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Architectural Control of Sunlight – Penetration through Windows

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Abstract: ***Now a day's sunlight has a great importance in designing of human settlement. This particular paper is devoted towards the sunlight inside the habitat with calculations and scientific method to achieve good results. In this paper give few examples regarding different angles, solar position (azimuth & altitude) for given period to calculate accurate depth of sunshades, Chajjas & Louvers.***
Keyword: Habitat, Solar position, Louvers, Chajjas Azimuth & Altitude.

I. INTRODUCTION

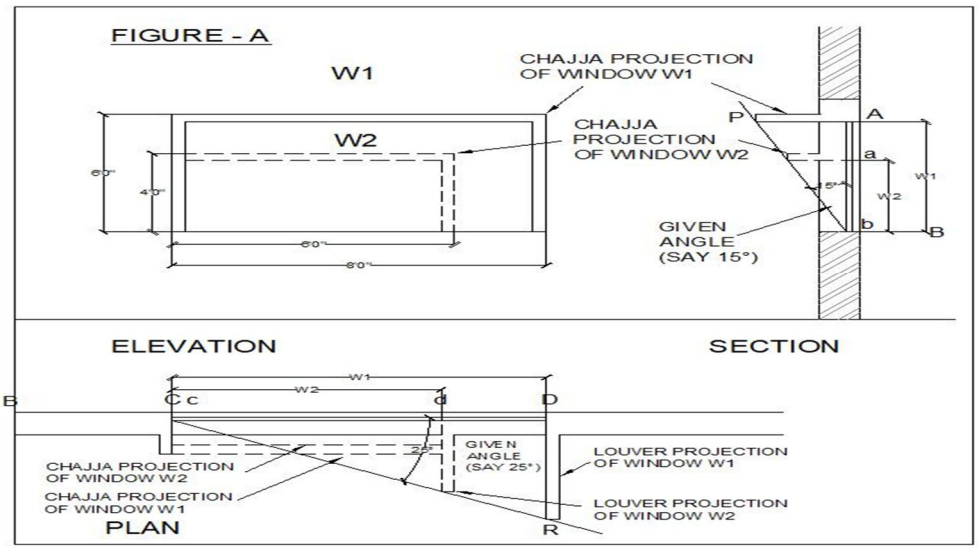
Comfort in buildings from the thermal point of view is now receiving more and more attention of architects and planners than paid hitherto. Traditional Devices like chajjas, deep overhangs of eaves & verandahs used for shading purpose, though quite common and fairly effective, do not give complete shadow cover, particularly in the direction of South, South-West and West. They are also either cut down in their projection, or entirely omitted sometimes for reasons of economy. Some of the old ideas of putting awning or weather shades in lighter materials like timber and A.C. Sheets are somehow no longer in vogue. The problem of satisfactory shading devices thus remained unsolved till the new idea of louvers or sun-breakers came to be used in India.

The introduction of this idea into our contemporary buildings has been so rapid that it has remained, more or less, a blind imitation of Western design rather than based on a scientific approach in relation to the solar path, correct orientation of buildings and their functional requirements.

An important step to solve this difficulty has already been taken by the publication of "Climatological & Solar Date for India." It gives a method of designing louvers through worked out examples. Although adequate and enabling a designer to evolve suitable louvers for a given latitude, time and orientation of window, it involves reference to Tables, some calculations and drawing work. The need to simplify it further and to provide some readymade solution for ready references at the planning stage is thus necessary. The projections of chhajjas and louvers thus obtained will give protection against the Sun only and they may in certain situations be not adequate for the wind and the rain. A fully scientific design for the latter is however not possible at this stage for want of sufficient data**.**

II. BASIC PRINCIPLES OF LOUVER AND CHHAJJA DESIGN:

A. Design



It is necessary to know the intensity and duration of sunshine on the window in question. The position of the sun and amount of solar incidence at a given time and latitude could be obtained from the charts, graphs and tables published in the "Climatological & Solar Data handbook". It is also possible with this data and shadow protractor to design a suitable louver for a window facing a given direction at a given time a latitude. The diagrams given in this paper have been worked out with the help of the above referred publication and they provide an easy and rapid method of determining chhajjas and/or louver projections in advance of the planning stage. In order to cover most important areas in the country, eight cardinal directions i.e. North, South, West, East, North-East, North-West, South-East and South-West, for the latitude 13 and 23 degrees North have been taken. These, roughly represent Madras and Calcutta regions and will hold true for an area of approximately 100 miles North and South of each of these latitudes. The time taken is the hottest period of the day (10a.m to 5 p.m.) and hottest period of the year (May-July). It allows some amount of sun to penetrate during the morning and evening cool hours in winter months, as there will be only partial shadow cover at this time. Shadow angles of solar position (azimuth and altitude) for this period and given direction of the window face, at given latitude, have been plotted both on horizontal and vertical planes, on which the projection for desired shadow cover depends. The extent of the projections falling within these angles, therefore, will give an adequate shadow cover to a desired window. Where the projection of a single chhajja or louver in either vertical or horizontal planes is abnormally long, the method of using a number of louvers giving the same shadow cover is also shown.

