Load of Lighting Arrangement:**

- Here load of lighting arrangement for per light point is to be considered

10) **Load of Fire Fighting Arrangement:**

- Load of Fire fighting arrangement at two joints in each roof truss to be considered

11) **Dead Load on Gallery** to be computed considering

- Self weight of roof sheeting
- Self weight of side sheeting
- Self weight of purins and side runner
- Self weight of chequered plate
- Self weight of deck plate
- Self weight of seal plate with stiffener
- Self weight of other members shall be taken as applicable to the respective members as per IS.808

12) **Conveyor load calculations should consider**

- Conveyor load stands for dead load of conveyor-
- Weight of idler (Carrying + return)
- Wt of stringer, Sh. Post, etc.
- Wt. of deck plate
13) Wt. of Hand rail

Wt. of side hand rail
Wt. of other hand rail.

C. Load Calculation:

I. DEAD LOAD(DL):

1) Internal Panel:

Load intensity on effective width of truss

2) Load on floor:

DL on 0.8 m wide right/left walkway and 0.175 m wide seal plate supporting members with s/w

DL on bottom chord members from 0.175 wide seal plate

DL from 0.175 m wide seal plate and 2.05 m wide seal plate supporting members

DL from 1 m wide middle walkway and 0.175 m wide seal plate supporting members with s/w

3) Load of side sheeting and side runner:

Load intensity is to be assumed to be acting on side sheeting

Load on Internal Portion:
load on top and bottom nodes of each verticals to be computed

Load on Portal
Load on top and bottom nodes of each verticals to be computed

4) Conveyor Load:

Total weight of conv.(excluding belt wt.)
Load from each short post/side to be calculated based on Short post spacing
5) **Load from handrail:**

Wt. of side hand rail  
Wt. of other hand rail  
Load from hand rail (other than side HR) to be considered

II. **LIVE LOAD (LL):**

1) **Load on Roof:**

Load intensity assumed to be acting on Internal Pannel and transferred to the trusses

2) **Load on floor:**

LL on 0.8 m wide right/left walkway and 0.175 m wide seal plate supporting members

LL on bottom chord members from 0.175 wide seal plate  
LL from 0.175 m wide seal plate and 2.05 m wide seal plate supporting members  
LL from 1 m wide middle walkway and 0.175 m wide seal plate supporting members

3) **Material Weight:**

Total Material weight of conv.(belt wt.+ live load on deck plate)

Load from each short post/side is calculated based on Short post spacing

4) **Load from pipe:**

Weight of service water pipe to be considered  
Weight of DS water pipe to be considered  
Weight of potable water pipe to be considered

5) **Load from Cable Tray:**

Load intensity of cable tray on one girder to be considered
Load intensity of cable tray on other side (pipe side) girder to be considered

6) **Load from Lighting Arrangement:**

30 kg on each node

7) **Load from Fire Fighting Pipe Line:**

Weight of Fire Fighting pipe to be considered.

III. **WIND LOAD:** As per IS.875 (Part.3)

1) **Load on Roof:**

Based on height and width of the gallery
And angle of roof
Wind pressure coefficients for roof to be calculated as per IS875 (Part3) and Consider
When wind blows across the conv.
When wind blows along the conv.
The pressure coefficients to be calculated on Windward Side and Leeward side with different configurations to be computed.
From this, UDL on Roof truss and end panels are to be computed

2) **Load on Side Sheeting:**

Consider height, width and length of the gallery
and calculate the Wind pressure coefficients for roof as per IS875
When wind blows across the conv. and When wind blows along the conv.

