EXTERNAL MOVABLE SHADING SYSTEMS (EMSyS) MANUAL
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Government of India updated the Energy Conservation Building Code (ECBC) in 2017 to establish minimum energy performance standards for new, commercial buildings in India with revisions that are more stringent, although the code remains voluntary in nature. In 2018 Government of India launched a code for residential buildings EcoNiwas Samhita (ENS) (Part I – Building Envelope) with the aim of improving thermal comfort and energy efficiency in residential buildings. To strengthen the adoption of these codes, Bureau of Energy Efficiency has been working on several aspects crucial to limit heat gains inside a building.

Windows are a crucial component that contribute to heat gains in a building significantly. Some studies show that on any intermediate floor, over 60% of the heat gains are through windows. The use of External movable shading systems (EMSyS) such as chiks, awnings, roller blinds, and shutters ensures that over 80% of the solar radiation coming inside through windows can be minimised. This would reduce the heat gain inside the building and also provide significant decrease the air-conditioning load and in turn the electricity bill.

This manual is a compilation of such EMSyS devices available in the country elaborating on their working mechanisms and other practical aspects. It also gives an indicative pricing and expected reduction in the solar heat gains for all products. Despite being cost-effective and easy to install, EMSyS devices are not so popular in the country. This is primarily due to lack of awareness. This publication, titled External Movable Shading Systems (EMSyS) Manual, is intended to bridge this gap.

To that extent, the Manual serves a valuable purpose by documenting the variety of EMSyS devices that are available in India that suit a large section of users. I would urge all architects and developers to refer the manual and adopt the most suitable solution for their respective projects. That will help further improve energy-efficient building design and construction practices in India.

New Delhi
4th December 2021

Abhay Bakre
Director General
Bureau of Energy Efficiency
MESSAGE

Jonathan Demenge
Head of Cooperation and Counsellor

At the outset, I would like to express my great satisfaction and gratitude to the Bureau of Energy Efficiency (BEE) for this successful collaboration: through the Indo-Swiss Building Energy Efficiency Project (BEEP) many great successes have been achieved.

This collaboration saw the development of an energy efficiency code document for the residential building sector, EcoNiwas Samhita (ENS) 2018. This manual on external moveable shading system (EMSyS) is an extension to the provisions of ENS 2018.

The concept of EMSyS derives from a simple and ancient technology which is found in buildings in many warm and cold regions and countries around the world, including in Switzerland. They have become part of the architecture. It helps blocking out the excessive heat and direct sunlight, while keeping the room inside cool. In Switzerland, very few buildings require air conditioning during the summer; but for those, installing EMSyS is a mandatory pre-requisite, which has considerable impacts in terms of reducing heat gain.

To this effect BEEP had initiated a design competition in 2015 to promote the development of indigenous EMSyS designs in the country. This led to the development of EMSyS designed and developed in India. These prototypes were later tested for their thermal performances. Later existing EMSyS products already available in India, were identified in a survey conducted under BEEP and are presented in this manual.

This manual shares all the relevant information on EMSyS products to provide a readymade design reference document for designers and developers, and motivate them to use them in buildings.

I hope that this External Movable Systems (EMSyS) Manual will be useful to the design professionals, and that it will contribute to BEE’s efforts in mainstreaming the adoption of ENS 2018 to reduce the energy consumption of buildings in India.

New Delhi
4th December 2021

Jonathan Demenge, PhD
Head of Cooperation and Counsellor
Swiss Cooperation office India, Embassy of Switzerland, New Delhi
MESSAGE

Bureau of Energy Efficiency
(Ministry of Power, Government of India)

Saurabh Diddi
Director


A lot of effort by different sets of people and institutions have gone into the preparation of this document. Guidance, innumerable reviews, unparalleled commitment and hard labour etc. are the different kinds of roles assumed by these people. Given below are the few names who have put in a substantial amount of time and effort in bringing out this document.

I am grateful to Mr Abhay Bakre, Director General, Bureau of Energy Efficiency, for his guidance to the development team. BEE places on record its gratitude to the officials of the Swiss Agency for Development and Cooperation (SDC), India – Ms Marylaure Crettaz, former Head of Co-operation and Counsellor, Swiss Co-operation office India, Embassy of Switzerland; Dr Johnathan Demengue, current Head of Co-operation and Counsellor, Swiss Co-operation office India, Embassy of Switzerland; and Dr Anand Shukla, Senior Thematic Advisor – for their constant engagement and in making available necessary technical support.

The core development team of the Indo-Swiss Building Energy Efficiency Project (BEEP) had burnt the midnight oil on several days to see to it that everything in the manual is in order. The team comprised Mr Pierre Jaboydeoff and Ms Chinar Sharma from the Swiss Project Management Technical Unit (PMTU) and Dr. Sameer Maithel, Ms Vernica Prakash, Mr Prashant Bhanware, and Ms Ishita Singh from Indian PMTU.

This document would not have been possible without the relentless efforts of Ms Akanksha Krishan, Ms Shatakshi Suman, and Ms Meenal Anandh, sector experts at BEE.