The projection of chhajjas and louvers could be reduced further by putting them in an inclined position both in the vertical as well as horizontaol directions. These have been shown in some cases and the alternative positions shown in dotted line indicate enough flexibility of design. The solar position being the main criteria of determining required projections, no dimension of windows are given in the diagrams, Architects and Engineers can choose their own window sizes and utilize the angles plotted in diagrams to ascertain chhajja and/or louver projections by co-relating the cill and jamb of the window in question with those of the corresponding window in the diagram, as shown in Figure B and as explained in the example.

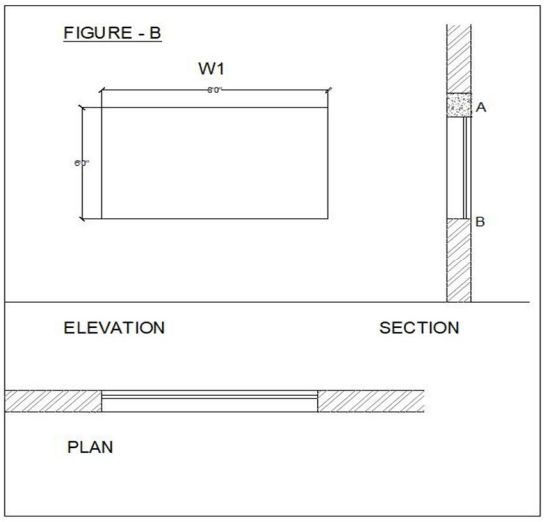
1) Example - 1

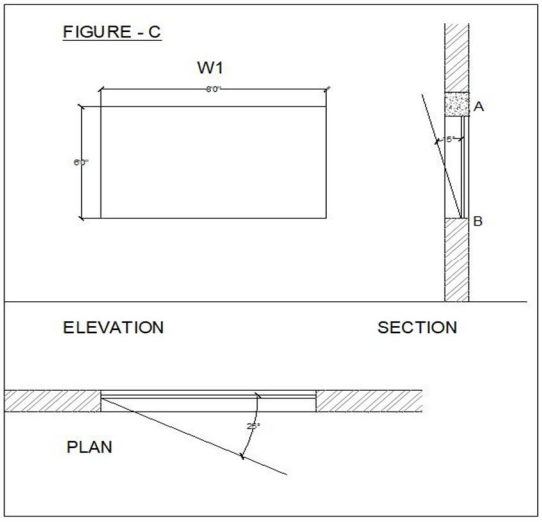
To find out chajja and louver projections for a window:

Size	:	8'-0 wide x 6'-0" high
Direction	:	Facing North
Latitude :	13° N	
Time	:	10.00 A.M to 5.00 P.M
Months :	May-June-July	

A. By Graphic Method

Similarly, for the projections of louver on the right side superimpose (as shown in fig. B& C) the plan of W_1 over that of W_2 so as to make the jamb C and frame C D to coincide with jamb c and frame of c d of W_2. Draw louver projection line D R to cut the line of 25° angle at R, the distance Q R is then the required projection i.e. 3'-9" as measured in actual drawing. The projection of louver is on the left side to be same as the chhajja projection.





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1) By Numerical Calculation For Accuracy

Projection OP = Tan Ø x A B

Where Ø is the angle of sun's position in altitude and A B is the height of window W_1 then Q R = 0.4663 x 8 = 3.73 feet.

Note:

a) The greater louver projection of 3.73 feet is because entire shadow cover is dependent on only one chhajja and two louvers, but will get reduced further if one or two more louvers are introduced in between the two jambs.

b) W_1 cited in the above example could in fact, for the purpose of superimposition, be any window drawn on tracing paper for which the louver and chhajja projection for a given latitude and direction of facing is to be found out, and W_2 a window facing the same direction and the same latitude corresponding to those given in the attached charts.

c) For the purpose of restricting the size of this digest windows for only two latitudes i.e 13°N and 23°N have been considered. Louvers and chhajja projections similarly worked out for the latitudes 19° and 29° are available from this Institute. So also, the prints of diagrams on larger scales for all the four latitudes are available.

B. Functional Aspects

The function of a chhajja or weather shade is to give protection against rain, sun and glare. It may, however, not necessary give complete protection because its location being only at the top of window, sides and lower portions are left exposed. One advantage of a chhajja, is that it permits free flow of air through the window.

Louver, as defined by the Oxford Dictionary is "An arrangement of overlapping boards, laths, or strips of glass admitting air but excluding rain". In the broader sense in which it is now used, the boards, laths or glass strips may be considered as having been replaced by in situ or precast reinforced concrete or brick, and their function, as admitting air but excluding not only rain but sun and glare also. The advantage of louvers over chhajja is, that if properly designed, they could give complete protection against sun and glare at the same time. Since, louvers could be provided in both horizontal and vertical direction they can give full shadow cover to the window.

