

Design of Retractable Roof for Open Auditorium

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Abstract - Design of a RETRACTABLE ROOF system for VVIT open-air auditorium by using tracks or rails with frames. The structure of the retractable roofs' system is fitted with twin-walled polycarbonate compact (looks like glass). Outer surface of all polycarbonate sheets are covered in a high-quality UV stabilization layer, which absorbs the effect of harmful UV radiation impairment, cracking unwanted colour changes in the polycarbonate. Retractable roof system is constructed with telescopic sliding segments which can be moved independently in both directions or as single synchronized telescopic system. Retractable roof system is constructed with telescopic sliding segments is safer than retractable glass roof systems. The main purpose of the project is to utilize the open air theatre during the day time and in the rainy season. The same mechanisms can also be used in stadiums, porticos, house roofs etc.

Keywords – Retractable Roof, structure, polycarbonate, UV stabilization.

I. INTRODUCTION

A retractable roof is a roof system designed to roll back the roof on tracks so that the interior of the facility is open to the outdoors. Retractable roofs are sometimes referred to as operable roofs or retractable skylights.

Retractable roofs are used in residences, auditoriums, restaurants and bars, swim centres and other facilities wishing to provide an open-air experience at the push of a button.

What it consists of:

Retractable roofs divided into three sections. They are-

1. Frames and Rails
2. Mechanism and its components
3. Trusses

1. FRAMES AND RAILS:

FOR FRAMES:

The frames are the one which covering an open place/terrace. They are made with aluminium & its alloys. Because of its great properties like-

- Low weight
- Low density
- High strength
- Superior malleability
- Easy machining
- Excellent corrosion resistance
- Good thermal and electrical conductivity
- It is easy to recycle.

The twin-walled polycarbonate sheets are used in frames because it has the properties like-

- Light weight
- High impact strength
- High light transmission
- Good weather resistance and UV protection
- High heat insulation
- Simply processed and installed

II. DIMENSIONS OF THE AUDITORIUM

The length of the auditorium = 35 meters

$35 * 39.3701 = 1377.9535$ inches

Berth of the auditorium = 27.3 meters

$27.3 * 39.3701 = 1074.80373$ inches

THE MASS OF THE FRAMES:

We designed four frames for the college open auditorium.

The mass of the frames are-

- a) FRAME 1: 3471 kg app.,
- b) FRAME 2: 3521 kg app.,
- c) FRAME 3: 3538 kg app.,
- d) FRAME 4: 3556 kg app.,

TOTAL = 14086 kg
= 14.086 ton

THE COST ESTIMATION FOR THE FRAMES:

The approximate cost estimation for the frames is-

Aluminium scrap per kg = 110/-

(Website: <https://m.indiamart.com>)

Total material cost = $14086 \text{Kg} * 110 \text{Rs/kg}$
= 15,49,460Rs

FOR RAILS:

The rails are used to run the frames on it. The rails are made up of the steel and its alloys because of its strength and hardness.

III. DIMENSIONS OF THE RAILS

The dimensions of the rail is = 1.5”*3.5”*1378”

THE MASS OF THE RAILS:

Mass of one rail =6357.44 kg

THE COST ESTIMATION:

The approximate cost of the rail per one = 8, 26,410Rs

For 2 rails = 16, 52,820Rs

IV. MECHANISM & ITS COMPONENTS

MECHANISM: TELESCOPIC SLIDING

The mechanism used in the retractable roof is automated telescopic sliding. The automated mean with motorised retractable system with help of rack and pinion system attached to the roof frames.

The mechanism components are-

- Timing belt
- Trolley assembly
- Stopper for trolley
- Pulley holder
- Double belt holder
- Bracket for belt holder

3. TRUSSES

The truss used to carry heavy loads and sometimes used as transfer structures. In this to carry the roof load we use the truss.

V. CONCLUSION

The general principle of cost vs. usage is – As usage increases, the cost comes down. We expect with this work done in a VVIT open air auditorium, there may be an increase in number of users either in commercial or domestic purpose.

The advantage of retractable roof dominates the cost. Definitely in near future, as number of consumer's increases, the cost will come down. The mechanisms used in the retractable roof system can also be modified according to the requirement, availability of new materials, new methods of manufacturing, new design approaches etc; we look forward more & more usage of retractable roof systems not only commercial aspects but also domestic usage.

