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मानक

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IS 14567 (1998): Winding in mines - Design of cages -
Guideline [MED 8: Mining Techniques and Equipment]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

खानों में कुण्डलन — पिंजरों के डिजाइन —
मार्गदर्शी सिद्धान्त

Indian Standard

**WINDING IN MINES — DESIGN OF
CAGES — GUIDELINES**

ICS 55.200

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BUREAU OF INDIAN STANDARDS
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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Mining Techniques and Equipment Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

Cages are important components of the suspension arrangements used in mining operations. They are the actual payload bearing component in whole of the cage suspension arrangement. Accordingly, design of the cages has to be carefully looked into, to avoid accidents.

Various types of cages are in use in mining industry. Most commonly used cage is single deck six-point suspension cage without balance rope. Other types of cages that have found greater adoption in the Indian mining industry are:

- a) Cages with balance rope (with friction or drum winding)
 - 1) Single deck cage (with single/multi-point suspension)
 - 2) Multi-deck cage (with single/multi-point suspension)
- b) Cages without balance ropes (with drum winding only)
 - 1) Single deck cage (with single/multi-point suspension)

The Coal Mines Regulations, 1957 and *The Metalliferous Mines Regulations, 1961* lay down specific provisions regarding cages. These provisions shall be duly taken care of during the design of the cages or other means of conveyance. These provisions are reproduced below for the guidance of users:

A) THE COAL MINES REGULATIONS, 1957

- 1) **Regulation 73(1)** — Every part of a winding installation including head gear shall be of sound construction and adequate strength and shall be maintained in safe working order.
- 2) **Regulation 76(10)(a)** — Every cage or other means of conveyance in which persons ride shall be:
 - i) covered completely at the top.
 - ii) closed in at the two sides in a manner sufficient to prevent persons or things from projecting beyond the sides.
 - iii) provided with a rigid hand-bar (rails) fixed in position where it can be easily reached by all persons in the cage or other means of conveyance.
 - iv) provided with suitable gates or rigid fences such that the gap between the floor of the cage or other means of conveyance and the gate or fence does not exceed 150 mm and that between any two members of the gate or fence does not exceed 250 mm. Gates or fences shall not open outwards and they shall be so fitted and maintained that they can not be accidentally opened.
- 3) **Regulation 76(10)(b)** — The floor of every cage or other means of conveyance shall be strongly constructed and so maintained as to prevent any part of the body of a person riding in the cage or other means of conveyance from projecting beyond the cage floor.
- 4) **Regulation 78(1)** — Every cage used for raising or lowering of tubs shall be provided with catches or other effective contrivances to prevent tubs falling out. The cage shall not be set in motion unless the catches or other effective contrivances are in operating position.
- 5) **Regulation 78(2)(a)** — The floor of every cage shall be kept clean and no skip, bucket or tub shall be filled to such a height that any of the contents can fall out.

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Indian Standard

WINDING IN MINES — DESIGN OF CAGES — GUIDELINES

1 SCOPE

This standard covers the guidelines for design of single deck cage with multi-point suspension arrangement and multideck cage with single point suspensions arrangement.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	Title
800 : 1984	Code of practice for general construction in steel (<i>second revision</i>)
5814 : 1970	Glossary of mining terms (shaft and associated equipment)
8500 : 1992	Structural steel — Microalloyed (medium and high strength qualities) (<i>first revision</i>)

3 TERMINOLOGY

For the purpose of this standard, terms and definitions given in IS 5814 shall apply.

4 GENERAL REQUIREMENTS

4.1 The welded joints of the structure shall be checked for their whole length for welding strength. All welded joints shall also be tested by non-destructive testing methods for any harmful defects.

4.2 Welding shall be done by Class 1 welder. All residual stresses shall be relieved after welding and no welding defects/cracks shall be allowed. Suitable non-destructive tests shall be carried out to check for the defects/cracks.

4.3 The fabricated cage shall be subjected to trail loading at the manufacturer's premises and all defects shall be rectified.

4.4 The centre of gravity of empty cage shall be at the rope centre. This shall be verified during trail of the fabricated cage at the workshop.