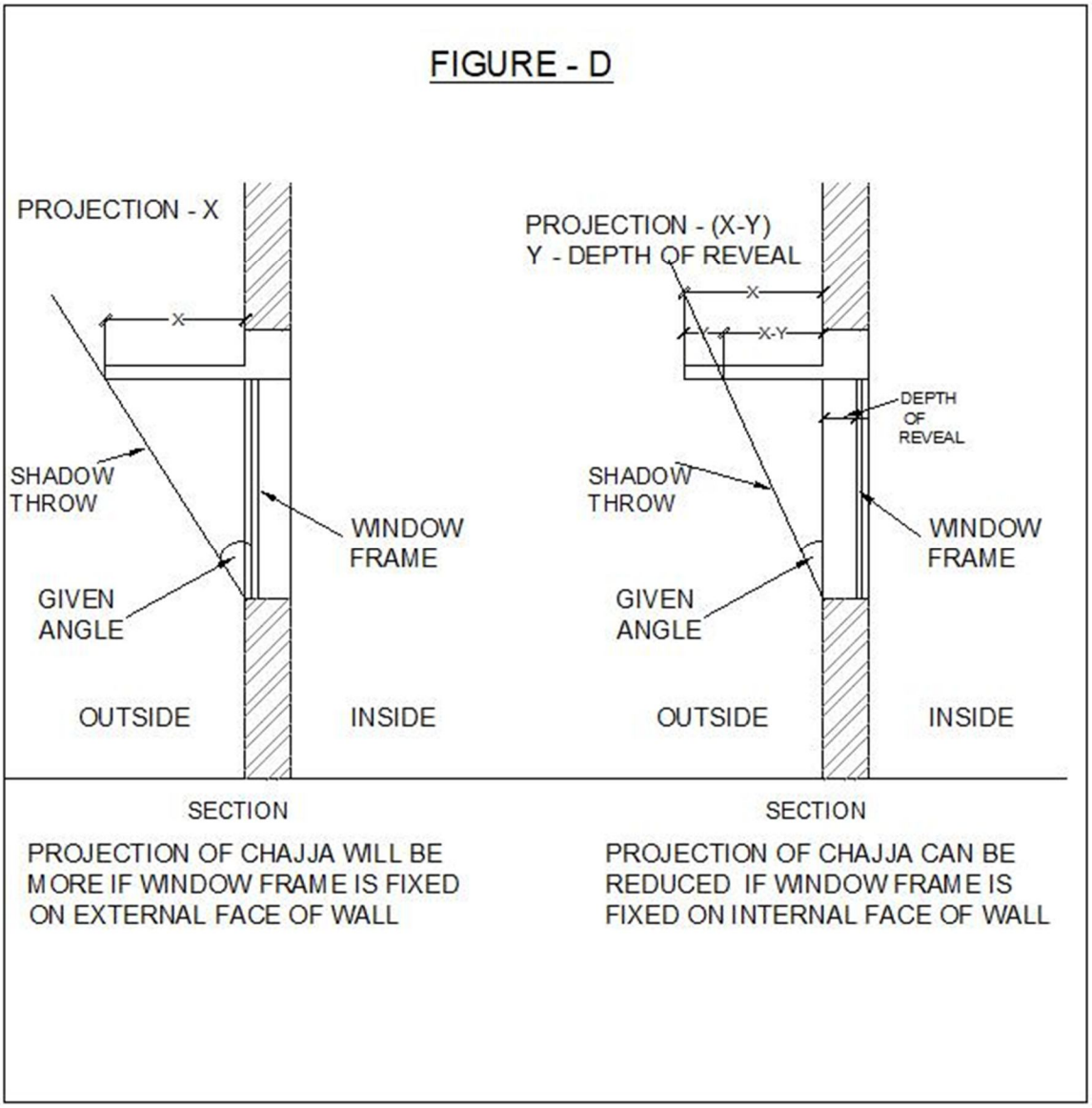
Chhajjas and louvers are very often provided for architectural treatments also. A judicious use of this element in building is therefore essential when the cost of providing them remains fairly high in proportion to their functional efficiency. The designer should decide at the first instance where and for what purpose he would provide them. With a proper study or local climatic conditions it is possible to find out whether simple chhajjas will be adequate or some form of louvers will also be necessary. It is also possible now to verify if only horizontal projection will be needed or only vertical projection will suffice or a combination of both are necessary.

A proper orientation of the building, as well as individual rooms are in relation to their use by itself will go a long way in reducing or even eliminating the need of chhajjas and louvers. Windows facing East or North will require very little protection against sun as compared with South and West. The morning sun from the East is not so oppressive and will generally be welcome. On the North wall too, the amount of solar incidence is much less. In areas where rain is not much of a problem, there will either by no necessity of providing chhajjas or louvers on the North and East or alternatively a smaller, projection may be sufficient.