This manual would not have been complete without the support of EMSyS vendors and manufacturers. Thanks to all of them for painstakingly responding to queries and filling out detailed questionnaire in time and sharing information on their products.

While BEE proudly presents this document, we would really appreciate receiving feedback from the stakeholders of the EMSYS and building industry to make it even better in the subsequent editions. We sincerely hope this this publication is of great value to one and all.

New Delhi
4th December 2021

Saurabh Diddi
Director
Bureau of Energy Efficiency
INTRODUCTION

There is a trend towards increasing the window-to-wall ratio and glazing area in both commercial and middle- to high-income residential buildings. Another trend noticed is to avoid the provision of chajjas or any kind of fixed shading. These are worrying trends, as these unprotected, large, glass facades and windows are the major contributors to the heat gain inside the building. In a survey carried out across 50 residential buildings spanning over 7 cities, the windows and the shading designs were found to have no co-relation to the local climatic conditions.

Windows serve multiple purposes of providing ventilation, daylighting, outdoor view, etc. However, the excessive heat gain through windows due to radiation is usually neglected in the design of new buildings and the buildings are not adequately shaded. Adequate shading is needed for optimising lighting, controlling glare, improving the thermal comfort, reducing the heat load, and hence in reducing the requirement for electricity for cooling and lighting to make buildings visually and thermally comfortable.

WHAT IS SHADING?

Shading is a simple method to block the excessive heat and radiation from the sun to get inside a building. This can be achieved by using simple architectural elements, which may be fixed or sophisticated movable systems outside the window. The primary objective is to block the intense solar radiation from falling on the glazed surface and entering the building during summer while allowing the solar radiation to enter during the winter months.

EXTERNAL MOVABLE SHADING SYSTEMS

While fixed shading elements such as chajjas, box windows, and vertical fins are extremely important and can provide shading on the northern and southern facades of the building when the sun is high up, it is dynamic/movable shading that can protect the eastern and western facades from the angular sun. Also, in a tropical country like India, which receives high amount of solar radiation, a significantly large fraction is in the form of 'diffused' radiation because of dust and clouds present in the atmosphere. In Delhi, ‘diffused’ solar radiation accounts for almost 50% of the total solar radiation during the peak summer season. While fixed shading is useful to protect from ‘direct’ solar radiation, it has limited effectiveness against ‘diffused’ radiation. An external movable shading device/system (EMSyS) can be adjusted in different positions depending on the sun’s trajectory throughout the day and block solar radiation from entering the building as they are placed outside the glass of the window. Such systems have the potential to reduce up to 80% solar gains coming inside the building through windows.

PERFORMANCE RESULTS OF EMSYS IN A REAL-LIFE BUILDING

While there is a huge potential of EMSyS for improving thermal comfort and saving cooling electricity, the evidence or real-life monitored data is hardly available in the public domain, especially in India. To address this gap, a real-life performance study was conducted to measure EMSyS performance under BEEP. The objective of the study was to quantify the impact of EMSyS in reducing the indoor temperatures in NV mode and in reducing the space cooling load in AC mode.

A simplified methodology for performance monitoring of EMSyS was developed for naturally ventilated (NV) mode as well as air-conditioned (AC) mode. One test room in each of two identical flats, one above the other, was selected for monitoring in a residential building in the NCR region which falls in the composite climate zone. One test room had EMSyS installed while the other had regular internal curtains (IC). Among different EMSyS products available, vertical screens were used for this monitoring study.
In both cases the measurements were first done for a week's duration in March and subsequently in June. The peak operative temperature\(^1\) in the room having EMSyS was lower by 3.5°C as compared to the room having IC which was observed during clear days with high direct normal irradiance\(^2\) (DNI). While around 32% reduction in cumulative cooling delivered was observed in test room with EMSYS compared to the cooling delivered in the test room with IC.

Following the field measurements, a simulation-based study was also carried out to check the thermal performance of EMSyS in different seasons, building orientation, location and glazing types. The key findings are:

- **Orientation**: The thermal comfort and energy savings potential for west and east facing windows was much higher as compared to windows facing north or south. Hence, using EMSyS should be prioritized for the East and West facades.
- **Location**: Cities and towns which have high solar radiation and dry climates see better performance by using EMSyS.
- **Glazing systems**: EMSyS with single glazing can give equivalent or better results in controlling indoor temperatures and reducing the cooling load as compared to high-performance double-glazing units. It also offers an advantage of better daylighting over using internal curtains with high-performance glass.

**ABOUT THE MANUAL**

This manual is a compilation of external movable shading products available in the Indian market. The information was collected by the development team through a market survey. These products are classified into three categories: Retractable Awnings, Vertical Screens, and Shutters. The manual aims to give comprehensive information to building designers and homeowners on these products and help them decide on the best ones suited to reduce solar heat gains in their projects/homes.

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1. **Operative temperature** is a simplified measure of human thermal comfort derived from air temperature, mean radiant temperature and air speed. It is useful in assessing the likely thermal comfort of the occupants of a building.