4.5 Suitable anti-corrosive protective paints shall be applied as per relevant Indian Standards.

4.6 Hand rails should be provided on both sides of the cage for every deck.

5 DESIGN REQUIREMENTS

5.1 Single Deck Cage

5.1.1 With Six Point Suspension (see Fig. 1)

5.1.1.1 Load conditions

Following load conditions shall be considered in the design of the cages:

- a) When the cage is hanging with full weight
- b) When cage is sitting on keps/platform with full weight
- c) When cage is sitting on catches
- d) When the cage is suspended from bell plate

5.1.1.2 Loads on cage

Assuming no balance rope is used, following loads act on the cages which are considered for the design of the cages:

- a) Self weight of the cage — A_1 kgf/cm²
- b) Weight of the total persons — B_1 kgf/cm² within the cage
- c) Weight of loaded mine car — C_1 kgf/cm² with coal/stone
- d) Weight of loaded mine tub — D_1 kgf/cm² with coal/stone

5.1.1.3 Total load (say P kgf/cm²) on the cage considered for the design of the cage shall be the maximum load out of the three alternatives given below:

$$A_1 + B_1 \text{ or}$$

$$A_1 + C_1 \text{ or}$$

$$A_1 + D_1$$

5.2 Multideck Cage

5.2.1 With Single Point Suspensions (see Fig. 2)

5.2.1.1 Load conditions

Following load conditions shall be considered in the design of the cages:

- a) When the cage is hanging with full weight
- b) When the cage is sitting on keps/platform with full weight
- c) When cage is sitting on catches
- d) When the cage is suspended from bell plate

