| INTER PLANT STANDARD IN STEEL INDUSTRY | | |
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| IPSS | **DESIGN AND FABRICATION PARAMETERS FOR TECHNOLOGICAL STRUCTURES FOR BELT CONVEYORS** | **IPSS:2-03-008-20 *(*Second *Revision)*** |
| | Corresponding IS does not exist | Formerly: IPSS: 2-03-008-97 (First Revision) |

## 0. FOREWORD

0.1 This Interplant Standard has been prepared by the Standards Committee on Conveyors, IPSS 2:3, with the active participation of the representatives of the steel plants, reputed consultants and established manufacturers of conveyors and conveyor equipment and subsequently revised with second revision in **September, 2020**.

0.2 This Inter Plant Standard was originally published in 1995 and thereafter it was revised with first revision in the year 1997. In the light of the experience gained in the usage of this standard since then and after extensive discussions with the executives in the steel plants and captive mines, consultancy organizations and the experts from the conveyor system fabricating organizations, this second revision has been finalized.

0.3 This standard has been formulated based on the IS: 11592-2000 “Code of practice for selection and design of belt conveyors”.

0.4 This standard is essentially futuristic, in nature and as such the developments in technology have been incorporated in it to the extent possible. Hence for new steel plants and in the expansion programs of the existing steel plants, deviation from the stipulations of this standard is not desirable. However, if the present situation in any existing steel plants so demands, the designer may deviate from the stipulations of this standard with respect to the dimensions, construction, etc.

## 1. SCOPE

1.1 This Inter Plant Standard covers the overall design and fabrication parameters for the technological structures for the belt conveyors system in a steel plant.

## 2. DESIGN POLICY

2.1 The overall design of belt conveyor system shall be in accordance with IS 11592:2000. Due consideration shall be given to the local site conditions so that the most economical, effective methods and materials are used. The local site conditions would include data on climates (including monsoon, temperature and its maximum variation per day etc.,), wind velocity and its direction, the seismic data of the place and other loads (including dead load of the structure and machinery, live loads, wind loads, seismic loads, thermal effects, earth and water pressures, erection load, bearing capacity of soil, etc.,).

2.2 Each structure (and structural member) shall be designed within permissible limits according to the general norms of design as per IS 800:2007 'Code of practice for general construction in steel' (Amendments 2).

2.3 Each building and structure shall be designed functionally so as to provide enough space for operation, maintenance, or removal of the machinery and give plant workers good and safe environment. Full access to the machinery shall be secure by means of manholes, erection hatches, gangway, platforms, stairs, etc. Access shall normally be through stair cases. Easy escape routes from area of predominant fire and explosion hazards snail be provided.

2.4 Natural ventilation details shall be such that these prevent the rain water from entering into the building.

2.5 Adequate natural and artificial lighting shall be provided to accordance with IPSS: 2-03-005-20 to permit the safe operation of plant without endangering personnel.

## 3. LOADS

3.1 The loads shall be taken as stated in clause 3 of IPSS: 2-03-001-20.

## 4. THERMAL STRESS CONSIDERATIONS

4.1 Steel structures shall be carefully designed in such a manner that the vertical braces and finishing materials shall be arranged so that they shall not be affected by expansion and contraction due to the change in temperature. Alternatively, provision by suitable detailing shall be made for such expansion contraction.

In this connection IS 800:2007 and IS 875 (Part 5):1987 'Code of practice for design loads (other than earthquake) for buildings and structures, Part 5 Special loads and load combinations (second revision) may be referred.

4.2 Structural members that are likely to be subjected to heat, such as those located near clinker coolers, etc., shall he protected with necessary insulation covering or heat resisting board.

## 5. VIBRATION EFFECTS AND RESONANT CONDITIONS

5.1 Frames and structures supporting items of machinery or equipment having revolving parts or causing vibration shall, whether they are independent or parts of building, be designed such that they not only safely carry the loads for such items, but in no case shall be in resonance with them (see clause 3.1 above).

5.2 In case of transfer towers only those beams which are directly supporting the rotating/ reciprocating equipment like motor, screen, crushers shall be checked for the vibration.

## 6. ALLOWABLE DEFLECTIONS

6.1 As in clause 7.14.5 of IS: 11592 – 2000, reproduces below:

Deflection for various structural members supporting conveyor structure shall not exceed the following:

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| 1. | Conveyor Gantry / bridge | Span/ 325 |
| 2. | Trestle supporting gantry in the transverse direction | Height/ 1000 |
| 3. | Stringer a supporting conveyor structural member directly supporting the tripper | Span / 900 |
| 4. | Member supporting the walkway and conveyor post | Span / 325 |

## 7. SAFE BEARING CAPACITY OF SOIL

7.1 This may be referred from the basic soil data furnished by the client or by carrying out test at site in accordance with the relevant Indian standard in case of huge civil work and poor soil strata.

## 8. SAFETY FACTOR AGAINST OVERTURNING

8.1 Restoring moment against overturning shall not be less than the sum of 1.2 times the maximum overturning moment due to dead load and 1.4 times the maximum overturning moment due to imposed loads and wind or earthquake loads. In cases where dead load provides the restoring moment, only 0.9 times the dead load shall be considered. Restoring moment due to imposed loads shall be ignored.

