

Unique Precast Framing System For Hawaii's Tallest Building

Honolulu's Alfred Yee develops H-shaped column tree unit for new Ala Moana Hotel

Hawaiian-born Alfred A. Yee is one of the world's leading authorities on prestressed and precast concrete. As head of one of the largest structural engineering firms on the Islands—Alfred A. Yee & Associates—Yee has made many important contributions to the concrete industry.

His most recent is an unusual precast column tree framing system used for the 38-story Ala Moana Hotel in Honolulu, which opened in August and is the tallest building in the state.

The H-shaped column trees, which support prestressed-precast floor plank, enabled the hotel to go up at a rate of one floor every three days. These components as well as smaller

cross-shaped sections, precast balconies and parapets plus prestressed foundation pilings were all supplied by Dillingham Precast.

Yee's unique framing system is based on the fact that most structural precast elements which are joined together at the juncture between beams and columns require joinery that is often elaborate and expensive.

The ideal point of joinery between these elements, he contends, should be located at the mid-span of beams and mid-height of columns. By integrally precasting the joints between columns and beams at the plant, the necessary continuity, ductility and toughness can be achieved at minimum cost.



Alfred A. Yee

Yee proved his point by developing a precast column tree with the "trunk" and "branches" integrally fabricated as units.

The H-frames produced by Dillingham were nominally 25 ft. wide by 10 ft. high. They required 4.7 cu. yds. of concrete and weighed about 11 tons each. The cross-shaped frames were half that width and weight.

The units were cast in special steel forms developed by Masa Uyehara, assistant plant superintendent. Casting took place with the forms in an upright position. Reasons for this were:

1. Accuracy in aligning the vertical splice sleeves and dowels.
2. Simplicity in forming the tops of beams where numerous stirrup protrusions were required for composite action between column trees and cast-in-place slab strips.
3. Uniform finish on all four sides of columns and beams.

The forms were stripped by removing one vertical form face on the column tree. This form face opened like a gate and moved on rubber tires to simplify removal and resetting.

To join the column trees together, Yee developed a cast steel splice sleeve with double-tapered frustums. The sleeves were filled with high-strength grout and helped contain the grout which moved outward when the deformed bars were under tension or compression. Grout in the wedge-

All precast work for 38-story hotel was supplied by Dillingham Precast.





H-frames were cast in special forms in an upright position.



Steel coil is wrapped around rebar to increase bond of lapped splice used to join tree branches.

shaped section of double-tapered frustums also prevented one bar from moving against the other.

The sleeves were embedded in the upper end of the tree trucks while the vertical rebars from the trees were embedded halfway into the sleeve. This allowed vertical rebars from the upper tree to be inserted in the remaining half.

Also, the sleeves were placed in a heavy cage of reinforcing ties in order to restrain buckling and spalling and resist horizontal shear due to seismic forces at the point of joinery.

The tree branches (beams) were joined at the mid-span by means of a lapped splice. To minimize the required length of lap for convenience in precasting, handling and erection, a spiral steel coil of No. 3. gauge wire was used to wrap lapped pairs of bars in a confining action to increase the bond of the lapped splice.

Before grouting took place, the bottom of the tree to be erected and the top of the matching lower tree were wetted down and washed clean.

Grout was filled into the sleeves of the lower tree unit and a heavy paddy of grout placed in the central area of the column cross section. The upper column leg then was placed on the lower column and, as dowels were inserted into sleeves, the excess grout oozed from it. The tree being erected was supported on tubular shores with adjustable jacks.

The elevation of the adjustable jacks was set so that the tree was initially resting in a position some $\frac{3}{8}$ in. higher than its final elevation. Final plumbing and elevation was achieved by a downward adjustment in the



Tree being erected was supported on tubular shores with adjustable jacks.

jacks after the tree was resting entirely on it.

Excess grout then was struck off and finished about $1\frac{1}{2}$ in. from the exterior face of the column.

After a floor of column trees was installed, the precast slabs were dropped in by crane. Plumbing, chases, conduits, etc. were placed in cast-in-place slab connection strips between the units.

Dillingham Precast, under the direction of manager Ken Wolfsen, produced 1,330 column trees for the Ala Moana job. Project contractor was Hawaiian Dredging & Construction Co.—parent company of the precast firm.

The hotel is owned jointly by Dillingham Corp. and Flagship Hotels, a division of American Airlines Inc. □

Trees averaged 25 ft. wide by 10 ft. high.