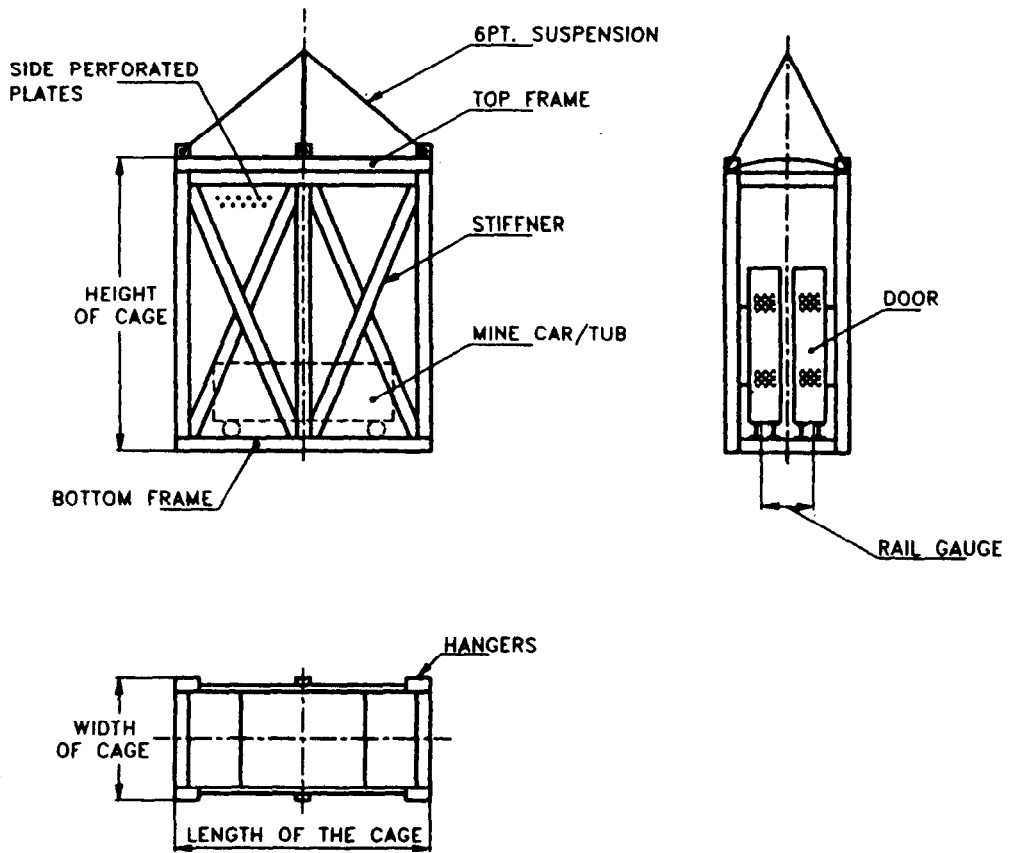


FIG. 1 TYPICAL SINGLE DECK CAGE WITH SIX POINT SUSPENSION

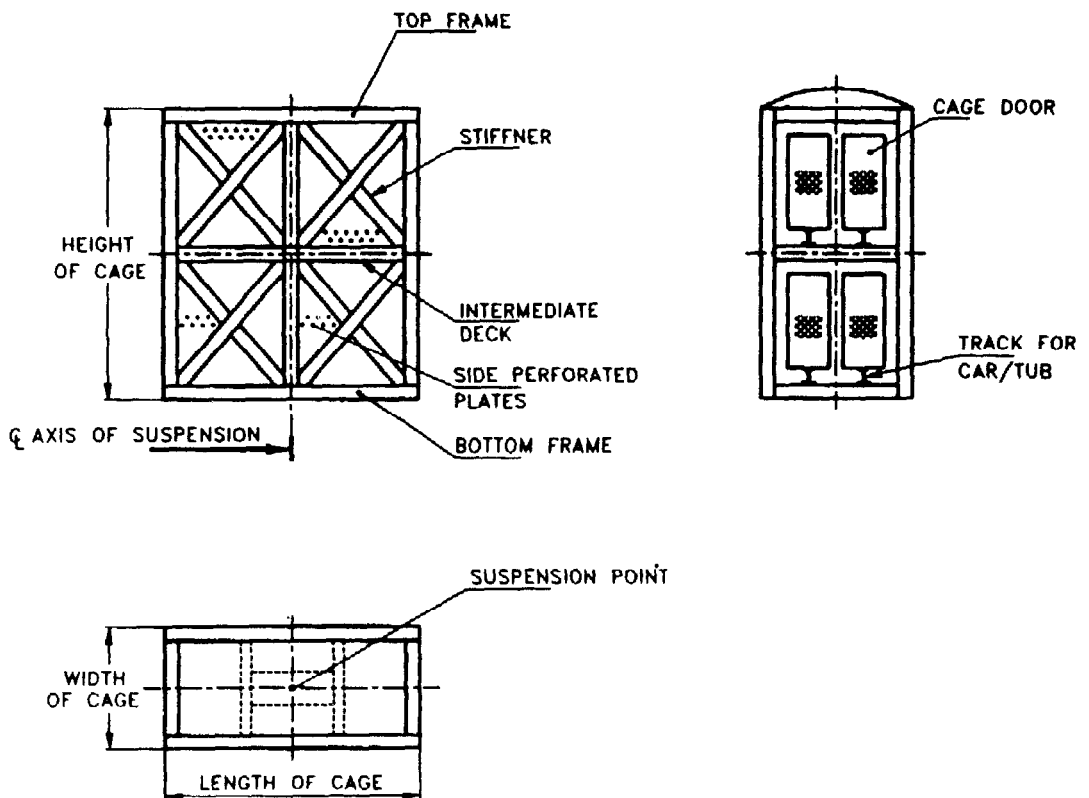


FIG. 2 TYPICAL MULTIDECK CAGE WITH SINGLE POINT SUSPENSION (TWO DECK)

5.2.1.2 Loads on cage

Assuming no balance rope is used, following loads act on the cages which are considered for the design of the cages:

- a) Self weight of the cage — A_1 kgf/cm²
- b) Weight of the total persons within the cage — B_1 kgf/cm²
- c) Weight of loaded mine car with coal/stone — C_1 kgf/cm²
- d) Weight of loaded mine tub with coal/stone — D_1 kgf/cm²

5.2.1.3 Total load (say Q kgf/cm²) on the cage considered for the design of the cage shall be the maximum load out of the three alternatives given below:

$$A_1 + B_1 \text{ or}$$

$$A_1 + C_1 \text{ or}$$

$$A_1 + D_1$$

6 GUIDELINES FOR DESIGN OF DIFFERENT ELEMENTS

6.1 Roof Frame

6.1.1 Load Condition 5.1.1.1(a)

In this cage the roof frame is subjected to compression only. However there would be a little bending effect due to the self weight of roof frame which is negligible. The load, causing the compression of the end channels and the longitudinal channels, shall be analysed. Accordingly, the L/R ratio and the factor of safety shall be calculated and maintained in accordance with IS 800.