2. **Direct Normal Irradiation (DNI)** is the amount of solar radiation received per unit area by a surface that is always held perpendicular (or normal) to the rays that come in a straight line from the direction of the sun at its current position in the sky.
RE-TRACTABLE AWNINGS

Composed of fabric that is stretched and retracted on a sub-structure designed as a truss, space frame or a planar frame depending on the applicability.
**SOLAR HEAT GAIN COEFFICIENT**

Solar Heat Gain Coefficient (SHGC) is a measure of the amount of solar radiation (heat) passing through the entire window, including the frame.

![Diagram of Pivot Arm (Simple Type) Awning]

**ANATOMY OF RE-TRACTABLE AWNING**

- **Cassette:** An accessory to provide protection to the awning if a direct structural projection is absent.
- **Wall/Ceiling Bracket:** Hidden from the view due to cassette. Used to anchor the awning to the structure of the building.
- **Crank Loop:** Used to anchor the hook, which rotates to open or close the awning.
- **Crank:** Used to rotate the opening and closing of the awning.
- **Pivot Arm:** Forms an axis about which the bottom rail rotates.
- **Bottom Rail:** Horizontal bar at the bottom of the blind keeps the screen taut in all positions.
- **Front Bar:** End rail of the awning. Used to fix the awning fabric's other end.
- **Top Rail:** Horizontal bar at the top of the blind, acting as the structural frame for the screen.
- **Screen:** The main element providing solar protection.

![Diagram of Anatomy of Re-Tractable Awning]

**MATERIAL**

- Aluminium powder-coated
- Anodised aluminium
- Mild steel
- Polyvinyl chloride (PVC)
- Polyurethane (PU) and PVC-coated
- PVC Flex
- Acrylic
  - Solution-dyed
  - PU + PVC-coated
- Polyester and Vinyl on polyester

**COST (₹/sq.ft)**

- Low: 0 - 200
- Medium: 200 - 500
- High: 500 - 1000

**WIND TOLERANCE**

- Low: 1 - 10
- High: 20 - 40

**LIFESPAN**

- 0 yr: Low
- 40 yr: Medium
- 40 yr: High

* The SHGC of the product is dependent on its material properties.
1. TYPES OF RE-TRACTABLE AWNING

1.1 PIVOT ARM AWNINGS

![Fig. 1.1a: Pivot Arm (simple type) Awning](image)

It operates on extendable arms, which are fixed to the exterior wall. The arms pivot in an arc, allowing the blind to extend and retract before locking into position.

![Fig. 1.1b: Pivot Arm (valance type) Awning](image)

It consists of an additional horizontal member that fixes the length of the awning’s fabric and makes this area like an immovable panel. The remaining length is connected to a pivot arm, which becomes the movable panel.

1.2 QUARTER-ROUND AWNINGS

![Fig. 1.2a: Quarter-round Foldable (spherical) Awning](image)

This awning has the shape of a quarter sphere, and hence all the dimensions (height, projection length, and radius) are equal. (Also known as Bull Nose Awning)

![Fig. 1.2b: Quarter-round Foldable (rectangular) Awning](image)

The rectangular awning has multiple panels that are attached radially to the corner, which forms the sub-structural space frame. These panels are installed with solar fabric. The awning is pulled together and stretched on a rope and pulley system.

1.3 FOLDABLE ARM AWNINGS

![Fig. 1.3a: Foldable Arm Awnings](image)

It has a base planar frame of aluminium, which has pre-tensioned arms to support the stretching and retraction of the awning while sustaining wind and rain.
2. WORKING MECHANISM

2.1 PIVOT ARM AWNINGS

2.1.1 CRANK-SHAFT GUIDED SYSTEM
A pivot arm awning pivots on a crank-guided system. The pivoted arm rotates depending on the length of the fabric, which is let loose by the user.

1. The fabric is rolled up to close the awning.
2. The fabric is rolled down to open the awning.
3. The fabric is directly attached to the bottom rail, which is fixed to the pivot arm. As there are no vertical members connecting the top rail and the bottom rail, the tension of the fabric locks the pivot arm in position.
4. It is useful in areas with frequent rainfall, as the fabric keeps taut in every position and does not let the water pool on the fabric and the user can be carefree.

2.2 QUARTER-ROUND AWNINGS

2.2.1 ROPE AND PULLEY SYSTEM
A quarter-round foldable awning has two types of pulleys: movable pulley and fixed pulley.

The string is used to pull all the movable pulleys together. When the tension of the string is released, the awning falls back to its open position due to gravity.
2.3 FOLDABLE ARM AWNINGS

2.3.1 CRANK-SHAFT GUIDED SYSTEM
In this mechanism, a simple rod is employed to open and close the awning. The crank is hooked to the roller and rotated clockwise; this motion releases the tension arms to stretch out and open. When the roller is rotated in anti-clockwise direction, the awning retracts.

There are two hooks in the awning:
1. For opening and closing the awning.
2. For adjusting the pitch of the awning.
3. ANCHORING MECHANISM

All types of awning’s frame have the following elements:
1. The structural load-bearing elements.
2. The elements that enable retraction.
3. The elements that form a connection between movable and fixed elements. They might serve the combined purpose of the above two.

