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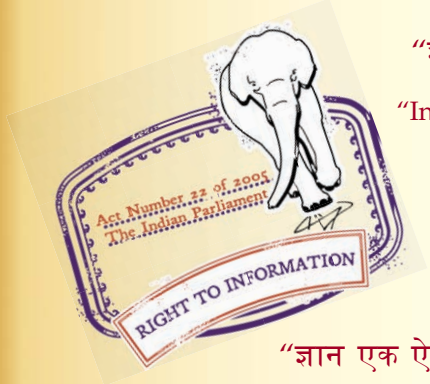
IS 3696-2 (1991): Scaffolds and Ladders - Code of Safety, Part 2: Ladders [CED 29: Construction Management including safety in Construction]

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Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 3696 ( Part 2 ) : 1991
( Reaffirmed 2002 )

# भारतीय मानक

# पाड़ एवं सीढ़ियाँ – सुरक्षा संहिता

## भाग 2 सीढ़ियाँ

( पहला पुनरीक्षण )

# *Indian Standard*

# SCAFFOLDS AND LADDERS — CODE OF SAFETY

## PART 2 LADDERS

*( First Revision )*

First Reprint JULY 1996

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BUREAU OF INDIAN STANDARDS
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Price Group 2

## FOREWORD

This Indian Standard ( First Revision ) was adopted by the Bureau of Indian Standards, after the draft finalized by the Safety in Construction Sectional Committee had been approved by the Civil Engineering Division Council.

Construction industry is inherently hazardous. From the point of view of safety, the conditions normally encountered in the construction industry do not lend themselves to the degree of control possible in other industries where more stable conditions are generally obtained. It may not be possible to completely eliminate the injuries and accidents in the construction industry because of the hazardous nature of operations involved. However, if safety precautions are properly enforced, it will help in minimizing accidental injuries in the various operations involved in different types of civil engineering works. Adoption of pre-determined safety measures in each of these operations will not only prevent or reduce accidents but also promote quicker and risk-free working of labourers resulting in increased efficiency with reduced costs of construction.

Ladders constitute one of the essential parts of construction equipment in any construction activity and in the absence of any permanent or temporary stairways provide means of access to all floors and platforms which are more than 1·5 m apart from ground or any other support for carrying out normal construction work. Inadequate attention is being paid at present in the use and selection of proper size and design of ladder for any particular job which results in many accidents. These accidents are generally caused as a result of the following :

a) Ascending or descending improperly,

b) Failure to secure ladder at top and/or bottom,

c) Structural failure of the ladder itself,

d) Carrying objects in hand while ascending or descending, and

e) Unsafe conditions of placing the ladder.

If sufficient care is given to the selection of proper size and design of a ladder for a job, the frequency of such accidents would be reduced considerably. Besides, this would bring additonal confidence in every workman who would be able to do his work safely and easily resulting in greater productivity of work.

This standard has been prepared with a view to providing adequate guidance to the users in the selection and use of ladders so as to minimize the extent of accidents from ladders in general building operations and other civil engineering works.

This standard was first published in 1966. In this revision details of load test to be performed on portable ladders of rigid construction have been incorporated and only or type of built-up ladder is recommended in addition to some other minor changes.

In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

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.

# *Indian Standard*

# SCAFFOLDS AND LADDERS — CODE OF SAFETY

## PART 2 LADDERS

## *( First Revision )*

### 1 SCOPE

This standard (Part 2) lays down the safety requirements for ladders used for the various jobs in general construction work including maintenance and demolition.

### 2 REFERENCES

The Indian Standards listed below are necessary adjuncts to this standard:

| *IS No.* | *Title* |
|---|---|
| 617 : 1975 | Specification for aluminium and aluminium alloy ingots and castings for general engineering purposes ( *second revision* ) |
| 1084 : 1983 | Specification for manila ropes ( *third revision* ) |
| 1410 : 1983 | Specification for coir-rope ( *second revision* ) |
| 1977 : 1975 | Specification for structural steel ( ordinary quality ) ( *second revision* ) |

### 3 TERMINOLOGY

**3.0** For the purpose of this standard the following definitions shall apply.

**3.1 Ladder**

An appliance or equipment usually consisting of two side rails joined together at regular intervals with cross pieces like steps, rungs or cleats and used in ascending or descending between two points at different levels.

