

# Design-Construction of United Bank Tower

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*Presents the design-construction highlights of a \$13 million high rise office building in Colorado Springs. A major feature of this prestigious building is the integration of both architectural and structural precast, prestressed concrete components and especially the dual function of exterior wall panels which provide aesthetic expression and serve as loadbearing elements.*

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**T**he new United Bank Tower is the predominant feature of the Palmer Center — a multipurpose redevelopment complex in downtown Colorado Springs, Colorado. In addition to the Tower building, the Palmer Center includes the 13-story Antlers Doubletree Hotel, a four-level underground parking structure, a retail arcade, a conference center and an attractive courtyard comprising water fountains and a pergola.

The 16-story building, which reaches a height of 248 ft (75.6 m) above grade, is the tallest structure in Colorado Springs — a thriving metropolis with a population of 300,000. The building comprises a gross area of about 249,000 sq ft (23160 m<sup>2</sup>).

The new building re-establishes the



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Artist's rendering of Palmer Center in downtown Colorado Springs, Colorado.

importance of a key crossroads in the business center. The site, which defines the western edge of the downtown area, is historically important and has traditionally marked the symbolic gateway into Colorado Springs and from the city to Pikes Peak and beyond.

Recognizing the historical significance of the site and the character of the financial institution which is the main tenant of the building, the exterior expression seeks to recapture the pioneering spirit of old by redefining it in contemporary terms rather than copying it. The concept is neoclassical, grand in scale, ordered in its massing, but intimate in detail. Above all, the expression is human in scale, with the intensity of detail concentrated at the street level to give texture and character to the public space and entrances and again at the top of the building to emphasize its profile and identity.

A key design feature of the building is the integration of the structural floor system [comprising 24 in. (610 mm)

double tees] with the loadbearing architectural wall panels. Thus, the exterior wall panels perform a dual function — providing the necessary aesthetics and principal loadbearing elements for the structure.

A limestone colored white matrix was used to produce the panels, which were given an acid etched finish. The meticulous detailing of the panels is reminiscent of skilled stone work, yet was produced efficiently by taking advantage of formwork economies. Repetitive features are combined in different ways to accomplish the rounded corner miters, varied reveals and cornice detailing.

The building was designed for a typical live load of 50 psf (2.39 kPa) plus a partition load of 20 psf (0.96 kPa). The second floor supported an unusually heavy money vault for which a total design dead load of 360 psf (17.2 kPa) was assumed.

The structure was designed for a wind load equivalent to Exposure C

with a basic wind speed of 85 miles per hour (137 km/hr).

Since the building is situated in Seismic Zone 1, a *K* factor equal to 1.33 was used in the design. It was found that seismic considerations controlled the design.

A total of 1185 precast concrete components (comprising double tees, inverted tee beams, mullions, wall panels and other elements) were used.

The exterior loadbearing architectural precast wall panels are typically 14 ft 6 in. x 16 ft x 8 in. thick (4.42 x 4.88 m x 203 mm). Vertical load transfer at the exterior of the building was accomplished by spanning from the core to the exterior walls horizontally to monolithically cast 13 x 30 in. (330' x 762 mm) column elements within the wall panels. Also, 11 x 15½ in. (279 x 394 mm) precast mullions, integral with the panels, allow incorporation of four windows in each panel. Inverted tee beams, supporting a portion of the double tee floor members, were skewed



reaction of 310,000 lbs (1380 kN) [ultimate] at midspan of an exterior wall panel. A single story panel could not carry that much load. The problem was solved by connecting the 13th floor wall panel to the 12th floor wall panel, thereby creating a composite, two-story Vierendeel truss/frame system 27 ft 6 in. (8.38 m) high with a span of 28 ft (8.53 m).

This unusual noncomposite/composite structural system demanded strict application of the principles of superposition and consistent deformations. The design also took into account horizontal shear connections across the 13th level joint, making the lower wall head section work composite with the upper wall sill section.

