ANALYSIS AND DESIGN OF UNITIZED CURTAIN-WALL SYSTEM FOR HIGH RISE BUILDING.

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ABSTRACT

Abstract- Façade gives the building an exquisite design (i.e. unique design), which distinguish the buildings from each other. The materials used in the construction of the unitized panels are aluminum, glass etc, which can be recycled later and will be used again. The distinctive appearance is often the subject of controversial debate. Nowadays, unitized curtain wall system is mainly used for high rise building's, it becomes the major investment in both the construction industry and long-term durability of a building. Compared to the RCC structure and steel structure the unitized curtain wall system is new in the construction industry. This report will mainly focus on the design and analysis of unitized curtain wall system using stiffness matrix method and structural analysis programme (i.e. Staad pro). Nowadays the unitized curtain wall system, even the simpler type, are far more sophisticated than the earlier glazing system, though the many earlier glazing systems still performing admirably. More than fifty years of experience in the glazing field enable us to overcome the difficulties of the pioneering design, which results in better products. Beginning with the relatively simple, but innovative concept in the early 1950's, a series of window and glazing panel units are supported by the simple framing member. Curtain wall system has been developed over the years, in to an innovation of a highly engineered design. The main objective of this paper is to analyze ad design the unitized curtain wall system for the high-rise building.

Keyword: - *Façade, glass, aluminum profiles, MS brackets, Load bearing structure, Anchors.*

1. INTRODUCTION

Façade is a French origin, which means the front face. Facades are the first aesthetical features of a building that distinguish one from another. They determine its distinctive appearance and are often the subject of controversial debate. As a visible and representative element, it combines design with- important everyday functions such as protection against wind and weather, as well as noise protection, the storage of heat and the generation of energy. The use of glass in exterior façade provides more light and good ambience to the inhabitants of the building, which gave rise to the more use of glass. From the architectural point of view, the use of glass gives the aesthetic view to the building. A structure which is made up of aluminum frame work and the glass is pasted on it is called as curtain wall system. The vertical aluminum structure is called as mullion which acts like a column and the horizontal aluminum profile is called as transom which acts as beam in particular. The first curtain walls were made with steel mullions, and the plate glass was attached to the mullions with asbestos or fiber glass modified glazing compound.

1.1 Previous Study

Pallavi Taywade, Santosh Shejwal (March 2015)- Structural design of a glass façade [1], In this paper author introduced the curtain wall system, then analyzed and designed the system to withstand the system under adversary loading conditions. Glass has become a major element while designing the modern commercial or public buildings. The use of steel structure improves the load bearing capacity of the structure and improve the transparency of facades.

2. TYPES OF CURTAIN WALL GLAZING

Based on the method of installation, the curtain wall is categorized in to three types.

1. Stick Wall System
2. Semi-unitized system (hybrid system)
3. Unitized system

Above three we used the unit panel system which is also called as unitized system. From above three categorized curtain wall systems, unitized curtain wall system is more reliable, less time consuming, economical type of system. Since the panels are pre-fabricated in the factory and then it is assembled on the site is shown in figure-2.2. Due to pre-fabrication it in factory, it eliminates the quality control issues and labor work is reduced significantly. In a unitized system, the manufacturer must rely on the qualified installers to ensure the air seals are properly installed between the split mullions. Nevertheless, the unitized system is most popular in the glazing industry due to its quality, durability and workability.

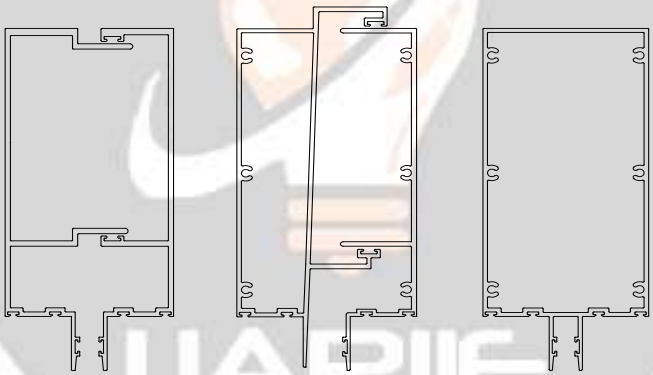

Figure-2.1 Unitized system (Split Mullion, Split Transom, Mid Transom)

Figure-2.2 Unitized panel & Fixing of Unitized Panel with MS Bracket

3. STRUCTURAL DESIGN

The curtain wall system is designed to withstand and resist all the loads as well as keep air and water from penetrating in the building. The imposed loads on the curtain wall is transferred to the building structure through structural interface (i.e. brackets) which attaches the mullions to the building. The curtain wall is designed for the following loads.