Light and ventilation are the other two aspects closely connected with the design of chhajjas and louvers and it is essential that care is taken to see that these are not unduly affected. An important point, very often overlooked in this respect, is the free circulation of air around the window. The box and egg crate type louver being provided are most unsuitable from this point of view. As no space is left between the wall face and louvers the outside hot air gets entrapped into the boxes and transmits the heat into the room through the window. The cooling effect envisaged through the shading is thus reduced to a great extent. Projection of wide louver at the window sill level not only reflects the sun light causing glare and heat radiation, but also leads to the splashing of rain water on the window glass panes. Provision of box or egg crate type louvers should therefore, be avoided as far as possible, unless required for some special reasons as in case of multistoried buildings where a continuous louvered screen is provided for shading windows at all levels.

C. Structural Aspect

Chhajjas and louvers, being required to project out considerably from the wall are normally designed as cantilevers which add to the construction cost. Though, unavoidable in most cases, it is possible to reduce their actual projection by taking advantage of the depth of reveals by putting the window close or even flush with the inside face of the wall as shown in Figure.D



There is demand for short notes summarizing available information on selected building topics for the use of Engineers and Architects in India. To meet the Digests from time to time and the present one is the eighteenth in the series.

III. CONCLUSION

It is a proper calculation for different design of louvers against the sunlight. It is scientific method to calculate the effective louvers to cut the sunlight. This paper has a proper example to make the reader more clarified to calculate the different types of window chajjases & louvers in particular direction.

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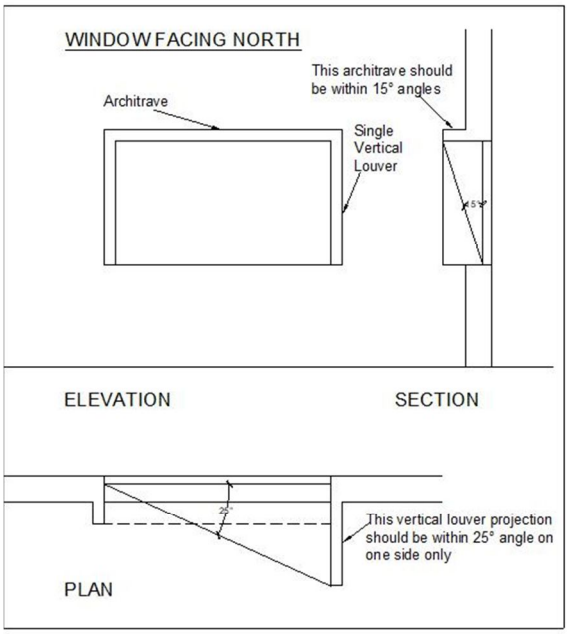
[2] Manual of Tropical Housing and Building Design by O HKoeeingsberger.



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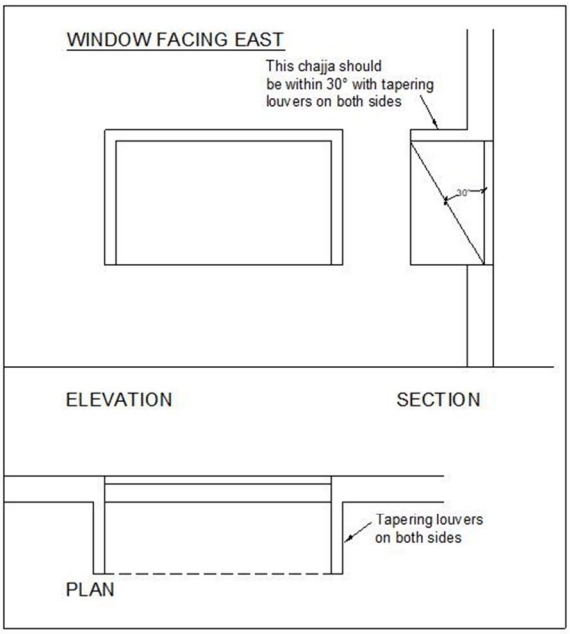

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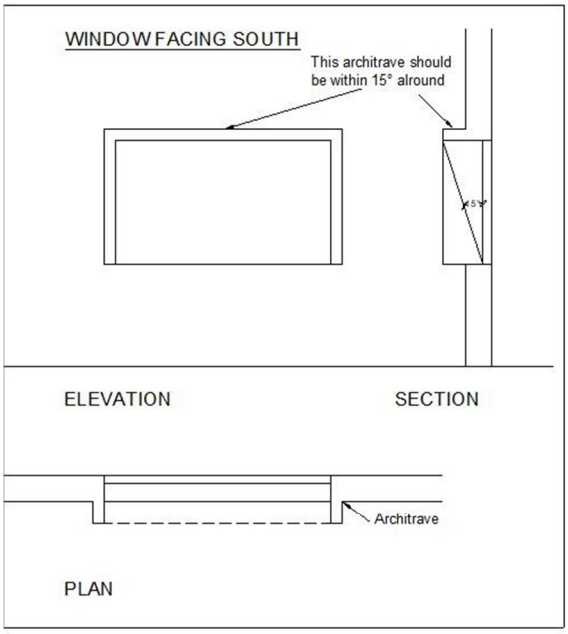