**3.2 Overall Length**

It is the overall length of up-rights of the ladder measured from end to end.

### 4 CLASSIFICATION OF LADDERS

**4.1** Ladders used in construction may be classified as follows.

**4.1.1** *Built-Up Ladders*

These are built on the job to its particular requirements. They are fastened to the structure in a fixed position, securely held in place and not moved about as required.

**4.1.2** *Portable Ladders of Rigid Construction*

These are used as and where required to give access to scaffolds, platforms, etc, in a building or other structure under construction or to any required location for repairs or maintenance. They may be of any type indicated under **4.1.2.1** to **4.1.2.6**.

**4.1.2.1** *Stock ladders*

Ladders which have one section and in which the side rails may be either parallel or spread wider at the bottom. They are lean-to-ladders, that is, their upper ends are supported by leaning against a wall or any other rigid support.

**4.1.2.2** *Extension ladders*

These lean-to-ladders have two or three sections with proper locking system. The upper sections can slide in guides or brackets so arranged that the length of the ladder can be varied as required between the fully extended position and the fully retracted position.

**4.1.2.3** *Sectional ladders*

These lean-to-ladders have two or more sections which can be joined end to end so as to function as a single ladder. However, unlike extension ladders, the length can be changed by the length of a whole section only.

**4.1.2.4** *Step ladders*

These are self-supporting ladders hinged near the upper end with a spreader arrangement between the two sections. When such a ladder is arranged for use, it is in the form of letter 'A'. Wide flat steps are secured to the side rails which form one of the sloping sides of 'A'. The other sloping side acts as a strut to support the ladder.

**4.1.2.5** *Trestle ladders*

These are self-supporting ladders similar to step ladders except that they have circular rungs on both the sloping sides.

**4.1.2.6** *Extension trestle ladders*

A ladder consisting of 'A' or trestle ladder, hinged at the top to form equal angles with the base when spread, and with an additional single ladder section having parallel sides which can be adjusted vertically and provided with a device to lock it in place.

4.1.3 *Rope Ladders*

These have ropes on either side, instead of rigid side rails, passing through holes in the rungs which are of planks. Rope ladders may also have rungs of other suitable types with non-slipping connections to side ropes. Rope ladders not being rigid have to be suspended from the top end.

## 5 MATERIALS

5.1 Metal ladder may be either of steel complying with IS 1977 : 1975 or of aluminium alloy complying with the suitable grade of IS 617 : 1975.

5.2 Wooden ladder may be either of timber or of bamboo and if of timber, it shall conform to the relevant Indian Standard.

5.3 Rope for ladder shall conform to the requirement of Grades I ropes laid down in IS 1084 : 1983 or IS 1410 : 1983. The diameter of the rope shall not be less than 25 mm.

## 6 CONSTRUCTION

### 6.1 General Requirements

6.1.1 All ladders shall be constructed to carry their intended loads safely.

6.1.2 Side rails of metal ladders shall be of sufficient cross-section to prevent excessive deflection in use.

6.1.3 Ladders which are to remain as a part of the permanent structure after completion of building operations, shall conform to any local, state or municipal bye-laws which may be applicable.

6.1.4 In case of wooden ladders no rung shall be fixed to the stringer with nails, spikes or other similar fixings. In bamboo ladders, however, the rungs may be fixed to the rails with spikes of appropriate design and strength.

6.1.5 Safety shoes, lashing or other effective means shall be used to avold danger of slipping.

### 6.2 Built-Up Ladders

All surfaces of the ladder shall be planed, free of splinters and edge of hand rails used shall be bevelled.

6.2.1 Rung spacing shall be uniform and not over 300 mm on centres. Rungs shall be recessed at least 12 mm into rails.

6.2.2 Ladders shall not exceed 6 m in length. The recommended dimensions for built-up wooden ladders are given in Table 1.

6.2.3 Top and bottom of each built-up ladder shall be securely fastened.

### 6.3 Portable Ladders of Rigid Construction

6.3.1 *Stock Ladders*

The overall length of stock ladders shall not exceed 10 m. The width between side rails at the base shall in no case be less than 290 mm for ladders up to 3 m in length. For longer lengths, this width shall be increased at least 6 mm for each additional 0·3 m of length. In the case of metel ladders, metal rungs shall be made of solid round steel rods, steel pipe or angle sections and securely fastened to the side rails by riveting, bolting or welding. Metal treads shall be flanged downward not less than 50 mm at each end and secured to each side rail by two bolts or rivets. Sefety type treads may also be used with angle supports at each end. All bolts and rivets shall have a close fit in the holes prepared to receive them.