Compute the following load cases
**When wind is blowing across the conv.**

Wind pressure in windward side
Wind pressure in leeward side

Wind load on verticals (Intermediate Panels)

Windward side (on Top support)
Windward side (Bottom support)

Leeward side (on Top support)
Leeward side (Bottom support)

When wind is blowing along the conv.
(Both windward and Leeward direction are opposite in sign)
wind pressure in perpendicular direction to wind flow

For Intermediate Panels
Wind Load on the verticals (Top support)
Wind Load on the verticals (Bottom support)

For End Portal

Wind Load on the portals (Top support)
Wind Load on the portals (Bottom support)

Other loads to be considered are
Seismic loads as per IS1893 if applicable

Summation of Load cases and Load combinations to be considered for analysis and design

*********************************************************
LOAD 1 [DL]
*********************************************************
SELFWEIGHT
*****Load on Roof:
JOINT LOAD
MEMBER LOAD
*****Load on Floor
*****DL on  left walkway and  seal plate supporting members
*****DL on  right walkway and  seal plate supporting members
*****DL on Bottom chord members from  Seal plate
*****DL from  seal plate and  seal plate supporting members
***DL from  middle walkway and  seal plate supporting members
*****Load of side Sheeting and Side Runner :
***Conveyor Load :
*****Load from handrail
****Wt of other Hand rail
*****Load of side Hand rail

LOAD 2 [LL]

**********Load on Roof:

JOINT LOAD
MEMBER LOAD
*****Load on Floor
*****LL on left walkway seal plate supporting members
*****LL on right walkway and seal plate supporting members
*****LL on Bottom chord members from Seal plate

MEMBER LOAD
*****LL from seal plate and seal plate supporting members
*****LL from middle walkway and seal plate supporting members

****Material Load:

MEMBER LOAD
*****Load from Pipes:
*****Load from Cable Tray:
*****Load from Lighting Arrangement:

JOINT LOAD
*****Load from Fire Fighting Pipe Line:

MEMBER LOAD
LOAD 3 [WL(+X)]

**********Load on Roof:
*****load on roof trusses

JOINT LOAD
*****Load on Side Sheeting:
****Windward side

MEMBER LOAD
LOAD 4 [WL(-X)]

**********Load on Roof:
*****load on roof trusses

JOINT LOAD
*****Load on Side Sheeting:
****Windward side
****leeward side

LOAD 5 [WL(+Z)]

**********Load on Roof:

JOINT LOAD
*****Load on Side Sheeting:
****Windward side

MEMBER LOAD
****leeward side

LOAD 6 [WL(-Z)]

Design Analysis Group (DNA), Corporate R&D Division, BHEL, HYDERABAD,INDIA
******Load on Roof :
JOINT LOAD
******Load on Side Sheeting :
***Windward side
MEMBER LOAD
***leeward side

Following Load combinations to be considered in analysis

LOAD COMB 101 [DL+LL]
  1 1.0 2 1.0
LOAD COMB 102 0.75[DL+LL+WL(+X)]
  1 0.75 2 0.75 3 0.75
LOAD COMB 103 0.75[DL+LL+WL(-X)]
  1 0.75 2 0.75 4 0.75
LOAD COMB 104 0.75[DL+LL+WL(+Z)]
  1 0.75 2 0.75 5 0.75
LOAD COMB 105 0.75[DL+LL+WL(-Z)]
  1 0.75 2 0.75 6 0.75
LOAD COMB 106 [0.9DL+WL(+X)]
  1 0.9 3 1.0
LOAD COMB 107 [0.9DL+WL(-X)]
  1 0.9 4 1.0
LOAD COMB 108 [0.9DL+WL(+Z)]
  1 0.9 5 1.0
LOAD COMB 109 [0.9DL+WL(-Z)]
  1 0.9 6 1.0

Mathematical model Input requirements

The mathematical model prepared should have
Nodal Data
Member connectivity Data
Member sectional Data base of all the different types of sections (Standard rolled as well as built-up sections)
Member material specifications
Member end release data
Member truss information
Support specification in appropriate coordinate system (should consider inclined galleries and its inclined supports)
Loading data as specified above
Design Parameters for design of members as per IS800 like
Effective length of each member in both directions for design
Code parameters like KY, KZ, LY, LZ
Design deflection limits
Design allowable yield stress
Net effective allowable interaction factors for wind/seismic as well as Dead load cases
Analysis and design commands