The precast concrete supplier (Rocky Mountain Prestress Inc.) was selected after bidding from design development drawings, which helped to shorten the construction schedule. A major benefit of this selection process was that the precaster provided valuable suggestions for reducing production costs and enhancing the quality of the architectural details.

The advantages of using architectural precast concrete walls in combination with prestressed double tee floor members are multifaceted:

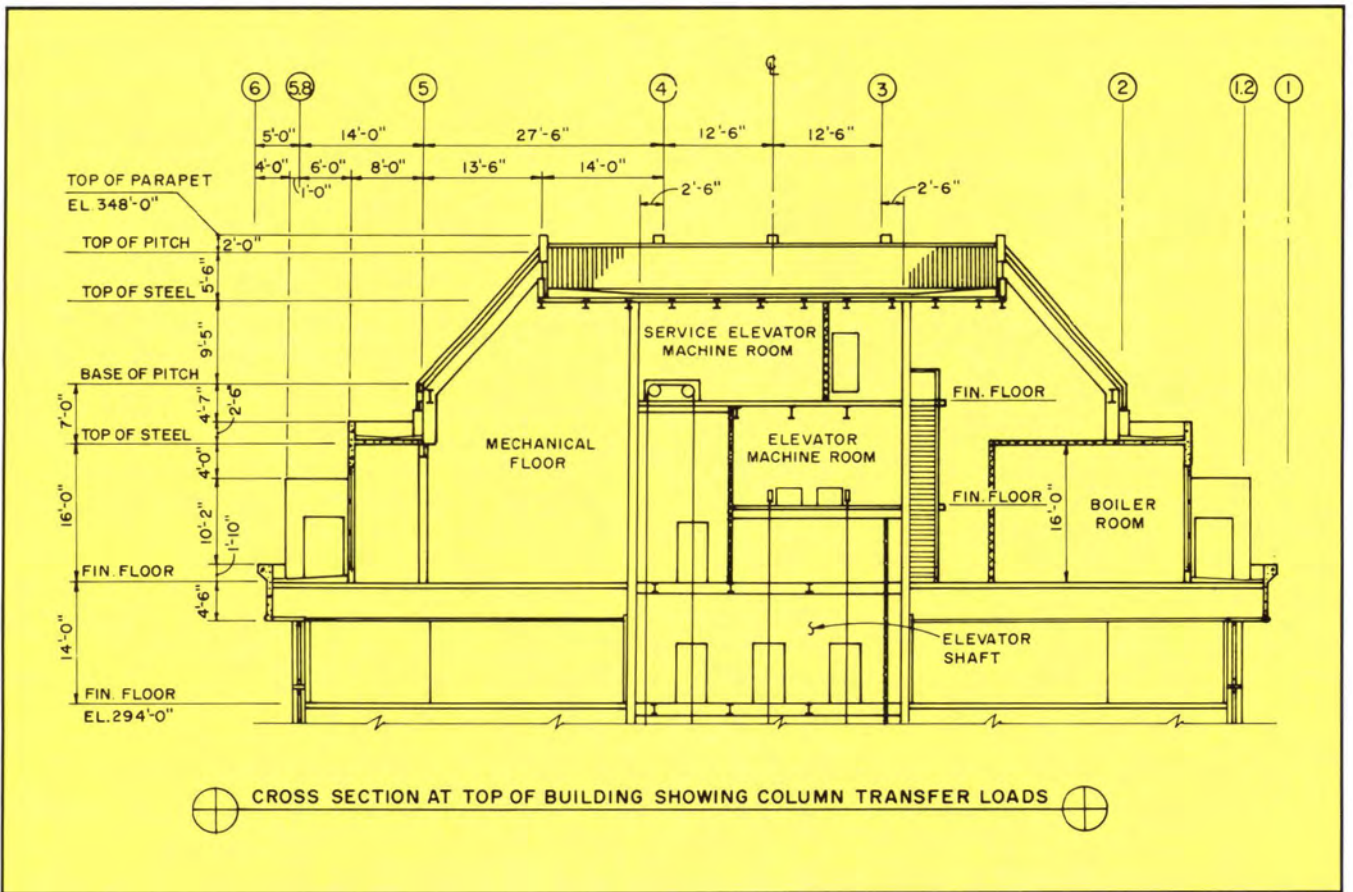
- Dual use of the exterior wall as a structural element and an architectural feature.

to bear into the cast-in-place concrete core to avoid additional interior columns. The monolithic columns in the exterior wall panels reduce the number of components to be erected and the subsequent connections. As a result, erection time was significantly reduced.

