VOLUMETRIC TRANSPARENCY:
Application of an Improved Double Glass Facade System to Cowgill Hall, Blacksburg
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Abstract

The initial idea for this thesis involved the design of an addition to Cowgill Hall on the Virginia Tech Campus in Blacksburg, Virginia. This addition, to be constructed with an envelope comprised primarily of glass, would be located on the south side of Cowgill Hall, adjacent to Cowgill Plaza. The all-glass box would add a transparent volume to the existing building, diminishing the barrier between inside and outside. The project would also energize the existing plaza by connecting the activity inside to outside and providing the dynamic reflection of a glass facade. Cowgill Hall would also be given new life by providing a new shared vertical space for dynamic communication and light. Potential problems associated with the all-glass box include high heat loss or gain, glare and noise control. A double envelope system of construction was explored as a means of solving some of these problems and an endeavor on literature review, technical research and design improvement of double glass facade was also made.
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Site
Volume + Transparency

Site Plan

1. Cowgill Hall
2. Cowgill Plaza
3. Burruss Hall
1. How is the addition connected to the existing structure?

2. What architectural transitions are necessary between the new volume and the existing surroundings?
Structure

Idea Development

Structural elegance and Lightness are the primarygoals of theatrium addition to achieve volumetric transpar-

cy. Several optional structural systems were studied by asking: How are the primary structure, secondary
structure and skin as a whole related and what role does each element play toward the goals?

1. Suspension Structural Sys-
tem:
A suspension structural sys-
tem is very light and elegant. It will also provide the possi-
bility of suspending the floor, which creates spatial benefits by offering usable area at the upper level without intrusive structure at the lower level of the atrium space. However, a steel truss may obstruct and occupy additional space on the plaza, which may make the facade too obtrusive in the plaza. Considering the existing Burchard Hall underneath the plaza, the construction pro-
cess would be difficult, and the foundations may not be easily accomplished.

2. Truss Structure with Mul-
lion System:
A truss structure may not be as light as a suspension struc-
ture, but it is an easier con-
struction method, with fewer conflicts with the existing un-
derground structure. A mullion system can also easily connect the structure and the glass skin. However, the steel truss does not belong to the language of the plaza and the surrounding buildings, which are glass and concrete or stone. A mullion system may also block up to 30% of the facade, causing loss of trans-
parency.
3. Truss Structure with truss suspension system: Instead of using a mullion system, a truss as a secondary structural system may be used, which can reduce the mass of the secondary structure, thus enhancing transparency. However, in this case, the depth of the steel truss system, plus the secondary truss suspension system, becomes a problem in terms of spatial efficiency because it consumes a relatively large portion of the atrium space.

The final solution uses a steel column and beam plus a secondary truss system, which has the best balance of lightness and minimum space usage. The structure is inside, so the facade has a planar appearance to the plaza.
Structure
Solution  Steel Column + Truss Suspension System + Spider + Prefabricated Double Glass Unit

Steel column structure-
The first element in the hierarchy of the structural system.

Truss suspension system-
The secondary element in the hierarchy of the structural system, transferring load from the spiders to the columns.
Spider-
The third element in the hierarchy of the structure, attaching the glass to the truss system.

Prefabricated double glass unit-
The fourth element in the hierarchy of the structure, attached to the spider, providing the enclosure of the atrium.
Structure
Truss System

Every truss unit is composed of two pieces of single steel rod. One member primarily resists positive pressure on the glass skin, while the other primarily resists negative pressure.

A truss system is a very light secondary system to support the spiders and glass skin. But it has to have a certain distance between the two members of the truss to hold the horizontal load. In order to save space, the truss system must be tightly integrated with the columns, so they overlap each other in plan rather than occurring as successive layers in the steel truss structure + secondary truss system alternative discussed earlier.
The dimension of the truss unit on the east and west facing facades are half that of the south-facing facade. Therefore its profile varies from the typical truss unit on the south facing facade.
Column clips are used to connect the column and the truss. They are designed to receive the two members of the truss, and grasp the column at the same time. Due to different locations of the columns and different truss types, the column clips need to have three different configurations.