Automated iterative procedure for carrying out Optimization The Optimization run to be carried out inside the softwares ( PROKON and STAAD Pro) The programs should choose automatically the required section from the software database of similar sections and perform the optimization interactively to get best possible weight reduction to satisfy the relevant codes of practice under considerations. ( the Optimized section sizes may be different for IS 800 working stress code and to that of IS 800 Limit state design for a given problem). The main requirement of developed tool is that the complete optimization runs to be carried inside the PROKON and STAAD Pro without any user intervention.

**The output should include**
Design results with interaction factors or reserve strength available for each member
The optimized section sizes and
Steel requirement tables section wise and plate thickness wise if applicable.

*PROKON is registered software of M/s Prokon Software Consultants (Pty) Ltd, South Africa
*FEMAP is registered pre/post processor software of M/s Siemens
*STAAD Pro is registered software of M/s Bentley Ltd

**Design of various other members:**
Design of various other members which are not the part of analytical model need to designed separately.
Such members are: Side runners, Conveyor supporting members, Side walkway supporting member, purlins and other members
Analysis and Design Checks and Optimization

1) Calculate the seismic coefficients and loading as per IS1893 and impose the loadings in both horizontal directions as separate load cases in the preprocessor if seismic analysis is required.

2) Generate different load combinations as per IS800

3) Calculate effective lengths of each of column members in both X and Z directions (Y is vertical direction)

4) Execute the job for all the load cases

5) Code check the results as per IS800 working stress and limit state design

6) Optimize or resize /modify the properties as per code check results and rerun and recheck and repeat if necessary

7) Calculate approx. weight of structure based on analysis with details such as
   - weight of members property wise

8) Calculate Raw material weight if different from above

9) Design Base plate and number and size of fixing bolts

10) Compute final weight and also report consolidated weights as per thicknesses and sizes

11) Export various figures to Auto cad or DXF files

12) Preparation of complete report automatically

13) The developed tool along with source code to be submitted

14) Installation and User manual to be prepared and submitted
Software tool Requirement for Galleries

The following tools to be developed based on the above logic and instructions for calculation of loads for preparation of mathematical model and for analysis and design with final optimized structure.( GUI based Design) in a single stoke of inputs.

Automated Development tool (for seamless execution at the push of a button) to be developed for

1) Single Conveyor Gallery Structure of length 12m using PROKON
2) Single Conveyor Gallery Structure of length 12m using STAAD Pro
3) Single Conveyor Gallery Structure of length 18m using PROKON
4) Single Conveyor Gallery Structure of length 18m using STAAD Pro
5) Single Conveyor Gallery Structure of length 24m using PROKON
6) Single Conveyor Gallery Structure of length 24m using STAAD Pro
7) Single Conveyor Gallery Structure of length 30m using PROKON
8) Single Conveyor Gallery Structure of length 30m using STAAD Pro
9) Double Conveyor Gallery Structure of length 12m using PROKON
10) Double Conveyor Gallery Structure of length 12m using STAAD Pro
11) Double Conveyor Gallery Structure of length 18m using PROKON
12) Double Conveyor Gallery Structure of length 18m using STAAD Pro
13) Double Conveyor Gallery Structure of length 24m using PROKON
14) Double Conveyor Gallery Structure of length 24m using STAAD Pro
15) Double Conveyor Gallery Structure of length 30m using PROKON
16) Double Conveyor Gallery Structure of length 30m using STAAD Pro

All the above tools should be prepared with the parameters (like different inclinations, different loads on belt, different wind loads etc) as mentioned in this specification.

The analytical model data is to be prepared initially (in FEMAP API language) should be checked and approved by the indenting department before proceeding with the process of analyzing and interfacing with the analytical softwares for design and optimization with automation.
Part 2 Specification for Trestles

Similarly the trestles on which the above galleries rest, have to be designed with appropriate system configurations.