The outside corners of the building are a complex maze of structural steel bearing onto the exterior architectural precast concrete panels, which in turn, bear onto structural steel that transfers load out to the typical exterior precast wall (see cross section at top of building). Also, in order to horizontally transfer the loads to the precast column elements, architectural panels had to be designed as Vierendeel trusses.

One interesting design challenge was encountered at the 14th level stepback where steel framing imposed a beam





- Quick and easy window installation. Also, weather protection for cast-in-place topping can be easily accomplished.
- Speed of erection. The double tee deck provides the form for the cast-in-place concrete topping. Double tee stems provide the necessary fire protection for the prestressing and

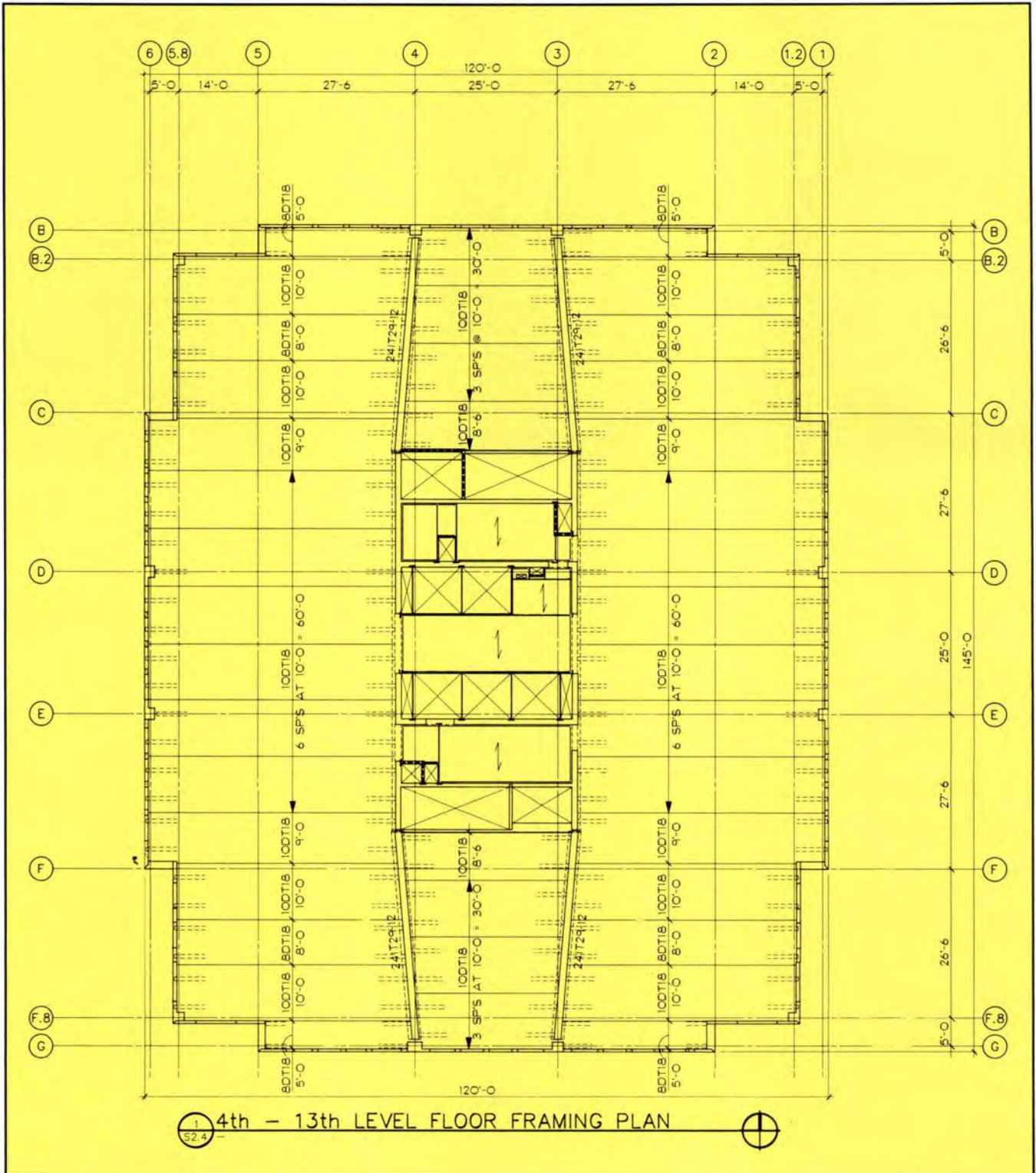
reinforcing steel required for the Type I, fire resistive rating.