The load-bearing element is anchored to the building structure in the following ways:
1. Wall-mount Brackets: The load-bearing element of the awning is bracketed to the wall, with specially designed wall-mount brackets.

2. Ceiling-mount Brackets: The load-bearing element of the awning is bracketed to the soffit/ceiling, with specially designed wall-mount brackets or di-casted steel L-brackets.
3. Cable-guided Installation: The cable is installed at soffit mount fixture, which is anchored to the floor or wall near the bottom rail of the awning, with a suitable bracket. The cable’s tension is ensured while securing it.

Fig. 3.1a: Ceiling Mount

Fig. 3.1b: Wall Mount

Fig. 3d: Cable-guided Installation

3.1 PIVOT ARM AWNINGS
3.2 QUARTER-ROUND AWNINGS

It is wall-mounted on three sides.

Fig. 3.2a: Anchor Points of the Awning

Fig. 3.2b: Awning Installation Method

This type of awning can be installed by a single person using a suspended swing from a four-storey (max) building.

3.3 FOLDABLE ARM AWNINGS

Fig. 3.3a: Ceiling Mount

Fig. 3.3b: Wall Mount

This type of awning can be installed by a single person using a suspended swing from a four-storey (max) building.
4. APPLICABILITY AND SIZING

4.1 PIVOT ARM AWNINGS

Fig. 4.1a: Applicability of Awning based on Building Component

Fig. 4.1b: Mounting Space

Fig. 4.1c: Optimum Sizing
4.2 QUARTER-ROUND AWNINGS

4.2.1 MOUNTING SPACE

Outdoor mounting access required.

4.2.2 SIZING

The height of the awning should be half the height of the window.

Fig. 4.2a: Applicability based on Building Component

Fig. 4.2b: Mounting Space

Fig. 4.2c: Sizing of Awning with respect to the Window

Quarter-Round Awning - Rectangular

Quarter-Round Awning - Spherical

Balcony

Window

Door Medium Rise

Outdoor mounting access required.

The height of the awning should be half the height of the window.
4.3 CUSTOMISABLE SIZING

The height of the awning can be compressed to maximum half the projection length. \( X \geq \frac{Y}{2} \)

For large spans, the awning can be extended by a combination of fixed and retractable awning.

Fig. 4.3a Side View of Quarter-Round Foldable, Rectangular Awning

Fig. 4.3b Perspective View of Quarter-Round Foldable, Rectangular Awning

4.4 FOLDABLE ARM AWNINGS

Outdoor mounting access required.

Fig. 4.4a Applicability based on Building Component

Fig. 4.4b Mounting Space

Fig. 4.4c Sizing (Sizing varies based on the manufacturer.)
5. CASE STUDY

5.1 PIVOT ARM AWNINGS

5.2 QUARTER-ROUND AWNINGS
5.3 FOLDABLE ARM AWNINGS

6. MAINTENANCE

Cost of the pH neutral detergent: ₹ 90/50 g at the frequency of 3-4 months.

Cost of the cleaning solution: ₹ 2000/8 ounces depending upon the dirt accumulated.

The manual pulley system can break or crack if not operated at 90 degrees. The system needs to be replaced after four or five years.

PVC joints and hinges at the corner can crack in hot and humid climate.

If water accumulates in the awning fabric, it can cause irreversible fabric stretching, which may result in the replacement of the fabric.

Special Coated Fabric for Chemical Cleaning

Water pooling causes irreversible fabric stretching
Motorisation:
All awnings can be motorised. and automated as per user preference.

Additional Cost for Motorisation (₹/piece):

- ₹ 18,000-38,000
- ₹ 50,000

Retrofitting:
EMSyS retractable awnings can be retrofitted.

Overheating in Motor:
Usage of the motor extensively (i.e., extracting and re-tracting awning alternatively without any break) can cause the motor to heat up and stop working temporarily, till the motor cools down.

7. KEY FEATURES/BENEFITS

7.1 PIVOT ARM AWNINGS

- Stays taut in all positions preventing water pooling.
- Allows ventilation while covering the complete elevation of the window.

Fig. 7.1a: Protects from Rain

Fig. 7.1b: Natural Ventilation Capability of the Awning
7.2 QUARTER-ROUND AWNINGS

1. Gives a three-sided protection from the sun and rain.
2. It can be made leakproof by applying a silicon layer at the joint of the awning and the wall.

Fig. 7.2: Protects from Rain and Sun

7.3 FOLDABLE ARM AWNINGS

1. Perfect solution for large-span shading.
2. Its slope is adjustable from 0° to 45° (approx).
3. Provides privacy as per requirement.

Fig. 7.3: Adjustable Pitch

8. ACCESSORIES

In case of no direct structural protection, a hood is installed to protect the awning.

