INTRODUCTION

The Hollow Core slab is manufactured in a standard 4' width and 8", 12" and 12½" thicknesses using a continuous concrete extrusion process. Zero-slump, high-strength concrete with a 28-day strength in excess of 8,000 psi and ½" diameter, 270 ksi, low relaxation steel strands are used in the process. The strands are pretensioned and fully bonded to the concrete to support the slabs under design loads. When the concrete reaches sufficient strength to bond the strands, the slabs are cut from the extrusion to customer-specified lengths. Narrow-width slabs are available at additional cost by rip-cutting standard width slabs. Economical layout of the slabs utilizes as many of the standard 4' wide units as possible with the remainder of the layout filled with non-standard width slabs or cast-in-place closure strips. Contact CTC's Marketing Department for special considerations and limitations.

The Hollow Core slab has a variety of uses, including floors and roofs for buildings and parking garages, decks for piers and short-span bridges, lids for storm water detention vaults, and lagging for retaining walls. Cast-in-place, composite concrete topping may be added to provide a smooth, level floor surface that serves as a horizontal diaphragm when properly reinforced. For untopped and non-composite topping applications, the horizontal diaphragm is provided by shear friction reinforcement in the grouted shear keys and in the end closure pours. See ICC Evaluation Service Report No. ESR-2152.

The following Span-Load Charts show the 8" and 12" sizes with and without a minimum 2½" thick composite topping. The 12½" size with topping is not shown as it is usually used in untopped applications. It is designed with a thicker top flange to provide the greater durability and increased "punch-through" capacity normally supplied by the topping.

DESIGN CRITERIA FOR DEVELOPMENT OF THE SPAN-LOAD CHARTS

ATTENTION: The Span-Load Charts were derived from computer-calculated data, are intended as an aid to preliminary sizing, and must be interpreted using sound engineering judgment.

The Span-Load Charts were developed as described below:

ALLOWABLE STRESSES – The extreme fiber stress under full service load is limited to $0.45f'_c$ for compression and $12\sqrt{f'_c}$ for tension in accordance with ACI 318-05 for Class U or Class T prestressed concrete flexural members.

FLEXURAL STRENGTH – The nominal flexural strength, ϕM_n, exceeds the required factored moment, $M_u = 1.2M_d + 1.6M_l$, in accordance with ACI 318-05, Sections 9.2.1 & 18.2.1. The strength reduction factor, ϕ, is calculated per Section 9.3.2.7. The stress in the pretensioned reinforcement at nominal strength (f_{ps}) is calculated in accordance with Sections 12.9 & 18.7.2, and all superimposed load is considered as live load. Where flexural strength governs the design, superimposed loads comprised of dead and live load combinations will increase the capacity over the values given in the Span-Load Charts.

SHEAR – The nominal shear strength, ϕV_n, exceeds the required factored shear, $V_u = 1.2V_d + 1.6V_l$, in accordance with ACI 318-05, Sections 9.2.1 and 11.1.1. Web shear strength (V_{cw}) is calculated in accordance with CTA Technical Bulletin 85B1. This method determines the applied shear which causes a principal tension of $4\sqrt{f'_c}$ at the centroid of the pretensioned member, as allowed in ACI 318-05, Section 11.4.3.2. Flexure shear strength (V_{ci}) is calculated as set forth in CTA Technical Bulletin 78B1. This method uses a modified version of Equation (11-10) of ACI 318-05, based on full-scale testing of Hollow Core slabs.

Filling a predetermined number of voids with cast-in-place concrete will result in higher web shear capacity in the transfer zone at the ends of the slabs. Contours in the Span-Load Charts indicate the number of voids filled with 3,000 psi concrete (typically to 2' from the face of support) to achieve the given capacity. The capacity of the filled voids is discussed in CTA Technical Bulletin 85B1.

All values in the Span-Load Charts are based on Hollow Core slabs without shear reinforcement. It is not possible to provide shear reinforcement in extruded Hollow Core slabs.

COMPOSITE CAST-IN-PLACE TOPPING – Full-scale load tests performed at Concrete Technology Corporation have verified that, for composite Hollow Core systems with factored horizontal shear stresses between the topping and slab of 90 psi or less, full composite action is achieved without intentionally roughening the top surface or providing mechanical ties. This is discussed in CTA Technical Bulletins 74B6 and 76B4. The composite Span-Load Charts are capped with a bold contour where horizontal shear would otherwise govern. Contact CTC's Marketing Department for further information concerning test results or special design conditions.

The weight of the cast-in-place topping has already been included in determining the allowable superimposed load on composite slabs. Do not deduct the weight of the topping from the values derived from the Span-Load Charts.

The natural camber of the Hollow Core slabs, combined with the wet weight of the cast-in-place topping, will normally require a variable thickness of topping to provide a flat finished floor. Residual Camber Contour charts are provided to estimate the amount of residual camber or sag after placement of the topping. The weight of the variable thickness in addition to the 2½" minimum has been considered in the development of the Span-Load Charts.

FIRE RESISTANCE RATING – The fire resistance rating of Hollow Core slabs is given in ICC Evaluation Service Report No. ESR-2152.

DEFLECTIONS – Total deflection is defined as the upward camber of the slab due to the eccentricity of the pretensioning less the downward deflection due to applied loads, including the long-term effects of prestress loss, creep and shrinkage. Allowable loads from the Span-Load Charts limit the theoretical total deflection to $l/180$. In addition, the deflection due to prestress and dead load, including long-term effects, is limited to $l/240$. Instantaneous deflections due to live loads are limited to $l/360$. The load combinations considered in the deflection analysis are 50% dead and live load, or 100% live load.

Associated building elements that may be affected by deflections should be placed with adequate tolerances. It is not practical to deflect the formwork to produce desired cambers. Suggested methods for calculating cambers and deflections are described in the 6th Edition of the PCI Design Handbook, Section 4.8.4. Contact CTC's Marketing Department with any questions about deflections.

ROUGH OPENINGS – The values in the Span-Load Charts apply to Hollow Core slabs without openings. Rough openings through the voided area of a Hollow Core slab normally have little effect on its load-carrying capacity. However, large openings that cut webs and strands can have a significant impact on the load-carrying capacity of the slab. Contact CTC's Marketing Department with questions on the capacity of slabs with openings.

RELATED PUBLICATIONS AVAILABLE FROM CTC

- Guide Specifications for Precast, Prestressed Hollow Core Slabs
- Hollow Core Slab Connection Details
- Field Handling and Erection of Hollow Core Slabs
- Concrete Technology Corporation Research Reports:

CTA Technical Bulletin 73B6, "Shear Diaphragm Capacity of Precast Floor Systems"
CTA Technical Bulletin 74B6, "Composite Systems Without Roughness"
CTA Technical Bulletin 75B10/11, "Flexural Bond Performance"
CTA Technical Bulletin 76B3, "Non-Destructive Testing of Concrete"
CTA Technical Bulletin 76B4, "Composite Systems Without Ties"
CTA Technical Bulletin 78B1, "Shear Strength of Hollow Core Members"
CTA Technical Bulletin 79B4, "Shear Strength of Continuous Hollow Core Systems"
CTA Technical Bulletin 80B3, "Shear Diaphragm Capacity of Untopped Hollow Core Floor Systems"
CTA Technical Bulletin 82B2, "Grouting Precast Floor Systems"
CTA Technical Bulletin 85B1, "Web Shear Strength of Prestressed Concrete Members"