## 9. GENERAL DESIGN REQUIREMENTS

9.1 Super Structures - All super structures unless specified otherwise shall be of steel frames with corrugated galvanized iron/ ACC sheet roofing, cladding and louvers (ACC/G.E.C) at the sides.

9.2 **Floors** - Continuous flooring shall be provided along the entire length and width of the gallery and there shall be no uncovered opening on the gallery floor except to allow vertical take up. Gallery walkways shall be covered with chequered plates or cast in situ or precast RCC slabs with anti-skid finish and the flooring below the conveyor shall be of steel sheets (3 mm thick minimum). Wooden flooring shall not be used for covering the floor. Where the floor is sloped or where ventilation is required through the floor, steel gratings shall be provided. The maximum width of openings in gratings shall not exceed 40 mm. The minimum thickness of periphery bars shall be 5 mm, internal main flats of 25x3 mm minimum and lacing bar shall be minimum 12x3 mm. The shape of the grating may be either honeycomb type or rectangular pattern or any other equivalent shape which may withstand the loads. The usual span of gratings shall not generally exceed 1.5 m.

Also see clauses 2.2.4 and 2.2.5 of IPSS: 2-03-001-20.

9.3 **Exterior Walls/ Roofs** - Roofing and side sheeting shall be of galvanized corrugated steel for protection against rain. For better natural illumination, every sixth sheet on side shall be of perspex or fibre reinforced plastic and shall be staggered on the opposite side wall. Gaps of 300 mm and 150 mm shall be provided at the top of the side sheeting below the roof sheeting and at the bottom of the side sheeting above the gallery floor, respectively, to allow natural ventilation and lighting. The roof sheeting shall be suitably extended to prevent entry of rain water through the top opening.

9.3.1 The area provided for natural lighting shall be about 10 percent of total floor area at each floor including ground floor for the structures enclosed from side. However, the area provided for doors used generally for exit and entry of man and material from the house shall not be included in the lighting area calculations.

Also see clauses 2.2.4 and 2.2.5 of IPSS: 2-03-001-20.

## 10. DOORS AND WINDOWS

10.1 All enclosed areas shall be provided with adequate doors giving access to stairways and platforms, and shall also be provided with windows appropriate for day lighting. The dimensions of doors shall be decided considering the passage of the largest indivisible component of the plant. All exterior doors or entrances shall be of steel, interior doors, windows and ventilators shall conform to relevant Indian Standard.

Also see clause 2.2.8 of IPSS: 2-03-001-20.

10.2 Windows and ventilators shall be glazed with 4 mm thick plain sheet glass. Windows for plant buildings shall be glazed with 6 mm thick wired glass, Georgian type. Fixing of glazing shall be in accordance with the relevant Indian Standard.

## 11. FACILITIES AND ACCESS FOR OPERATION, MAINTENANCE AND REPAIR

11.1 Each building and structure shall be designed functionally so as to provide enough space for operation, maintenance or removal of the machinery and give plant workers-good and safe environment. Full access to the machinery shall be secured by means of manholes, erection hatches, gangway, platforms, stairs, etc. Access ladders are to be avoided as far as possible.

Also see IPSS: 2-03-009-20.

## 12. STAIRS

12.1 Stairs shall be provided with a landing at intervals of not more than 4 m measured vertically. Landings shall be 0.9 m or more in length measured towards direction of travelling. Stairs shall generally be 800 to 1200 mm wide with 250 mm tread and 200 mm rise maximum. Staircases shall be made of structural steel preferably. Tubular members shall be used for hand rails. Head room clearance shall be 2.1 m or more measured vertically from any nosing to the nearest soffit, piping, equipment, lighting fixture, etc.

12.2 Maintenance stairs shall be 800 mm wide with maximum 45˚ inclination. The tread shall be 250 mm. Alternatively, ladder may also be used in the event of space problem.

## 13. WALKWAYS

13.1 For walkway in gallery, refer to IPSS: 2-03-001-20 “Design parameters for galleries and tunnels for belt conveyors in steel plants”.

## 14. HAND RAILS

14.1 Tubular members unless otherwise specified by the purchaser, shall be used as hand rails around all opening (such as stair, chute or empty space in floor). This shall also be provided around the periphery if the flooring material (Chequered plated/grating/RCC slab) is not extended up to the side wall cladding leaving gap of about 75 mm. The tow shall be provided only where the protrusion of angle supporting flooring is omitted, however, this shall not be applicable to staircase. Hands rails shall be provided at the following locations:

i) Around all open platforms, stairways, landings and link walkways.

ii) Around the edges of all floors where buildings are not enclosed and the fall height from the floor is more than one metre.

iii) Around the perimeter of all open machinery pits and sumps more than 1.0 in deep or the edge of the surrounding platforms as the case may be.

iv) Around all accessible flat roofs.

v) Detachable

vi) Alongside the walkways or conveyor bridges which are not enclosed; and

vii) Around erection openings, etc.