Fig. 8a: Awning with Hood

Fig. 8b: Awning without Hood
VERTICAL SCREENS

Composed of fabric that provides solar protection by folding or rolling vertically up and down over the glazed surface of the opening
**Solar Heat Gain Coefficient**

**Clutch Roller Blind Cassette Track-Guided**

![Fig. A: Closed Position](image1.png)

![Fig. B: Open Position](image2.png)

**Anatomy of a Vertical Screen**
- **Cassette:** Cassette acts as a cover for the top rail. It protects the blind in closed position from dirt and dust. It is an optional accessory, but can be used for aesthetics.
- **Screen:** Screen is the main element of the blind. Its main purpose is to provide shade.
- **Bottom Rail:** It is the horizontal bar at the bottom of the blind, which keeps the screen taut in all positions.
- **Top-Rail:** It is the horizontal bar at the top of the blind. It acts as the structural frame for the screen. It is hidden from view by the cassette.
- **Side Tracks:** Side tracks are installed on either side of the blind. They act as channels to guide the screen movement and provide for sturdiness against wind.

**Material**
- **Aluminium**
  - Powder-coated
  - Anodised
- **Stainless Steel**
- **Polyvinyl chloride (PVC)**
- **Acrylic**
  - PU-coated
  - Solution-dyed
- **Polyester, vinyl, and cotton blends**

**Cost (₹/sq.ft)**

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<th>Material</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
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<td>Aluminium</td>
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<tr>
<td>Polyester, vinyl, and cotton blends</td>
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**Wind Tolerance**

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**Lifespan**

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<tr>
<td>0</td>
<td>0</td>
<td>40 y</td>
<td>40 y</td>
</tr>
</tbody>
</table>

*The SHGC of the product is dependent on its material properties.*
1. TYPES OF VERTICAL SCREENS

1.1 CLUTCH ROLLER BLINDS

It has the screen rolled-up on the top rail. The bottom rail scrolls up or down with the help of a guiding system to open or close the blinds.

It has a cassette installed on its top rail for the protection of the shade, where there is no immediate projection over the shade or for aesthetic purpose.

1.2. VENETIAN BLINDS

Instead of a screen, these blinds have equally spaced horizontal slats, which can be stacked up with the top rail to close the blind. Additionally, they come with a wand, which can be employed to rotate the slats at desired angles with respect to the angle of sun’s rays.

1.3 OUTDOOR CURTAINS

Curtains provide shading by their sliding and folding motion. They are usually suspended by a horizontal rod or channel.
1.4 ROMAN FOLD BLIND

The blind is sub-divided into multiple horizontal panels. When the cord strings are pulled, the blind folds up by forming overlapping pleats of the fabric.

Fig. 1.4a: Roman Fold Blind - Simple

Fig. 1.4b: Roman Fold Blind - Sealed Panels

1.5 ROLL-UP BLINDS

The top rail of a roll-up blind acts like a frame to anchor the screen. The bottom rail is used to roll the screen up or down.

Fig. 1.5a: Roll-up Blinds - Simple

Fig. 1.5b: Roll-up Blinds - Fixed Valance

2. WORKING MECHANISM

2.1 CLUTCH ROLLER BLINDS

A clutch roller blind has the screen wrapped on the top rail of the blind. It provides shade by increasing the suspension length of the screen, which unrolls from the top rail. In close position, the screen is completely wrapped on the top rail.

Fig. 2.1a: Components of Clutch Roller Blind

Fig. 2.1b: Cassette Designs
2.1.1 Clutch Roller Blinds (Simple) - Compatible Track Types

1. Cord String Guided (Simple) - As explained in the Roman fold blinds section. (Refer 2.4.1)
2. Crank Shaft Operated (Simple) - As explained in the Roman fold blinds section. (Refer 2.4.1)
3. Cord String Guided (Cable Guided) - Similar to a simple cord string blind, these blinds have side cable as tracks to guide the blind and prevent it from blowing along the wind.
4. Crank Shaft Operated (Cable Guided) - Similar to a simple crank shaft operated blind, these blinds have side cable as tracks to guide the blind and prevent it from blowing along the wind.

2.1.2 Clutch Roller Blind (Cassette)

1. Track Guided Systems:
   Track guides have side channels as guiding tracks, in which the screen moves up and down. These tracks are preferred for motorised blinds as it makes the functioning easier.
2. Zipper Track Guided Systems:
   Similar to track-guided systems, Zipper tracks have a zipper installed in the track. The blind zips and unzips in the tracks when rolled up and rolled down.
2.2 VENETIAN BLINDS

Venetian blinds have horizontal slats. When the strings are pulled down, all the slats start to stack upwards and lift the blinds up.
The blinds have a two-cord system:
1. One cord is used to move the blind vertically.
2. The other cord is used for rotating the slats.

2.3 OUTDOOR CURTAINS

Outdoor curtains have two types of suspension systems.
1. Rod based.
2. Channel based.

2.4 ROMAN FOLD BLIND

A Roman Fold Blind is sub-divided into multiple horizontal panels. Each panel is connected to the inner ring in two positions.
1. In the closed position, the cold string is pulled to make the panel fold to half its length and overlap with the panel above it.
2. In the shading position, the cold string is let loose so that the panel opens to its full length one by one.
2.5 ROLL-UP BLINDS

2.5.1 STRING AND PULLEY SYSTEM

In the string and pulley system, the string is attached to the bottom rail through the pulley. Pulling and releasing the string make the blind open and close, respectively.