6.1.1.1 Removable type of intermediate decks may be designed in case of multi-deck cages if long material are to be transported by the cages.

6.1.2 Load Condition 5.1.1.1(b)

In this case, any significant load is not acting on the roof frame as the cage is sitting on the keps/ platform.

6.2 Hangers

6.2.1 Load Conditions 5.1.1.1(a) and 5.2.1.1(a)

In this case, the hangers are subjected to tension. Accordingly analysis shall be carried out for tensile stress developed in the hanger which shall not be greater than one-tenth of the ultimate tensile stress.

6.2.2 Load Conditions 5.1.1.1(b) and 5.2.1.1(b)

In this case, the hangers are not subjected to any significant load as the cage is sitting on the keps/ platform.

6.2.3 Load Conditions 5.1.1.1(c), 5.1.1.1(d), 5.2.1.1(c) and 5.2.1.1(d)

Under these conditions, the hangers are subjected to tension. Accordingly tensile stresses developed in the hanger shall be analysed which shall not be greater than one-thirtieth of the ultimate tensile stress.

6.2.3.1 The material used for the manufacture of hanger shall be high tensile steel conforming to IS 8500.

6.2.3.2 Slenderness ratio

The cross section of the hanger shall be so selected that this ratio is less than 200.

6.2.3.3 Stiffness

Vertical stiffeners shall be used in cross direction to increase the horizontal rigidity of the side plates. The hangers shall be rigidly fastened/welded with the top frame, bottom frame and side plates.

6.2.3.4 Side plates

Side plates of at least 3.15 mm thickness (without perforation) shall be used at both sides of the cage to prevent objects falling into the shafts. For inspection of guide ropes, an opening of 250 mm × 250 mm in line with the guide ropes may be provided with sliding arrangements for closing the opening.

NOTE — There shall be at least six hangers for this type of cage (three on each side).

6.3 The deck shall have at least 1.9 m clear head space above it to enable persons to stand.

6.4 Intermediate stiffeners along the width of cage shall be used at regular interval for rigidity of the chequered plate.

6.5 Rails, if any, shall be fixed at proper gauge rigidly to the floor along with check rails for the appropriate mine car/tub. The chequered plate used for flooring shall be at least 6 mm thick and properly secured.

6.5.1 If rails are provided, car/tub catcher units shall be provided in the floor.

6.5.2 In case of multideck cages, the provisions of **6.5** shall be provided at each intermediate floors/deck of the cages.

(Continued from second cover)

A) THE METALLIFEROUS MINES REGULATIONS, 1961

- 1) **Regulation 80(1)** — Every part of a winding part of a winding installation head gear shall be of sound construction and adequate strength and shall be maintained in safe working order.
- 2) **Regulation 84(11)(a)** — Every cage or other means of conveyance in which persons ride shall be:
 - i) covered completely at the top.
 - ii) closed in at the two sides in a manner sufficient to prevent persons or things from projecting beyond the sides.
 - iii) provided with a rigid hand-bar (rails) fixed in a position where it can be easily reached by all persons in the cage or other means of conveyance.
 - iv) provided with suitable gates or other rigid fences such that the gap between the floor of the cage or other means of conveyance and the gate or fence does not exceed 150 mm and that between any two members of the gate or fence does not exceed 250 mm. Gates or fences shall not open outwards and they shall be so fitted and maintained that they can not be accidentally opened.
- 3) **Regulation 84(11)(b)** — The floor of every cage or other means of conveyance shall be strongly constructed and so maintained as to prevent any part of the body of a person riding in the cage or other means of conveyance from projecting beyond the cage floor.
- 4) **Regulation 86(1)** — Every cage used for raising or lowering of tubs shall be provided with catches or other effective contrivances to prevent tubs falling out. The cage shall not be set in motion unless the catches or other effective contrivances are in operating position.
- 5) **Regulation 86(2)(a)** — The floor of every cage shall be kept clean and no skip, bucket or tub shall be filled to such a height that any of the contents can fall out.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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