The Galleries are supported mainly on TWO types of Trestles

a) Double legged Trestle and

b) Four legged Trestle

Typical arrangement of these trestles is as shown below:

The spacing will depend on the configuration of layout, gallery lengths etc.

The trestles width will be different for Single conveyor gallery and that for Double conveyor gallery.

Typical two legged trestles and their arrangement is shown below:
As seen from the above the height of Trestle and its configuration varies depending on the location and heights.

Typical 4 legged Trestles are as shown below:
The design of trestle is based on the following parameters:

**For TWO LEGGED TRESTLE**

Height of the trestle = \( \text{in m} \)
Width of base Of trestle in m -(Different for Single and Double Conveyor system)

Load coming from Side LHS and RHS long Galleries

Dead Load =

Live Load =

For LHS Gallery design wind pressure considered, for a given height (to be taken from Gallery Calculations)

and here wind pressure to be considered, along the height of trestle (different values for different heights)

Similarly For RHS Gallery design wind pressure considered, for a given height (to be taken from Gallery Calculations)

and here wind pressure to be considered, along the height of trestle (different values for different heights)

Hence, total Wind Load to be computed

Horizontal (max)

Horizontal (min)

Vertical (max)

Vertical (min)

Therefore, UDL, wind load to be considered as (For up to 10.0 m height)

(For 10.0 m to 15.0 m height)

(For 15.0 m to 20.0 m height)

(For 20.0 m to 30.0 m height)

(For 30.0 m to 40.0 m height)

(For 40.0 m to 50.0 m height)

And Calculate wind Pressure, Pz (For up to 10.0 m height) for Class ? Structure and Terrian Category ? as per Indian Design codes

Pz (For 10.0 m to 15.0 m height) for Class ? Structure and Terrian Category ?

Pz (For 15.0 m to 20.0 m height) for Class ? Structure and Terrian Category ?

Pz (For 20.0 m to 30.0 m height) for Class ? Structure and Terrian Category ?
Pz (For 30.0 m to 40.0 m height) for Class B Structure and Terrian Category 2

Pz (For 40.0 m to 50.0 m height) for Class B Structure and Terrian Category 2

max. Min. loads to be computed

Then check for horizontal deflection of Trestle from the output to be \( < \frac{L}{1000} \)

Calculate the base plate and shear key details as per codes

**DESIGN OF TRESTLES Base plate**

Vertical DL Unit in tones and LL along with WL (for \( \pm \) Z) to be considered

Maximum bearing pressure on concrete, to be computed as per code

and should be less than allowable bearing capacity.

The foundation bolts are to be designed as per the requirement.

Considering x nos bolt tension per bolt is computed

**Design of Bolt:**

Here maximum tension per bolt

**Design of Shear Key:** Here, maximum shear per leg is considered

Considering xxx mm wide X xxx mm deep shear key with xx mm thk. and check grouting BM at the bottom face of base plate and design the key

Similarly 4 legged Trestle has to be designed .

**FOUR LEGGED TRESTLE** considered parameters are:

Height of the trestle

Width of base along Z-direction

Width of base along X-

For Load calculation from LHS and RHS gallery to be taken
i) Dead Load and Live Load

Load on each leg coming from each RHS m long Gallery
Dead Load

Live Load

Load on each leg coming from each LHS m long Gallery
Dead

Live Load on each leg coming from long gallery

Hence, total Wind Load to be computed

Horizontal (max)

Horizontal (min)

Vertical (max)

Vertical (min)

Therefore, UDL, wind load to be considered as (For up to 10.0 m height)

(For 10.0 m to 15.0 m height)

(For 15.0 m to 20.0 m height)

(For 20.0 m to 30.0 m height)

(For 30.0 m to 40.0 m height)

(For 40.0 m to 50.0 m height)

And Calculate wind Pressure, \( P_z \) (For up to 10.0 m height) for Class ? Structure and Terrian Category ? as per Indian Design codes

\( P_z \) (For 10.0 m to 15.0 m height) for Class ? Structure and Terrian Category ?