6.3.2 *Step Ladders*

The overall height of step ladders shall not exceed 6 m. Step ladders higher than 3 m shall be equipped with rope of chain placed midway between the automatic spreader and the bottom of ladder. Steps shall be secured to the side rails by means of nails, or screws and reinforced with tie rods between side rails under alternate steps. Ladders shall be provided with an automatic locking device or spreader to hold it in an open position. The minimum width between side rails at top step, inside to inside, shall be not less than 300 mm with a spread of 25 mm for each 300 mm of length of spread ladder.

6.3.3 *Extension Ladders*

The overall length of the extended ladder shall not exceed 18 m. The sliding section shall not exceed two in number. Locks and guides shall be of such design and construction as to make the extension ladder equal in strength to a ladder of equal length constructed of continuous side rails.

6.3.4 *Sectional Ladders*

The overall length of sectional ladder shall not exceed 10 m. The bottom and intermediate sections shall not exceed 2 m each and the top section shall not exceed a length of 3 m. The connecting joint shall not be less than 300 mm in length andshall fit closely without building unnecessary play. Each grooved end of the sections shall be reinforced and metal sheet of not less than 1·25 mm thick properly secured thereto and riveted above the groove extending to the depth of rail.

Rungs shall be not less than 30 mm in diameter and shall be fixed to the side rails by mortise and tenon joints of at least 22 mm and shall be spaced not more than 300 mm apart centre to centre.

**Table 1 Dimensions of Wooden Built-Up Ladders**

( *Clause* 6.2.2 )

| Length | Inside Width, *Min* | | Cross-Sectional Size of Uprights, *Min* | Size of Cleats, *Min* |
|---|---|---|---|---|
| | Bottom | Top | | |
| ( 1 ) | ( 2 ) | ( 3 ) | ( 4 ) | ( 5 ) |
| m | mm | mm | mm | mm |
| 3 to 3·75 | 500 | 430 | 50 × 100 | 22 × 75 |
| Over 3·75 to 5 | 530 | 450 | 50 × 100 | 22 × 75 |
| Over 5 to 6 | 585 | 500 | 50 × 100 | 22 × 95 |

6.3.5 *Trestle and Extension Ladders*

Trestle ladders shall not exceed 6 m in length and the base or extension section of extension trestle ladders shall not exceed 6 m. Trestle ladders and base section of extension trestle ladders shall be so spread that the width of the trestle at the bottom, inside to inside, is at least 150 mm per 300 mm length of ladder. The single ladder section shall be so hinged at the top that when the ladder is spread, they form equal angles with the base. The rungs shall not be less than 30 mm in diameter and shall be fixed to the side rails by mortise and tenon joints of at least 22 mm and shall be spaced not more than 450 mm apart centre to centre. The minimum distance between side-rails of trestle ladders and the extension section of trestle ladders shall be not less than 300 mm. The extension section shall have parallel side rails. The tops of side-rails of trestle and base of sections of extension trestle ladders shall be cut on a bevel to prevent them from spreading. A locking device or spreader to hold the front and back section securely in an open position and each pair of side-rails rigidily to one another shall be an integral part of each ladder. The locking device for securing the extension section to the base shall be of an approved design. The extension trestle ladders shall be checked to ensure that when assembled, their strength is equal to that of a continuous single ladder.

### 6.4 Rope Ladders

The diameter of rope shall be not less than 25 mm. Planks forming steps shall be not less than 38 mm thick. The steps shall be securely held in position by suitable means.

## 7 INSTRUCTIONS REGARDING USAGE

### 7.1 Built-Up Ladders

**7.1.1** When fixed ladders are to be used for ascending to heights exceeding 9 m, landing platform shall be provided. Where ladders connect different floors, the ladders shall be staggered and protective landing with the smallest possible opening shall be provided on each floor.