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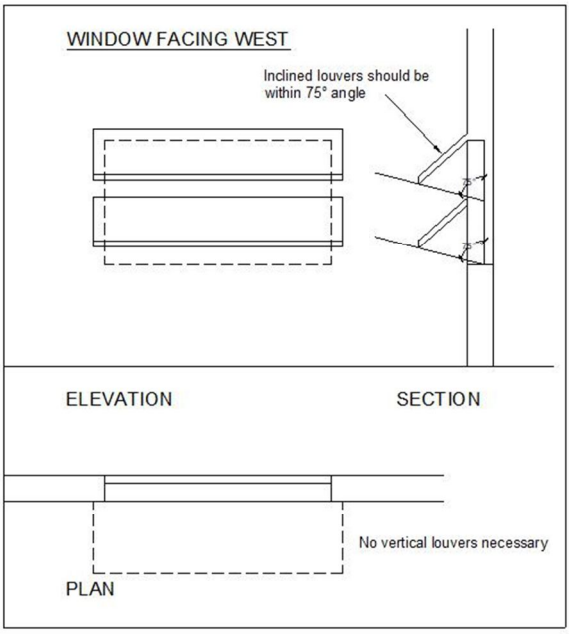

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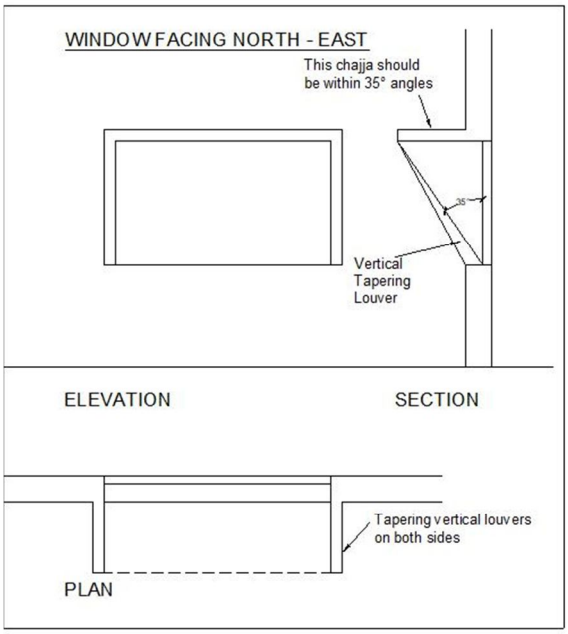

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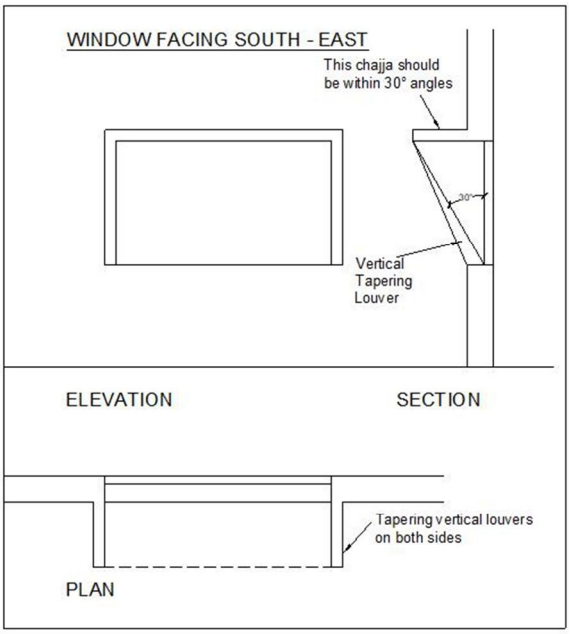

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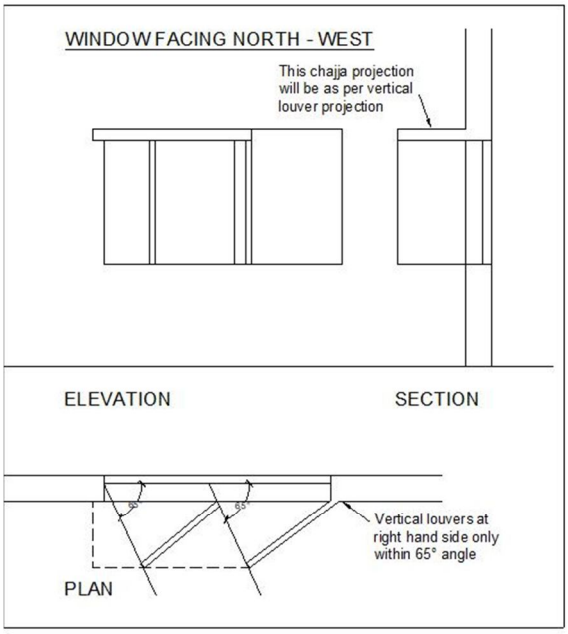