\( P_z \) (For 15.0 m to 20.0 m height) for Class ? Structure and Terrian Category ?

\( P_z \) (For 20.0 m to 30.0 m height) for Class ? Structure and Terrian Category ?

\( P_z \) (For 30.0 m to 40.0 m height) for Class B Structure and Terrian Category 2

\( P_z \) (For 40.0 m to 50.0 m height) for Class B Structure and Terrian Category 2

max. Min. loads to be computed

Then check for horizontal deflection of Trestle from the output to be \( < L/1000 \)
Calculate the base plate and shear key details as per codes

DESIGN OF TRESTLES Base plate

Vertical DLUnit in tones and LL along with WL (for Z) to be considered

Maximum bearing pressure on concrete, to be computed as per code and should be less than allowable bearing capacity.

The foundation bolts are to be designed as per the requirement.

Considering x nos bolt tension per bolt is computed

Design of Bolt:

Here maximum tension per bolt

Design of Shear Key: Here, maximum shear per leg is considered

Considering xxx mm wide X xxx mm deep shear key with xx mm thk. and check grouting BM at the bottom face of base plate and design the shear key accordingly.

Software tool Requirement for Trestles

The following tools to be developed based on the above logic and instructions for calculation of loads for preparation of mathematical model and for analysis and design with final optimized structure. (GUI based Design) As in earlier case the initial mathematical model to be developed and interfaced in FEMAP API.

Automated Development tool (for seamless execution at the push of a button) for

1) 2 legged Trestle Structure of Heights up to 25m for Single Conveyor using PROKON

2) 2 legged Trestle Structure of Heights up to 25m for Single Conveyor using STAAD Pro

3) 2 legged Trestle Structure of Heights above 25m for Single Conveyor using PROKON
The analytical model data is to be prepared initially (in FEMAP API language) should be checked and approved by the indenting department before proceeding with the process of analyzing and interfacing with the analytical softwares for design and optimization with automation.
Part 3  Specification for Transfer Towers

Similarly the transfer towers on which the above galleries rest, have to be designed with appropriate system configurations.

The Transfer towers are supported mainly on TWO types of transfer points

a) Type 1 Bunker Transfer Point Structure for 500MW Boilers and

b) Type 2 Bunker Transfer Point Structure for 600MW Boilers

These will for Double conveyor system for the present

Typical arrangement of these trestles is as shown below:

Typical Arrangement of a Transfer Tower
The design of Transfer Towers is based on the following parameters:

- Height of the Tower = in m
- Width of base Of TP in m - (for Double Conveyor system)
- Load coming from Side LHS and RHS long Galleries
Dead Load

Live Load

For Gallery design wind pressure considered, for a given height (to be taken from Gallery Calculations)

and here wind pressure to be considered, along the height of trestle (different values for different heights)

Hence, total Wind Load to be computed along the height of Tower

Horizontal (max)
Horizontal (min)
Vertical (max)
Vertical (min)

And Calculate wind Pressure, $P_z$ for Class x Structure and Terrian Category x

And max. Min. loads to be computed

Then check for horizontal deflection of TP from the output to be $< L/1000$

Calculate the base plate and shear key details as per codes

DESIGN OF TRESTLES Base plate

Vertical DLUnit in tones and LL along with WL (for $\pm Z$) to be considered

Maximum bearing pressure on concrete, to be computed as per code

and should be less than allowable bearing capacity.

The foundation bolts are to be designed as per the requirement.

Considering X nos bolt tension per bolt is computed

Design of Bolt: Here maximum tension per bolt to be considered

Design of Shear Key: Here, maximum shear per leg is considered

Considering xxx mm wide X xxx mm deep shear key with xxx mm thk. and check

grouting BM at the bottom face of base plate and design the shear key.
Software tool Requirement for Transfer Towers

The following tools to be developed based on the above logic and instructions for calculation of loads for preparation of mathematical model and for analysis and design with final optimized structure. (GUI based Design) considering interference free column joints (1000mm away from floors), chute loads, machinery loads. As in earlier case the initial mathematical model to be developed and interfaced in FEMAP API.

