Tender Technical Specification

Technical Specification for Development of Parametric Programs for Customization and Optimization of Double Conveyor Galleries of varying span used in Coal Handling Plants (CHP) in-house at Corp R&D Hyderabad.

Tender Requirements

Development of Design Automation Tools for Customization of Analysis and Optimization of Double Conveyor Gallery in Coal Handling Plant (CHP) considering various loads and their combinations as per Indian Standard Codes using FEMAP for parametric modeling and interfacing such tool with the available software such as STAAD Pro, with auto execution for modeling, analysis including design optimization with technical reports and BOM as per Technical Specification provided by BHEL.

The complete work will be carried out in Corp. R&D Division, BHEL Hyderabad and the required infrastructure like Workstations and Software will be provided by the company. The work will be for duration of 8 months.

The work needs to be carried out by suitable manpower, who will be guided by internal experts. The manpower provided should work as per BHEL timings and working days (i.e., 8.00 am to 4.30 pm, 6 days per week). Manpower requirements with the desired skill sets are listed below.

(1) Structural Engineer

Scope of the work

- Structure considered here is double conveyor gallery of varying span.
- Preparation of 3D models in STAAD
- Calculation and imposition of loads as per IS codes.
- Interpretation of results according to Indian standard codes and correcting errors.
• Design and prepare detail analysis report from STAAD Pro as per the requirement.

Qualifications/Requirements

- Degree in Civil/Mechanical Engg., preferably post graduate in structural Engg.
- Above Five years of experience in Structural Analysis and Design.
- Knowledge in codes like IS800, IS875 and IS1893
- Experience in coal handling plant structures (preferred)
- Expertise in tools like STAAD. Pro (must) and FEMAP (preferred)

(2) Software Engineers

Scope of the Work

• Preparation of GUI
• Decode the existing program written in FORTRAN.
• Generation of parametric model using FEMAP API program (Visual Basic)
• Interfacing the above program with STAAD Pro.
• Development of code to get the output with optimum member sizes and corresponding weight of the structure.

Qualifications/Requirements

- Bachelor Degree in Engg. preferably in Computer Science/Masters (preferred) in relavant field..
- Above 3 years of experience in programming.
- Expertise in FORTRAN, Visual Basic, Visual C++.
- Experience in parametric programming.
The total system of automated program is basically divided into following sections

- Development of parametric mathematical model of double conveyor gallery.
- Generation of 3D Mathematical model.
- Imposition of loads calculated as per relevant codes and constraints for various conditions
- Development of interfaces with existing software for the above program
- After execution of program in analysis package, retrieval of properties, analysis data, forces and moments
- 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
- Prepare model with revised properties for optimization
- Rechecking results for system safety and further optimization and calculation of sectional properties
- Preparation of general bill of material and calculation of weights
- Preparation of .dxr file from analysis model suitable for plotting in AutoCAD.

The customized Design and Analysis Tool for the Double Conveyor Gallery is to be developed as per the technical specification given below. The brief technical scope is as under.

1. Basic initial geometry is to be arrived based on physical requirements of space, size and capacity.
2. Development of parametric programs to convert the physical configuration into finite element models using FEMAP with parameters and constraints.
3. 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.
4. Interpretation of results according to Indian standard codes
5. Iterative analyses to get acceptable design (Stress and deflections) from consideration of weight.
6. Converts the final configuration into drawings, BOM, and auto generation of design report.
7. The scope mentioned above is detailed with some more intermediate steps as mentioned below.

**General guidelines for customization of Parametric program**

1. The complete work will be carried out in BHEL Corp. R&D. The necessary infrastructure (for the development work) will be provided by BHEL. This will be for duration of 8 months and the developer has to stay at his own expenses and BHEL will not pay any expenses towards travel, boarding and lodging or any other charges.

2. 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.

3. The software logic prepared will be the property of BHEL and will be protected through copyright / patent by BHEL.

4. The concerned engineers should maintain strict confidentiality of the joint work being carried out and should sign the confidentiality agreement before starting the work.

5. 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 STAAD Pro software, which is available at BHEL. However the engineers are free to develop the programs on any other platform suitable to them, but final interfacing must be done with the above available software at BHEL (FEMAP, and STAAD Pro).
6. The design must comply with Indian Standard codes like IS 800 working stress design codes should be incorporated in the analytical engine for automatic design checks.

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

8. Each phase of program will be tested by Corp. R&D team along with the concerned engineers before proceeding to the next phase.

9. 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.

10. 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.

11. Technical evaluation will be based on the code developed for the example problem (provided with this document) or any other structural problem inline with tech-specs wherein the program interfaces both FEMAP and STAAD Pro.

12. Offer received, lacking any of the requirements mentioned in the example problem (or any other problem submitted nonconforming to the above requirements) will not be considered for technical evaluation.

**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 100metres high. Typical Layout of a plant is as shown below:
**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:
Typical Coal Handling Plant (CHP) System

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 depends on site condition such as layout of roads, piping and location of other equipment.

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

It is proposed to standardize varying lengths of galleries of span 6m to 30m for the purpose of optimization and development of tool.

Some typical Double Conveyor galleries are shown below:

![Diagram of conveyor galleries](image)

**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 “X or 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 walk way and conveyor supporting structures.

**Development Tool Requirement:**

The design Optimization GUI based development tool has to be prepared for double conveyor gallery. 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 double conveyor galleries.

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

The Details Are

**Double Conveyor Systems**

The program has to be developed for the double conveyor Gallery of varying span 6m to 30m.

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:

1. **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 Tones/Hr (Add 20%ExtraLoad)

2. **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)**

3. **The end of Portal to be suitably designed for the above inclination**

4. **Belt speed - Program should input variable belt speed for each gallery.**

5. **Walk way - following to be considered**
a. Single side walk way

b. 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)

6. Inclusion of seal plate -- length and weight of coal to be considered.

7. Deck Plate to be considered and dust load to be considered.

Mathematical model should be prepared for the following configurations.

- Double conveyor Gallery of span 6m to 30m made up of flat members.
- Double conveyor Gallery of span 6m to 30m made with combination of flat and tubular sections.

Options for selecting different bracing patterns should be provided for both structures.

Option for selecting initial section properties should be provided.

**Other parameters as required by the site conditions and customer requirement**

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

Site Location.

wind speeds as per IS875.

Seismic loads as per IS1893.

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
Working stress 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
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