2.5.2 ROLL-UP BLINDS: SIMPLE

A Roll-Up Blind’s top rail acts like a frame to anchor the screen. The bottom rail is used to roll the screen up or roll it down.

2.5.3 ROLL-UP BLINDS: FIX VALANCE

A Roll-up Blind with fix valance has an additional valance screen. This screen is suspended to hide the cord, which works as a locking mechanism.

2.5.4 CORD LOCKING MECHANISM

The cord lock installed on top of the blind enables locking the cord of the blind at any desired position.
3. ANCHORING MECHANISM

3.1 CLUTCH ROLLER BLINDS AND VENETIAN BLINDS

3.1.1 ANCHORED TO THE WALL
The top rail is anchored to the wall with the help of fasteners. Hence the blind is anchored just above the window (see figure on the left). A clutch blind with side tracks would require space on the ground or wall for fixing Venetian Blind and a clutch roller blind (simple) can be anchored to the door in a similar manner.

3.2 ANCHORED TO THE CEILING
The top rail is anchored to the soffit of the ceiling with fasteners or hooks. Hence the blind is anchored in Clutch blind with side tracks require side fixing (see image 3.2b).
3.3 OUTDOOR CURTAINS

3.4 ROMAN FOLD BLINDS AND ROLL-UP BLINDS

Roll-up and Roman Blind’s top rails function as the anchoring member. These blinds can be anchored in the following ways:

**Anchored to the Wall**
The top rail is anchored to the wall with the help of fasteners. Hence the blind is anchored just above the window.

**Anchored to the Ceiling**
The top rail is anchored to the soffit of the ceiling with fasteners or hooks. Hence the blind is anchored in level with the window frame.

**Anchored to the Shutter**
The blinds can be anchored to the shutter frame, like in the case of a door. The top rail of the blind is anchored to the top rail of the door.
4. APPLICABILITY AND SIZING

4.1 CLUTCH ROLLER BLINDS

The maximum size of blinds varies with the choice of fabric.

4.2 VENETIAN BLINDS

Venetian blinds come in various slat depths; the maximum dimensions of blinds vary accordingly.
4.3 **OUTDOOR CURTAINS**

![Diagram of Outdoor Curtains](image)

**Fig. 4.3:** Applicability based on Building Component

4.4 **ROMAN FOLD BLINDS**

![Diagram of Roman Fold Blinds](image)

**Fig. 4.4a:** Applicability based on Building Component

**Fig. 4.4b:** Sizing (Sizing may vary depending on the manufacturer.)
4.5 ROLL-UP BLINDS

Fig. 4.5a: Applicability based on Building Component

Fig. 4.5b: Sizing (Sizing may vary depending on the manufacturer.)
5. CASE STUDY

5.1 CLUTCH ROLLER BLINDS

Fig. 5.1: Private Residence at Chennai

5.2 VENETIAN BLINDS

Fig. 5.2: Bengaluru, Karnataka
5.3 ROMAN FOLD BLINDS

Fig. 5.3: Verandah View of a Private Residence

5.4 ROLL-UP BLINDS

Fig. 5.4: Verandah View of a Private Residence
6. MAINTENANCE

6.1 CLEANING OF BLINDS AND CURTAINS

In general, a mild detergent can be used for cleaning all types of blinds and curtains to remove dirt and corrosion-induced rust.

6.2 CLUTCH ROLLER BLINDS

**MILD DETERGENT**
- Mild detergent can be used to remove dirt build-up.
- Frequency as per usage and surrounding climate.

**DRY LUBRICANT**
- Use dry lubricants for tracks and movable parts.
- Petroleum-based lubricants are not advised as they accumulate dirt and dust, which can impede the operation of the blind.

6.3 VENETIAN BLINDS AND CURTAINS

**MILD DETERGENT**
- Mild detergent can be used to remove dirt build-up.
- Frequency as per usage and surrounding climate.

**VACUUM CLEANING**
- Vacuuming the dirt can quickly remove dirt from difficult places.
- Frequency as per usage and surrounding climate.

6.4 CLUTCH ROLLER BLINDS

**MILD DETERGENT**
- Mild detergent can be used to remove dirt build-up.
- Frequency as per usage and surrounding climate.

**REPLACEMENT OF PANEL**
- Damaged panels alone can be replaced, thus saving the cost of buying a new blind. The cost of replacement depends on the quality and cost of the fabric.

6.5 VENETIAN BLINDS AND CURTAINS

**MILD DETERGENT**
- Mild detergent can be used to remove dirt build-up, rust, and corrosion.
- Frequency as per usage and surrounding climate.

**REPLACEMENT OF CORD LOCK**
- Damage to the cord lock is dependent on the frequency of its usage. Care should be taken while operating the cord that is parallel to the blind. A damaged cord lock can be replaced. Also care should be taken to operate the cord parallel to the blind.

