



Executive Summary

Innovative architecture demands innovative engineering solutions. The unusual shape and site constraints of the University of Cincinnati Athletic Center led to the initial design of a perimeter diagrid lateral system. This system has three main issues which must be addressed:

- 1) The original design is much heavier than a typical gravity-only perimeter system. Material costs are high.
- 2) Welded connections at each diagrid node are time and labor intensive. Labor costs are relatively high.
- 3) Very little of the usable window viewing height is glazed. Views of the surrounding landscape are limited.

This report is the culmination of a yearlong senior thesis project which researched the building and investigated the above issues. Three possible approaches to these problems, called “Solution Areas” were identified:

- I) Keep the perimeter lateral system in the current configuration while changing the material of its members
- II) Keep the perimeter lateral system while modifying its architectural (and hence structural) geometry
- III) Move the lateral system from the perimeter to within the building, changing the envelope to a curtain wall

Analyses were performed to determine feasible alternatives in each area. Several methods of analysis were used to compare between the alternatives and the original system. These methods included hand calculations, spreadsheet tables, computer modeling, and even simple qualitative evaluations.

The results found that changing the material in Solution Area I did not produce any additional benefits over the original steel wide flange system. Modifying the geometry in Solution Area II made the system more structurally efficient, but other factors decreased its effectiveness. However, removing the diagrid in Solution Area III and replacing it with a perimeter truss and braced frame system led to significant advantages, both structurally and architecturally. These advantages include:

- Reduced structure weight and increased efficiency
- Opportunities for more usable windows by opening up the façade with a curtain wall
- Minimal impact to the interior layout
- No change in floor-to-floor height
- No impact on floor framing layout

Preliminary daylighting and construction management studies were also performed to evaluate the perimeter truss design and its effects on the rest of the building. The studies further refined the design, and found that the new curtain wall does not have any major issues which would be detrimental to its feasibility.

Overall, the structural redesign of the University of Cincinnati Athletic Center was successful. The innovative perimeter truss and braced frame system is a viable alternative to the original diagrid not only from a structural engineering standpoint, but from an architectural perspective as well.