1. Dead Load
2. Wind Load
3. Barrier Load / Imposed Load / Live Load

Applicable Standard Codes

ASTM E1300 **(**2004**):** Standard Practice for Determining Load Resistance of Glass in buildings.
BS 8118 **(**1991**):** Structural Use of Aluminum. Code of Practice for Design
BS 5950 **(**2000**):** Structural Use of Steelwork in Building. Code of Practice for Design. Rolled and Welded Section.
IS 8147-Indian Standard Code of Practice for Use of Aluminum Alloys
IS 800-1984 Indian Standard Code of Practice for General Construction of Steel
IS 875-1987 (Part-1 dead Loads) Indian Standard Code of Practice for Design
IS 875-1987 (Part-3 Wind Loads) Indian Standard Code of Practice for Design
AAMA TIR-A11- 1996 Maximum Allowable Deflection of Framing System for Building Cladding Components at Design Wind Load.

Software Used for Analysis & Design

- Staad Pro V8i
- Ansys
- Hilti Profis Anchor

3.1 Wind Pressure Computation for Framing

Length	L	163105	mm	Ratio		For Computation of
Width	W	163576	mm	H/W	0.89	Wind load as per
Height	H	146600	mm	L/W	1	IS 875 1987-(Part 3)

Wind Load- 1.5 kPa

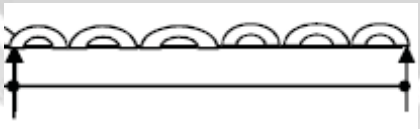

Figure-3 Uniformly Distributed Load due to Wind Load

3.2 Typical Mullion Analysis

Max Span Length	=	4.1	m
Max Bracketing span	=	4.1	m
Max Number of Split Transom per unit	=	1	no's
Number of Mid Transom Per Uni	=	2	no's
Max Deflection (δactual)	=	19.43	mm
Permissible Deflection (δperm)	=	Min (Span/175 or 20 mm) (AS per AAMA)	
Therefore, Permissible Deflection	=	20 mm	

δ actual < δperm (Provided section is ok)

3.2.1 Staad Results for Mullion

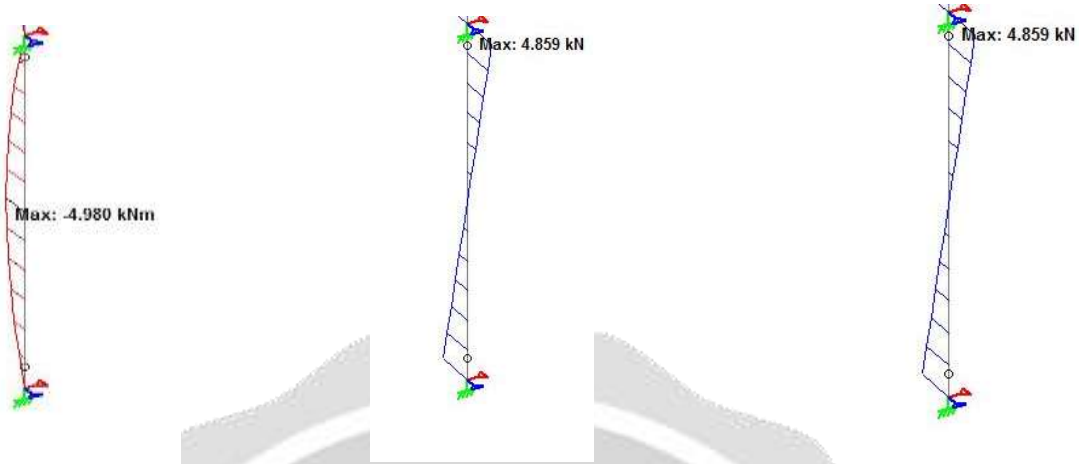

Figure-3.2.1. a Max. Bending Moment, Shear force, Axial force Diagram for Mullion