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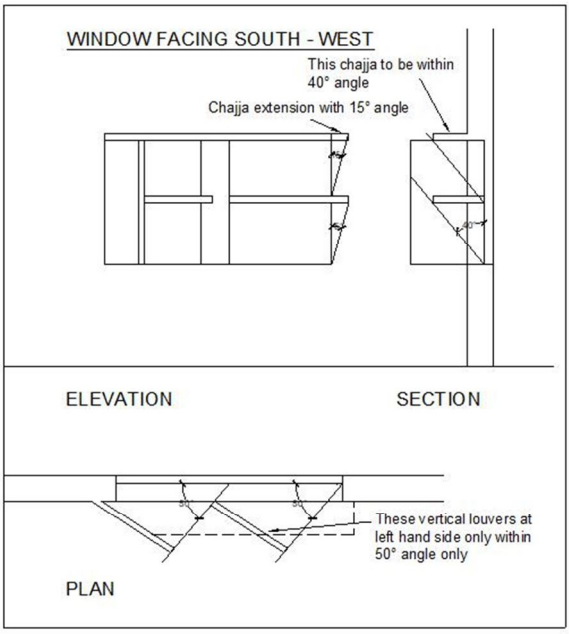

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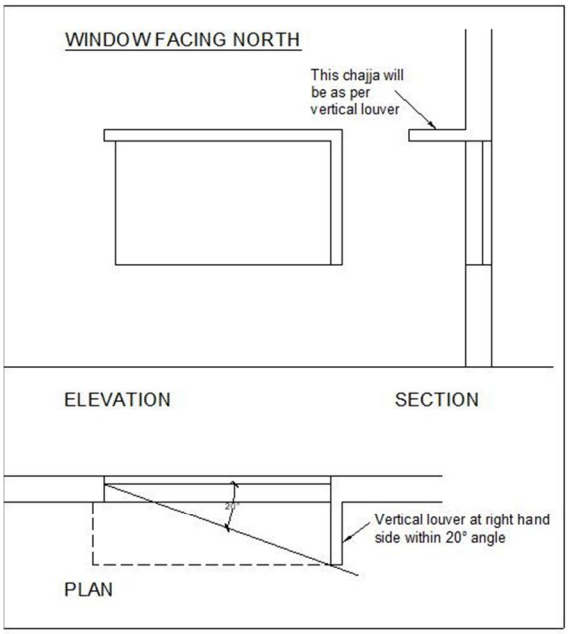

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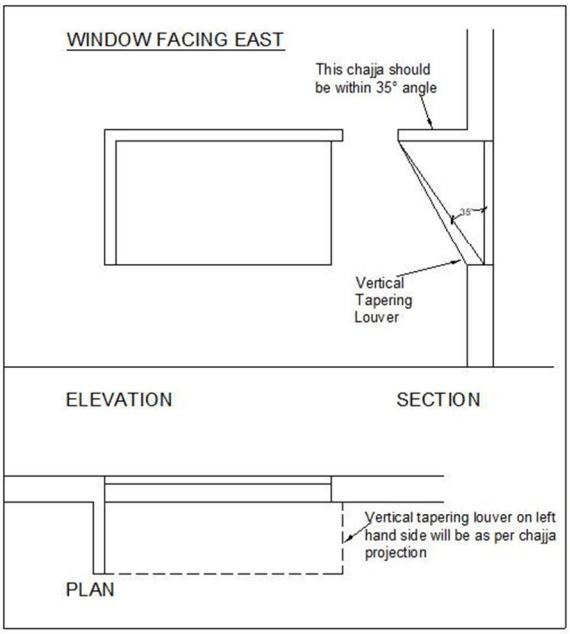

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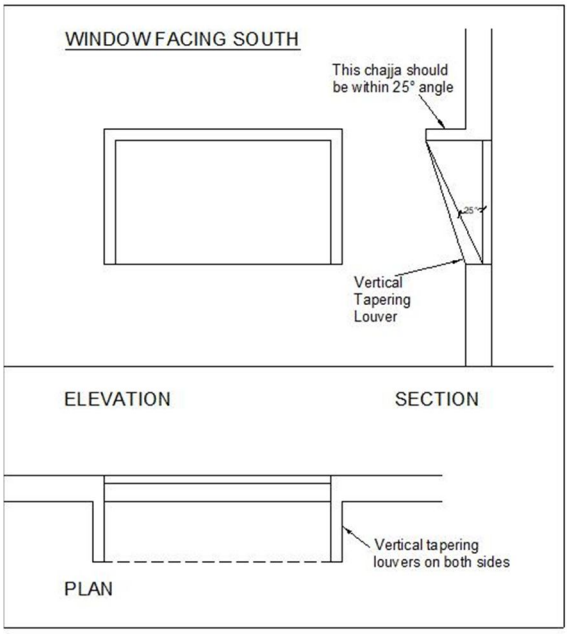