Also see clause 7.14.1 (e) of IS: 11592 - 2000.

## 15. LIFTING BEAMS AND SUSPENSION HOOKS

15.1 Lifting beams shall be provided for service facilities of equipment where required.

## 16. HOPPERS

16.1 Hoppers shall be made of steel unless otherwise specified. Steel hoppers shall have the required structural thickness plus 4.5 mm as abrasive wear and corrosion allowance. In case liners are provided, the additional allowance of 4.5 mm shall not be necessary. Minimum steel plate thickness shall be 8.0 mm. Any surfaces on which raw materials are sliding down shall be made free from projections or depression to avoid any obstruction to the free flow of the material. Hopper slopes, valley angles and shape shall be such that the contents can flow smoothly without choking. RCC hoppers may be used where they are advantageous from the technology considerations.

## 17. EMBEDDED PARTS IN SUB-STRUCTURE TUNNEL AND PIT

17.1 In sub-structure tunnels and pits, all equipment except for heavy ones shall be secured by anchor plates/ anchor fasteners. No embedded anchor bolts or anchor boxes shall be used in order to secure the water tightness or sub-structures, tunnels and pits.

## 18. CONNECTIONS OF STRUCTURAL MEMBERS

18.1 All site connections shall be by welding, riveting or high strength friction grip bolts conforming to IS 3757:1985 ‘High tensile friction grip bolts (first revision)’and installed according to IS 4000:1992 'Code of practice for assembly of structural joints using high tensile friction grip fasteners'. However, connections for stairs, side girts, purlins, etc., may be by black bolts.

## 19. BRACING SYSTEM

19.1 Steel structures shall be provided with bracings to transfer horizontal force in an effective manner. Where stiffness or strength at floor level is found insufficient in steel structures, this shall be compensated by horizontal bracings located in roofs or floors. Bracing shall be well arranged in such a manner as will not cause torsion and concentrated force within a horizontal plane, taking into account the distribution of the stiffness and the building weight. The loads to be shared by braces shall be of reasonable value with consideration given to their stiffness and deformation and strength in the routes through which the forces are transferred.

## 20. STRUCTURES FOR SUPPORTING MACHINERY, CABLES PIPES, DUCTS ETC

20.1 Throughout the plant all necessary steel structures or reinforced concrete structures for supporting machinery, hoppers, chutes, ducts, pipes, cables and the like shall be provided, within the scope of work.

## 21. CONVEYOR BRIDGES

21.1 Conveyor bridges shall be of open or closed type depending upon technological requirements. It shall have 800 mm wide walkways on one side and 500 mm wide walkway plus 300 mm wide cable rack, if any, on the other side of the conveyor belt. Both sides shall be provided with walkways. Due to heavy rainfall all belt conveyors outdoors shall be covered with 0.6 mm galvanized iron sheets, suitably curved to allow rain water to fall on the sides. For open type bridges, walkway floors shall be covered with chequered steel plate flooring of thickness not less than 6 mm or by gratings as specified in 9.2. Hood coverings of conveyors shall be in segments for easy approach and maintenance.

21.2 When a conveyor bridge is provided over a road or walkway, it shall have a floor made of chequered plates or steel plates so as to prevent something from dropping through. When the bridge is sloped, anti-skid protection on the walkway shall have to be taken. When conveyor bridges pass over plant roads clearance between the road surface and the lowest points of the bridges shall not be less than 3.5 m or the height needed for passage of the largest individual component of the plant equipment whichever is larger. Measures for preventing any object on the bridge to fall down shall also be taken into consideration in such case. Necessary toe plate shall be provided on walkways, if required (refer 14).

21.3 In general, the main components of the conveyor bridge structures shall be parallel chord bridge trusses which shall transmit technological and structural loads to trestles, stringer beams carrying all structural floor loads as well as technological loads from conveyor, raker posts to support top chord of the

bridge truss, floor bracings and end posts between bridge trusses to transmit the wind loads on the bridge to supporting trestles and the trestles themselves. End portals shall be used as alternate to raker system.

21.4 The supporting trestles of the gallery shall generally be hinged at top and bottom excepting the rigid trestle in each expansion block which shall be designed as a cantilever, free at top and fixed at bottom.

21.5 All trestles shall rest on concrete foundations the top of which shall be more than or equal to 300 mm above the finished ground level. Conveyor bridges longer than 150m shall be designed with expansion provisions. The expansion joint shall be provided by means of twin trestles at either sides of each expansion block or any other method. All vertical loads, technological as well as structural shall be transmitted to the supporting trestles by the main truss. The lates wind forces shall be transmitted through the bracings to the end portals which, in turn, shall transmit the same to supporting trestles. The longitudinal and horizontal forces along the conveyor comprising mainly of the longitudinal wind drag force shall be transferred through the lower structures provided at head end/tail of conveyor because such tower structures are very stiff compared to trestles. Encasement of steel trestles may be considered if required in special areas.

## 22. JUNCTION HOUSES

22.1 Please refer IPSS: 2-03-005-20 "Design considerations for lighting of junction houses, conveyor galleries and tunnels.

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