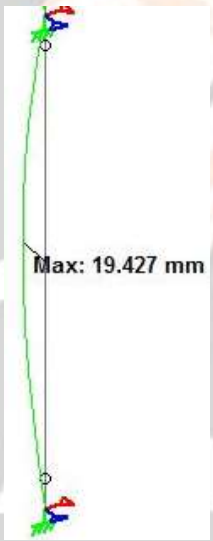

Figure-3.2.1. b Deflection of Mullion

3.3 Design of Glass as Per ASTM E 1300

Glass Size	=	1157 mm x 2100 mm
Type of Glass	=	6 mm Hs + 12 mm AG + 6 mm HS (Double Glass Unit)
Wind Load	=	1.5 kPa
Max Deflection at Centre	=	14.90 mm
Allowable Deflection of Glass	=	B/60 or 19 mm
	=	19.28 mm or 19 mm

3.4 Base Plate Design

Width (B)	=	220	mm
Depth (D)	=	200	mm
Thickness (t)	=	8	mm
Max BM	=	0.492	kN-m

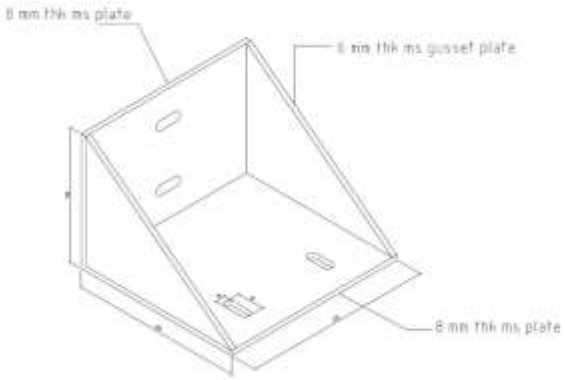

Figure-3.4 Mild Steel Bracket

3.5 Check for Through Bolt

Nos. of Bolt	=	2.0 Nos.	
No. Of Interface	=	1.0 Nos.	
Max. Vertical Shear Force	=	3.81 kN	(V) (2.0 Times Factored)
Max. Horizontal Shear Force	=	14.58 kN	(H) (1.5 Times Factored)
Día Of Bolt	=	12 mm	
Shear Stress Induced in Bolt	=	22.49 N/mm²	
Tensile Stress Induced in Bolt	=	85.96 N/mm²	

3.6 Bearing Check for Mullion At bolting point

Max Vertical Shear Force	=	3.81	kN
Thk. Of Mullion at Bolting Point	=	4.0	mm
Nominal Dia. Of Bolt	=	12.0	mm
No. Of Bolts	=	2.0	Nos.
Bearing Area of Mullion	=	96	mm²
Bearing Stress In mullion	=	39	N/mm²

Figure-3.4 Exterior View of Mfar Philips, Bengaluru

4. CONCLUSION

1) In the design consideration of unitized curtain wall system, there are some major items which will affect the structural integrity of the system, are the provision of movement and weather tightness are the chief concern.
2) The result of analysis on glass indicated that the size and wind pressure governed the deflection and stress behavior of glass, so it becomes a major issue while designing glass.
3) The use of steel in load bearing structure improves the transparency of façade because it has been possible to keep the unitized panel member slender as much as possible.
4) In this study, the unitized curtain wall system is introduced and the system is being analyzed using the finite element and using structural analysis software (i.e. Staad-Pro)

5. ACKNOWLEDGMENT

It is my privilege to express my deep sense of gratitude to all who have helped me during the course of my Project work. It is my prime duty to acknowledge my honorable guide and Co-guide Asst. Prof. VijayKumar Bhusare and Professor Asst. Prof. Prashant Patil for their stimulating, benign supervision throughout my work and also for giving constructive guidance, inspiration and untiring help and suggesting to do work on this interesting Project topic. I must also acknowledge Professor Prof. S. R. Suryavanshi for his encouragement and guidance.

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