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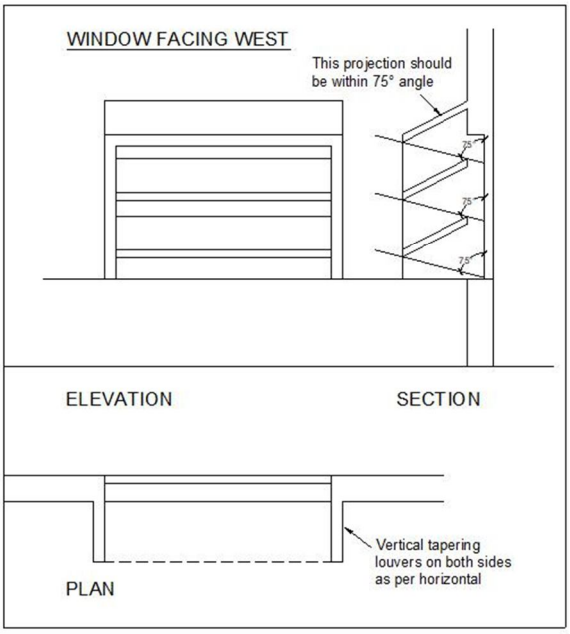

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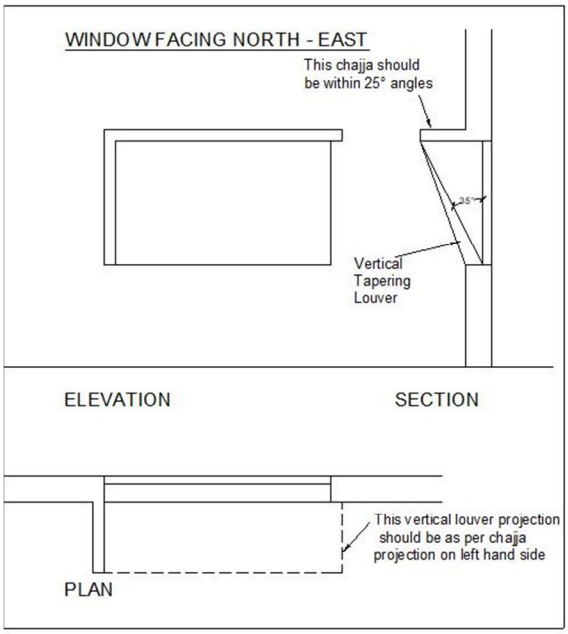

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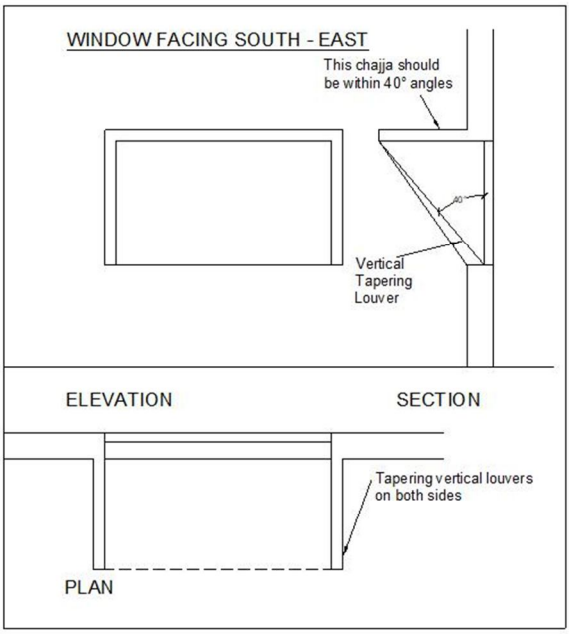

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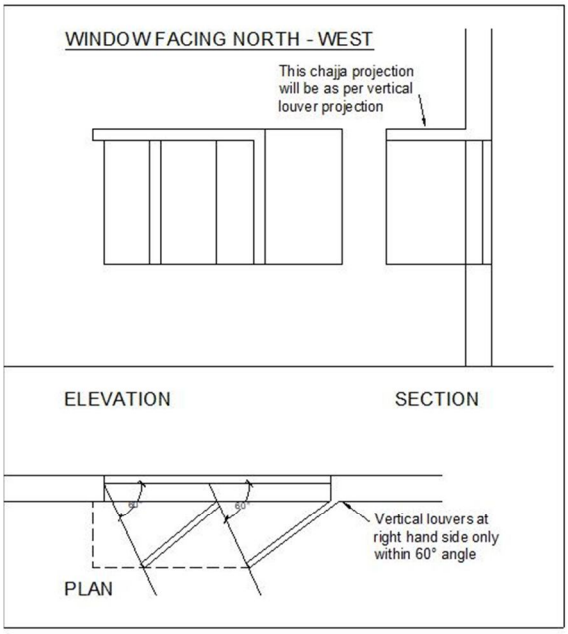