Also design has to be qualified and checked for natural frequency of the system

Automated Development tool (for seamless execution at the push of a button) for

1) Type 1 Bunker TP Structure for 500MW Boiler Double Conveyer using PROKON
2) Type 1 Bunker TP Structure for 500MW Boiler Double Conveyer using STAAD Pro
3) Type 2 Bunker TP Structure for 600MW Boiler Double Conveyer using PROKON
4) Type 2 Bunker TP Structure for 600MW Boiler Double Conveyer using STAAD Pro

The analytical model data is to be prepared initially (in FEMAP API language) should be checked and approved by the indenting department before proceeding with the process of analyzing and interfacing with the analytical softwares for design and optimization with automation.

Combined Programs:

Finally 2 software tools are to be developed on each for PROKON and STAAD Pro combining the required number of galleries and trestles as a single file for execution considering the loads from galleries, wind loads and seismic loads etc.

Tool 1 – Combine 4 to 6 galleries with trestles and transfer towers. if required as per the plant layout requirement using PROKON Software

Tool 2 – Combine 4 to 6 galleries with trestles and transfer towers. if required as per the plant layout requirement using STAAD Pro Software
General:

All the above tools should be prepared with the parameters (like different heights, different loads due to wind, different gallery loads etc) as mentioned in this specification.

There will a total of 38 different tools (16 for Galleries, 16 for Trestles and 4 for Transfer Towers) Plus 2 programs for combined entries of galleries and trestles for PROKON and STAAD Pro.

The analytical model data is to be prepared initially (in FEMAP API) and should be checked and approved by the indenting department before proceeding with the process of analyzing and interfacing with the analytical softwares for design and optimization with automation.

Finally a common GUI is to be prepared to choose appropriate type of structure either for a gallery or for trestle, then choose for single or double conveyor system before proceeding further for choosing length of gallery or height of trestle as the case may be. The project data like loads, inclinations etc should then be chosen in a stepped manner for creating the mathematical model. The analysis has to be carried out, design and optimization be done seamlessly and automatically without user intervention by interfacing the code developed with the analysis programs as given above.

The output will be optimum design of the structure with relevant sectional data and required drawings in AutoCAD DXF file formats and with automatic generation of required report.
Delivery Scheme:

The delivery of the developed tools must be made in a proper stepped delivery (delivery in parts) for immediate implementation of the programs at BHEL for their use.

Stage 1:

a) Preliminary GUI for input data:

The typical GUI screens consist of different parameter to be input for proper mathematical modeling and analysis requirements.

Typical Forms required (not limited to those shown as an example here) are as shown below:

![Design Tool for Coal Handling System](image)

The above form should have links to show basic wind speed map and values of various Indian Cities as per IS 875 code and also show the seismic zones Indian map and zone factors for various cities in India as per IS1893 code of India.

The First form should also include option for designing Trestles or Galleries or Transfer towers (Only first two are shown above as an example).

Next form will depend on the chosen structure, it can be for galleries or for Trestles or Transfer towers.

A typical input data forms are shown below for Galleries (please note that the variables shown in the figures are tentative and will depend on the actual problem, they me more variables or less than shown below).
The above format shows only for 12m 18m and 24m galleries, the option to design 30m gallery as per earlier specification also has to be included and also model generation in FEMAP also to be included. There may be other parameters need to be included during the course of interaction.

The above shows a typical input sheet and there may be other parameters need to be included as per requirement of load calculations and model preparation. Similarly different forms for Trestles and Transfer Towers need to be prepared taking into considerations all the possible input data as required for correct mathematical modeling and preparation of design data input files.