Motorisation:
Roman and Roll-up blinds can be motorised and automated as per the preference of a user. Roll-up blinds are not motorised usually.

Cost of Motorised Vertical Screens (₹/sq.ft):
- ₹7,000-30,000
- ₹50,000

Cost of Motorised Vertical Screens (₹/sq.ft):
- ₹7,000-30,000
- ₹50,000

- Motorisation: Roman and Roll-up blinds can be motorised and automated as per the preference of a user. Roll-up blinds are not motorised usually.

Vertical screens can be retrofitted.

Cost of Motorised Vertical Screens (₹/sq.ft):
- ₹7,000-30,000
- ₹50,000
7. KEY FEATURES/ BENEFITS

7.1 CLUTCH ROLLER BLINDS

Zipper tracks are more efficient in windy conditions compared to other vertical screens.

Fig. 7.1: Clutch Roller Blinds

7.2 VENETIAN BLINDS

Venetian Blinds reflect diffused daylight in the interior space and create more daylit areas.

Fig. 7.2: Venetian Blinds
7.3 OUTDOOR CURTAIN

As curtains have slits, they let a through-passage even in completely open position.

7.4 ROMAN FOLD BLINDS

1. Each panel can be removed separately without replacing the whole blind.
2. Monsoon blinds are mainly Roman blinds with water-proof screens for the panels.

7.5 ROLL-UP BLINDS

1. The cord-locking mechanism enables easy operation.
2. Roll-up blinds are the most commonly available blinds.
3. Roll-up blinds are available in natural material such as bamboo.
SHUTTERS

Composed of solid materials such as wood and PVC and are designed as louvers or solid in-fill panels. The glass panel of the opening is inside, while the shutter faces the outside.
SOLAR HEAT GAIN COEFFICIENT

SHUTTER WITH ADJUSTABLE LOUVER

**Fig. A:** Shutter - Louvers at 0°

**Fig. B:** Shutter - Louvers at 45°

**Fig. C:** Shutter - Open State

**ANATOMY OF A SHUTTER**

- **Louver**: The adjusting of louver angles results in different proportions of shading.
- **T-Post**: T-Post is a part of the structural member that helps in anchoring.
- **Frame**: The frame is used to anchor the shutters to the wall.
- **Top-Rail**: It is a horizontal bar at the top of the panel. It acts as the structural frame for the shutter panel.
- **Bi-Fold Panel**: Bi-fold panel is the main element of a shutter, which provides shading by opening and closing. The shutters are opened and closed by folding the bi-fold panels against each other.
- **Bottom Rail**: Bottom rail is the horizontal bar at the bottom of the panel. It acts as the structural frame for the shutter panel.
- **Single Hinged Panel**: It is the main element of the shutter, which provides shading by opening and closing, by swinging on the hinges.
- **Tilt-rod**: The tilt-rod is used to rotate the louvers of the shutter.

**MATERIAL**

- **Aluminium**
  - Powder-coated
  - Sublimated polyurethane-coated (PU-coated)

- **uPVC**

- **PVC**

- **Timber/Engineered Wood**

**COST (₹/sq.ft)**

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<th>Material</th>
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<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber/Engineered Wood</td>
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<td>2000</td>
<td>1000</td>
</tr>
<tr>
<td>uPVC</td>
<td>0</td>
<td>2000</td>
<td>1000</td>
</tr>
<tr>
<td>PVC</td>
<td>0</td>
<td>2000</td>
<td>1000</td>
</tr>
<tr>
<td>Aluminium</td>
<td>0</td>
<td>2000</td>
<td>1000</td>
</tr>
</tbody>
</table>

**WIND TOLERANCE**

- **Low**: 0-50 km/h
- **High**: 50-100 km/h

**LIFESPAN**

- **Frame**: 30-40 years
- **Screen**: 30-40 years

*The SHGC of the product is dependent on its material properties.*
1. TYPES OF SHUTTER

1.1 SHUTTERS WITH ADJUSTABLE LOUVERS

An external shutter with rotatable louvers, which operate with the help of an in-built lever or a rod slider.

Fig. 1a: Shutters with adjustable Louvers

1.2 SHUTTER WITH FIXED LOUVERS

An external shutter having fixed louvers. The angle of tilt of the louvers can be customised.

Fig. 1b: Shutter with Fixed Louvers

1.3 SHUTTER WITH ADJUSTABLE COMBINATION LOUVERS

A shutter with alternative sets of louvers, operated with the help of two levers.

Fig. 1c: Shutter with Adjustable Combination Louvers
2. WORKING MECHANISM

2.1 SHUTTERS WITH ADJUSTABLE LOUVERS

![Louver Operation Methods]

- A lever, installed on the vertical member of the frame of the shutter, is used to rotate the louvers.
- A vertical slider, installed on a channel on the vertical frame member of the structure, is used to rotate the louvers.
- The vertical movement of the rod enables rotation of the shutter slats.

