Medical Office Building
Malvern, PA

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Structural Option
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Executive Summary

This report considers the lateral systems of the Medical Office Building in Malvern, Pa. The building site is in a corporate park with several low to medium rise buildings. It is an extension of an existing complex and joins the previous buildings with a sky bridge. Although mostly office space, the building does include a small auditorium that is used for conferences and stockholder meetings. The open office space and auditorium benefit from the 28’ square bays that are the basis of the structural system. The gravity system is composed of filigree slabs and beams resting on cast in place concrete columns. The lateral system is made up of cast in place frames in the east-west direction, and framing beams in the north-south direction.

The frames and beams in the building were analyzed based on strength and overturning. Deflection was not considered because the building is only four (4) stories above grade and was considered to be very stiff. The lateral loads that were utilized in the analysis were those due to wind. These loads were distributed to the frames in both directions based on the relative stiffness of each frame. The wind loads were divided among the stories based on the pressure gradient. Torsion in the frame was found to be 3189’k, the effects of this moment were felt mostly by the outermost frames in the north-south direction. The combined load of torsion and direct shear was used to calculate the overturning moments for each frame. The critical frame for overturning was determined to be a combined effect of the two west most north-south frames.

The overturning moments experienced by the critical frames were 47530’k and 24362’k. These frames together generated a net uplift of 576k on the column between them. After applying the axial loads to the column from above, 205k of uplift still existed. This means that the frame will overturn unless underpinning is provided. This underpinning may be provided by the strip footing at the base of the column that also bears the weight of three other columns that are not likely experiencing a net uplift. The remaining frames experienced significantly less uplift and were not considered to suffer from uplift.

In addition to uplift, the strength of the individual members in the frames had to be tested. A spot check of a beam and column in the east most central frame was used to determine the adequacy of member strength. The beam and column considered are those on the exterior bay below the top floor. A mistake in the load calculation resulted in a moment of 657’k, well above the strength of the beam, which was found to be 367’k without the safety factor. A 30% reduction of the negative load to estimate the correct amount found the ultimate moment to be 460’k, which places the beams design within an error resulting from design assumptions.

The column was also affected by the incorrect moment generated in the beam, but no corrections were necessary to verify the design. The column experienced an axial load of 326.9k and a moment of 308’k, the actual moment would be less so the use of the incorrect moment is conservative. Using column tables it was found that a reinforcing ratio of roughly 0.010 was required and the current design provided 0.015 so the column checks out.

Overall, the lateral system check is good. The overturning of the one frame may be resolved by the foundation design. The discrepancies in the beam can be dismissed as errors in analysis. The column appears to be over designed for the top, but is probably good for the bottom of the frame.