There will certain number of inputs as default values and the user should be able to modify these values with proper check button controls. Controls are also required to move back and forth the forms.
Stage 1 b)

The mathematical model should consist of (but not limited to the following):

- i) nodal Coordinates
- ii) member connectivity,
- iii) preparation of data base of all the sections as per Indian Codes,
- iv) identification of truss elements and member end release codes,
- v) support and material specifications,
- vi) material specifications
- vii) identification of members with proper section with sectional data base tables.

Stage 2

2i) calculation of effective lengths of various members as per their end connections,
2ii) Dead Load calculations
2iii) Live load calculations,
2iv) Wind load calculations as per IS875 code
2v) Seismic load generation, if required as per IS1893
2vi) All other loads and relevant load combinations as per codal requirements (IS800)
2vii) Generation of various parameters required for IS 800 code check
2viii) Imposition of loads in the model and creation of different loads and their combinations as required by Indian Design codes of practice.

Stage 2

2ix) Automatic creation of input files as required for different soft-wares mentioned above
2x) Automatic execution of analytical model and tabulating the required forces and moments required for code checking as per IS800
2xi) Finding out the reserve strength and carryout the optimization automatically within the GUI prepared without any user intervention with the available database of sectional sizes as specified by BHEL
2xii) Preparation of final Optimized input files and running automatically and tabulating the results of code checks
2xiii) Calculation of bill of material and raw material requirements
2xiv) Preparation of design report automatically with all the tables of input as well as output results and code check results with BOM
2xv) Preparation of dxf files of model for use in AutoCAD
**Delivery schedule**

**Delivery Part 1)** First Phase to be completed within 12 weeks after placement of Purchase order consists of
- Of stage 1 criteria above part a and in part (b) upto (vi) the details of mathematical model and tool for generating the model in FEMAP for the following
  - a) 4 types of Single conveyor galleries for 12m,18m, 24m and 30m length galleries (4 GUI programs for in FEMAP)
  - b) 4 types of Double conveyor galleries for 12m,18m, 24m and 30m length galleries (4 GUI programs for in FEMAP)

**Delivery Part 2)** Similar tools for
- 2 types of 2 legged trestles for Single Conveyor system (2 GUI Programs)
- 2 types of 2 legged trestles for Double Conveyor system (2 GUI Programs)
- 2 types of 4 legged trestles for Single Conveyor system (2 GUI Programs)
- 2 types of 4 legged trestles for Double Conveyor system (2 GUI Programs)

**Delivery Part1 and Part2 as above to be submitted in FEMAP API format tool within 16 weeks after above period**

**Delivery Part 3)** Preparation of other data such as effective length calculations, load calculations as per **Stage 2i to Stage 2Viii** and preparation of input files in PROKON and integrating with PROKON software within 12 weeks after delivery of above with validation (from BHEL) for Galleries, within 8 weeks for Trestles and within 16 weeks for Transfer towers including the required GUI Programs

**Delivery Part 4)** Preparation of input file and integrating with other standard softwares like STAAD Pro, Design checks with PROKON and STAAD Pro, Automatic runs for generation of Optimized structures (2xi to 2xii), Validation of all files of galleries, trestles and Transfer towers etc to be delivered within 12 weeks after part 3 above

**Delivery Part 5)** Delivery of final part Consisting of one Final GUI (One each for PROKON and STAAD Pro) incorporating all the above required modules and submission of User manuals, details of software codes, list of files generated as required in the specifications etc to be submitted within 12 weeks after Part 4 delivery. This should include the Final GUI for combined Structural System of Galleries, trestles and Transfer Towers as per layout for PROKON and STAAD Pro

The above delivery periods are to be adhered strictly in order to complete the Project in time.

**Note:**
The developer has to enter into NDA with BHEL before taking up this work and the Information contained in Tender Documents is confidential and should not be used for any other purpose other than for quoting/executing for this envisaged work.

-------------------------------------------- End of Tender Specification --------------------------------------------