Fig. 2.1a: Operated by Lever
Fig. 2.1b: Operated by Slider
Fig. 2.1c: Operated by Rod

2.2 SHUTTERS WITH FIXED LOUVERS

The various opening states of a shutter are used as a dynamic shading state for various angles of the Sun. The common operating shutter methods available are as follows:
1. Sliding Shutter
2. Sliding and Folding Shutter
3. Hinged Shutter
4. Fixed Shutter
2.3 SHUTTER WITH ADJUSTABLE COMBINATION LOUVERS

They have two louver sets in a single shutter with the following configuration.

The shutter has alternatively installed louver sets, controlled with two different levers.

![Fig. 2.2a: Case 1](image1)

The shutter is divided into two parts and each part has a separate set of louvers, operated by two different levers.

![Fig. 2.2b: Case 2](image2)
3. ANCHORING MECHANISM

3.1 ANCHORED FROM TOP AND BOTTOM RAILS

Shutters can be anchored through Frame or channels provided only on top rail or bottom rail or both.
Compatible working mechanisms:
1. Sliding shutter
2. Sliding and folding shutter

Fig. 3a: Anchored from Top and Bottom Rails

3.2 ANCHORED FROM THE VERTICAL MEMBERS OF THE FRAME

The shutter are anchored to the vertical members and usually over a swing opening.
Compatible working mechanism:
1. Side hinged shutter

Fig. 3b: Anchored from the Vertical Members of the Frame
3.3 ANCHORED FROM ALL FOUR SIDES OF THE FRAME

The shutter is anchored to all four sides of the frame. Compatible working mechanism: Fixed Shutter

Fig. 3c: Anchored from the Vertical Members of the Frame

4. APPLICABILITY AND SIZING

Sizes can be customised, but with limitations that vary depending on the material used. For aluminium louver shutter, the maximum size is 3 x 8 ft.

Fig. 4.1a: Applicability based on Building Component

Fig. 4.1b: Sizing (Sizing varies based on the manufacturer.)
5. CASE STUDY

Fig. 5: Shutter with Adjustable Combination Louver Window in a Private Residence at Ahmedabad

6. MAINTENANCE

1. Mild Detergent (Rs 90/kg)
   Mild detergent can be used to remove dirt build-up, rust, and corrosion. Frequency as per usage and surrounding climate.

2. Dry Lubricant (Rs 970/250 ml)
   Dry lubricant for louver tracks and blade hinges. Petroleum-based lubricants are not advised as they accumulate dirt and dust, which impedes the operation of the louver. Frequency as per usage and surrounding climate.

Motorisation: All shutters can be motorised and automised as per the preference of a user.

Cost for Motorised Shutters (₹/sq.ft):

- ₹ 1,200-1,500
- ₹ 2,000

Additional Cost for Motorisation (₹/piece):

- ₹ 7,000-30,000
- ₹ 50,000

EMSyS-Shutters can be retrofitted.
7. KEY FEATURES/ BENEFITS

1. Allows air circulation while providing shade from direct solar radiation.
2. Provides for a view outside with privacy.
3. Provides for security as the louvers cannot be manually removed from the shutter.

A few suggestions on how to operate the shutters in different seasons is given below.

For Summer Months
- Preferred louver angles during summer months to block direct solar radiation: 0° - 90°
- Preferred louver angle for natural ventilation during night: 90° (perpendicular to the wall)

For Winter Months
- Preferred louver angles during winter months to allow direct solar radiation: 90° - 180°
- Preferred louver angle to prevent heat loss during night: 0° (parallel to the wall)
A comparison of the three categories of EMSyS products covered in the manual with reference to their life and initial cost is given in the following graph. The most long-lasting external shading product is an external shutter made out of wood or metal. Though it is the most expensive among the three categories, it is also the best performing product with the lowest solar heat gain coefficient in the closed position and will last almost as long as the building itself. In the case of re-tractable awnings and vertical screens, the frames have a fairly long lifespan, while the fabric or the screen material may need to be replaced at regular intervals. Between the two, vertical screens provide better shading compared to re-tractable awnings.

**Fig. 1 Comparison of Cost vs Lifespan**
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VERTICAL SCREENS
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SHUTTERS

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Indo-Swiss Building Energy Efficiency Project

The Indo-Swiss Building Energy Efficiency Project (BEEP) is a bilateral cooperation project between the Ministry of Power (MoP), Government of India and the Federal Department of Foreign Affairs (FDFA) of the Swiss Confederation. The Bureau of Energy Efficiency (BEE) is the implementing agency on behalf of the MoP while the Swiss Agency for Development and Cooperation (SDC) is the agency in charge on behalf of the FDFA. The Project Management and Technical Unit (PMTU) is responsible for programme implementation, which includes selected technical work, management tasks programme, and programme outreach.

About Bureau of Energy Efficiency

Bureau of Energy Efficiency (BEE) is a statutory body under the Ministry of Power, Government of India. It assists in developing policies and strategies with the primary objective of reducing the energy intensity of the Indian economy. BEE coordinates with designated consumers, designated agencies, and other organizations to identify and utilise the existing resources and infrastructure in performing the functions assigned to it under the Energy Conservation Act.

For further information

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