### 7.2 Portable Ladders of Rigid Construction

**7.2.1** Before use, all ladders shall be tested for load test. They shall have not only adequate strength but rigidity as well. For load test, a test load of 1·5 times the mass of worker plus the mass of 16 bricks shall be hung from each rung. The rung and the ladder shall not show any distress or noticeable bending. The lower rungs may be tested by reversing the ladder. Unless otherwise specified, the mass of worker shall be taken as 68 kg. Load test shall be done when ladders are brought to the construction site and when damage to ladders is anticipated or observed on visual inspection. If a ladder shown tendency to spring, a brace shall be attached to its middle and properly supported from some other non-yielding fixed object. Ladders longer than 5 m length require more cautious testing.

**7.2.2** No ladder having a missing, defective rung or one which depends for its support solely on nails, shall be used. Defective ladders shall be promptly and propely repaired or replaced.

**7.2.3** Ladders shall not be used as guys, braces or skids or for any other purpose for which they are not intended. They shall not be used in horizontal position as runways. They shall not be over-crowded.

**7.2.4** Wherever possible, ladders shall not be spliced. Where splicing is unavoidable, it shall be done only under the supervision of engineer-in-charge.

**7.2.5** Ladders leading to landings or walkways shall extend at least one metre above the landing and shall be secured at the upper end.

**7.2.6** To prevent slipping, a ladder shall be secured at the bottom end. If this cannot be done, a person shall be stationed at the base whenever it is in use. As a further precaution, the pitch at which a lean-to-ladder is used shall be such that the horizontal distance of its foot from the vertical plane of its top shall be not more than one quarter of its length. If the surface of the floor on which the ladder rests is smooth or sloping, the ladder shall be provided with non-slip bases.

**7.2.7** If the use of ladder is essential during strong winds, it shall be securely lashed in position.

**7.2.8** No ladder shall be placed or leant against window panes, sashes or such other unsafe or yielding objects, nor placed in front of doors opening towards it. If set up in driveways, passageways or public walkways, it shall be protected by suitable barricades.

**7.2.9** When ascending or descending, the user shall face the ladder, use both his hands and place his feet near the ends of the rungs rather than near middle.

**7.2.10** It is dangerous to lean more than 300 mm to side in order to reach a larger area from a single setting of the ladder. Instead, the user shall get down and shift the ladder to the required position.

**7.2.11** Metal ladders shall not be used around electrical equipment or circuits of any kind where there is a possibility of coming in contact with the current. Metal ladders shall be marked with signs reading "*CAUTION* : DO NOT USE NEAR ELECTRICAL EQUIPMENT".

**7.2.12** Step ladders shall always be used in a fully open position and fixed with a safety locking device. These shall not be used where strenuous action on the part of the workman is called for.

**7.2.13** Extension ladders shall be used only up to 18 m in length. Locks and guides shall be properly checked to ensure for proper locking and full extension of the section. At least two men shall be employed to raise or move these ladders.

**7.2.14** Sectional ladders shall be checked to ensure that they are properly combined end to end before they are put to use.

**7.2.15** Trestle and extension trestle ladders shall always be used in a fully spread position.

### 7.3 Rope Ladders

The top of rope ladders shall be properly tied to a strong support or otherwise held securely.

## 8 INSPECTION AND TESTING

**8.1** Wooden ladders shall be inspected at least once in a week for damage and deterioration. Ladders longer than 5 m length require more caution inspection. Close visual inspection is recommended in preference to load testing.

**8.2** Metal ladders shall be inspected at least once in three months and all parts checked for wear, corrosion and structural failure.

**8.3** All ladders shall be carefully inspected, if incidentally dropped or otherwise damaged in use.

**8.4** Rope ladders shall be tested at least once a month.

## 9 STORAGE AND MAINTENANCE

### 9.1 Storage

Ladders shall be stored, if possible, under a suitable cover, protected from weather in a dry location. They shall be exposed to good ventilation. Ladders shall be supported during storage so as to avoid sagging and permanent set.

### 9.2 Maintenance

**9.2.1** Wooden ladders shall be periodically treated with a clear preservative such as varnish, shellac or linseed oil. Painting shall not be adopted as defects and cracks are likely to be covered up by the coating.

**9.2.2** Metal rungs shall be cleaned to prevent accumulation of materials which may destroy non-slipping properties. All fittings shall be carefully checked.

**Bureau of Indian Standards**

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