

# USSynthetic Building 4



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## Introduction

US Synthetic is a synthetic diamond manufacturing company located in Orem, Utah. Over the last ten years, US Synthetic has nearly doubled its employee count and annual revenue. In 2011, US Synthetic added a third building to its campus to increase its production of synthetic diamonds.

Building 3 was designed and built to be connected to a future building. With company growth continuing as expected, US Synthetic contracted Diamond Engineering to design Building 4.

Diamond Engineering's design of Building 4 will offer the client nearly 40,000 square feet of additional administrative and production space. Building 4 will tie into Building 3 and will match the campus's aesthetic style.

Building 3 was built with tilt-up concrete walls and a steel frame. Diamond Engineering evaluated three other alternatives along with tilt-up concrete in order to present US Synthetic with other options that could possibly be more economical.

## Design Criteria

US Synthetic provided Diamond Engineering with design criteria for Building 4. These included a construction cost within the designated budget, a construction time less than six months, minimal maintenance required, and a cohesive aesthetic.

## Alternatives

Diamond Engineering evaluated four design alternatives on the criteria outlined in Table 1.

- Tilt-Up Concrete
- Corrugated Steel
- Concrete Masonry Units (CMU)
- Cast in Place Concrete

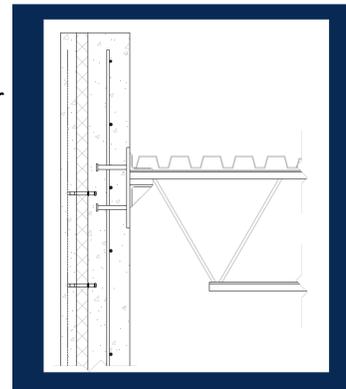
Special emphasis was given to stakeholder input and therefore it was given a weight factor of two.

Table 1- Alternatives Decision Matrix

Design Criteria	Tilt-Up Concrete	Corrugated Steel	CMU	Cast in Place
Design Cost	3	4	1	4
Construction Cost	4	4	1	4
Construction Time	4	3	2	2
Maintenance	4	1	4	4
Aesthetic	4	1	2	3
Stakeholder Input	4	1	2	3
Total Rating	26	15	14	23

## Selected Alternative

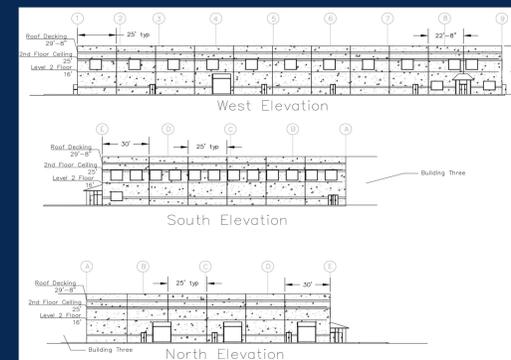
Diamond Engineering selected as the preferred alternative the tilt up concrete design. The primary driver of this decision was the client's input. Building 3 of the US Synthetic campus was previously constructed with tilt up concrete and the client insisted the two match aesthetically.



Tilt-up concrete design involves casting concrete slab walls on site around the exterior of the building. After the slabs cure they are tilted up to form the exterior walls.

These exterior walls are supported by a steel frame infrastructure and the concrete foundation slab.

Figure 1 – CAD Rendering and Elevation Views



Isometric rendering of Building 4 and Elevation views of the three exterior sides of Building 4

Figure 2 – US Synthetic Campus-Orem, UT



Overhead view of the US Synthetic campus with the proposed footprint of Building 4 (outlined in red)

## Design Process

Diamond Engineering determined the different live and dead loads that meet the ASCE codes in Orem, Utah. The girders and joists for the roof were the first parts to be engineered. From there, Diamond Engineering designed a roof decking as well as the different shear tab connections to the girders and joists.

Once the roof was finished, the columns and concrete panels were then engineered to withstand the loads transferred from the roof. Each panel consisted of thirteen inches of concrete with two inches of insulation sandwiched in the middle to control the interior temperature. The final element designed was the footings for the walls and interior columns. The total estimated cost to construct the building is approximately \$4.6 Million.

## Support

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