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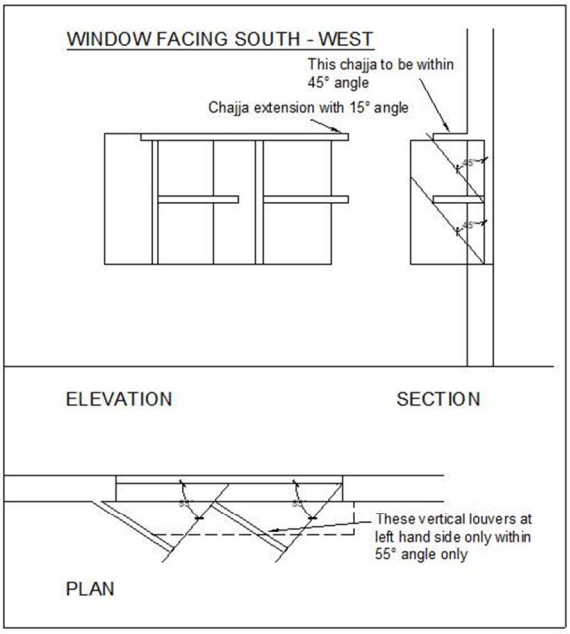

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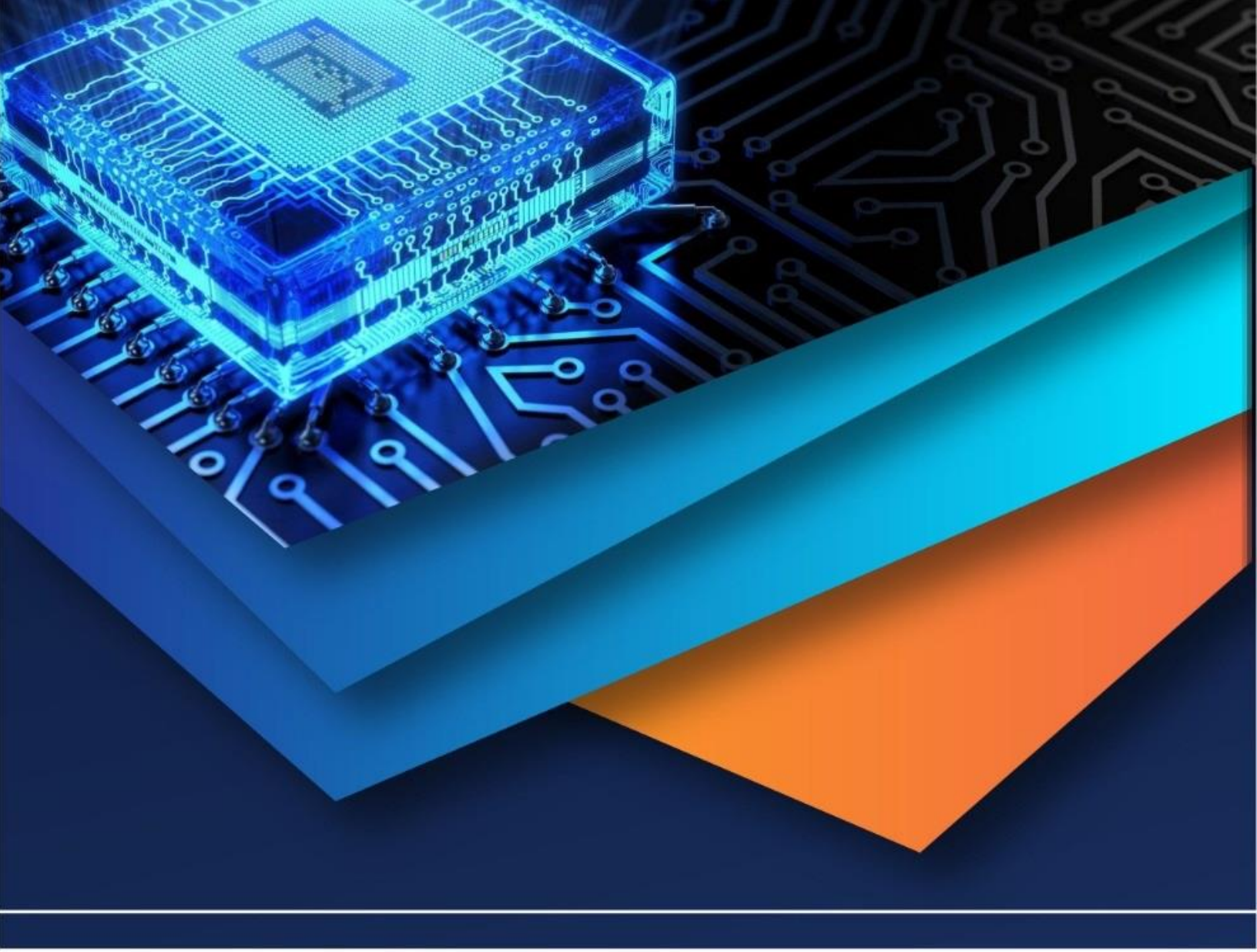

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