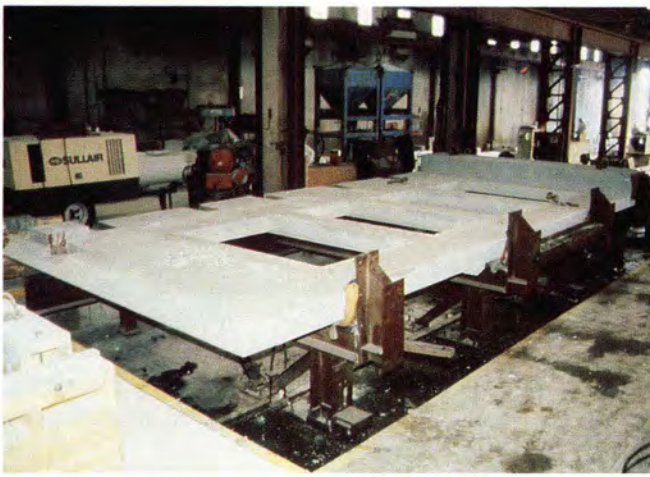
- A column free interior allows for flexible use of office space.
- A rich and permanent appearance of the facade is provided by architectural precast concrete and yet, economy is attained in repetitive detailing and reuse of formwork. Ex-

terior maintenance costs will be minimal.

- The mass of the exterior precast panels provides thermal efficiency throughout the changing Colorado seasons, and helps isolate the interior from exterior noise.

The end result is a structurally more efficient and cost effective building







than would have been attained by a more traditional approach.

The precast concrete components were produced at the Rocky Mountain Prestress plant in Denver and transported by truck [about 70 miles (113 km)] to the project site in downtown Colorado Springs. Although some special handling and safety precautions were required to transport the precast components, this operation was carried out efficiently and on schedule. Prior to erection, the architectural panels were cleaned.

The erection of the precast concrete components began in early 1990. Due to the fast track schedule, a tower crane and a mobile tower crane were employed to hoist and place the precast components.

The Tower building was erected over a four-story below grade parking structure that was supplied by Stresscon Corporation of Colorado Springs.

The project was essentially completed by July — a construction period of less than 5 months. This allowed early tenant occupancy of the building. The United Bank Tower complex was officially opened on October 23 in a grand ceremony which included the mayor of the city, town officials, dignitaries and special guests.

The total cost of the building was about \$13 million.

The project won an award in the 1990 PCI Professional Design Awards Program. The jury comment reads as follows: "Outstanding integration of structural and architectural precast concrete into a cohesive whole. A great advertisement for the industry with its high quality image. Detailing is excellent. Very classy throughout."

## Credits

Architect: Klipp Partnership, P.C., Denver Colorado.

Structural Engineer: Structural Consultants Inc., Denver, Colorado/San Diego, California.

Precast Prestressed Concrete Manufacturer: Rocky Mountain Prestress Inc., Denver, Colorado.

General Contractor: M.A. Mortenson Company Inc., Denver, Colorado.

Owner: Birtcher-Kraus Properties Inc., Colorado Springs, Colorado.

