Design Guide for Precast Prestressed Concrete HollowCore Plank

Introduction

This HollowCore System Design Guide has been designed to illustrate the many ways in which hollow-core precast concrete can function as a multi-purpose building system or as an integral component of a building system. Owners, contractors, architects, and engineers will discover that HollowCore building systems can be used in a wide variety of settings and offer a myriad of benefits. HollowCore systems are cost effective, allow construction to remain on budget and on schedule, require less maintenance, and create less environmental impact than conventional building materials.

HollowCore is a prestressed concrete flat profile slab containing continuous hollow voids that run throughout the length of the extruded element. The voids within the HollowCore slab reduce the weight and cost of the slab dramatically, making it an ideal building component. Lighter weight, cost effectiveness and Fire Rating make HollowCore slabs a standard choice for bringing added value to floor and roof deck systems.

Residential applications include single family and multi-family dwellings, the hospitality industry, and specialized housing, such as dormitories, assisted-living and nursing homes. Be it low-, mid-, or high-rise construction, a hollow-core structure is fire resistant, moisture resistant, allows less sound transmission, offers flexible floor plans, and meets unique building needs and challenges. Hollow-core precast concrete helps manage heating and cooling demands, resulting in reduced energy costs. The safety, security, and high fire resistance it offers keep insurance rates low as well. Structurally, a hollow-core building system provides high load capacity for floors, open clear spans, high vibration resistance, finished ceilings and floors, reduced floor-to-floor height, and natural space for electrical conduit, plumbing, and HVAC ductwork.

This manual includes sections addressing Frequently Asked Questions and technical data, as well as product cross section details and connection concepts. Also enclosed are sample specifications and a set of typical general notes.

The purpose of this technical data is to aid in selecting and detailing precast concrete HollowCore plank manufactured by TaraCon Precast. The load tables presented herein are intended as a guide only. Final design is determined by our engineering department based on information presented in the final plans and specifications. To ensure the optimum selection for your application, please contact us for assistance. Although care has been taken to provide the most accurate data possible, **TaraCon Precast** does not assume responsibility for errors and omissions.

Table of Contents

HollowCore System Uses

Single & Multi-Family Residential

HollowCore building systems offer numerous benefits at a cost-effective price. The unique precast elements can be used to form a column free area under the, single family unit garage. These elements act as flooring components that allow designers to implement parking garages under multi-family homes. A HollowCore system can be erected quickly reducing building costs and speeding construction time, while still providing the flexibility to accommodate multiple penetrations with minimal preparation for final conditions. HollowCore slab floor systems form fire separations and noise barriers; the system provides superior moisture control and protection. Although not specific to multi-family residential construction, units with integral balconies can be produced so that all floor components are from a single source supplier.

Hospitality

The benefit of having long spans, fast erection cycles, and year-round constructing possibilities, make HollowCore building systems the ideal solution for specialized housing units, like hotels, dormitories, and nursing homes. Buildings like motels and assisted-living units also reap the benefits of HollowCore because it slows the spread of fire and noise within these irregularly subdivided structures. The additional loading required for assistant-living facilities is efficient and safely handled with this precast flooring system. The underside of the slab system can act as a direct ceiling avoiding the need for any additional ceiling systems and/or their associated materials.

Mixed-Use Structures

Every building and facility complex serves our community in a different respect. One might hold a few hundred cars, while the other might hold a couple decks of retail space, yet the third might hold both and retail and parking, in addition to a couple residential units. HollowCore floor slab systems provide construction flexibility, fire separation, vibration isolation, and the structural support required to span almost any challenge that large or small multi-deck buildings require. Whether the frame is precast, cast-in-place, masonry, or structural steel it can be accompanied by a HollowCore floor slab system.

Mid-Rise & High-Rise

Vertical construction, such as hotels, motels, dormitories, mixed-use, and residential, in which shallow floor depths combine with open floor plans, can take advantage of hollow-core slab’s long spans, fast erection, and all-year construction. Specialized beams of precast prestressed concrete or steel create shallow floor systems supported on precast columns. The lightweight nature of the product allows erection by tower crane, decreasing site congestion. Precast concrete’s fire-resistance makes it an excellent material for tower construction by reducing the spread of fire, smoke, and noise between rooms and floors. Precast balconies can be integral components in the load bearing system.

Manufacturing & Commercial

With today's ever increasingly complex manufacturing and commercial facilities flexibility, versatility, capacity, and efficiency are keys to a valuable long-lasting investment. When making the decision to build with HollowCore floor slabs systems, you do not only reap those benefits, but many more. Highly complex layouts, unlimited floor plan configurations can be brought to life when using this durable, lightweight, concrete flooring system.

Office

Business owners appreciate the resilience, speed, and efficiency, which every concrete building has to offer. The resilience of precast structures leaves a legacy that passes for generations. The structural characteristics of precast concrete allow for less space utilization, and in return, more gain in usable area per every story of height. The floor and roof elements on a HollowCore building system are low profile, this suggests the option of placing more stories in the same given amount of height, utilized by other building systems. Efficiency an essential characteristic considered by every designer and business owner – HollowCore proves its efficiency rating by increasing sound resistance, adding fire protection, and reducing energy costs.

Correctional Facilities

Correctional Facilities usually have intricate floor plans with heavy and complex loading scenarios. HollowCore building systems allow for long spans under heavy loads, which makes them an ideal component for use in designing such facilities. Since the precast slabs have long span distance the count of obstructions is greatly reduced, therefore security and supervision are greatly simplified.

Building System Variations

Bearing Wall Systems

Bearing wall systems provide compartmentalization, outstanding fire safety between units, significant thermal benefit, and reduced noise transmission. Well-suited for dwellings with multiple residents, these systems are traditionally used in the multi-family and the hospitality construction markets.

Frame Systems

For large open areas with long clear spans, a hollow-core frame system is ideal. Loft space has become a primary residential construction market, and a building utilizing a hollow-core construction system has a distinct advantage. With a shallow overall structural depth, building height can be reduced. This building system is traditionally used for office construction, but residential units are being developed, illustrating the growing popularity, and varied uses of hollow-core floor systems.

Floor and Roof Systems

Complex geometry and floor plans are easily designed using a precast hollow-core system. Layouts can be adjusted to accommodate inconsistent or repetitive bearing geometries. Optimal use of the material can be achieved and minimal in-place forming requirements are primary benefits of a hollow-core system.

The Manufacturing Process

Elematic® HollowCore is a machine extruded, precast, prestressed hollow-core plank. The planks are manufactured on 310-foot-long beds in standard widths of 48 inches and thickness of 6, 8, 10, 12 and 16 inches. High strength prestressing strands are cast into the planks at the spacing and location required for the given span, loading and fire cover conditions. The planks are cut to length for each project using a diamond-blade saw. After the planks are cut, they are removed from the casting beds and placed into storage. All Elematic® materials equal or exceed the requirements of applicable ASTM specifications. The concrete mix is designed to have release strength of 3,000 psi or 3,500 psi, and a 28-day compressive strength of 6,000 psi. The prestressing strands are uncoated, seven wire, low relaxation with a minimum ultimate strength of 270 ksi.

Load Table Design Criteria

The tables herein list allowable live loads in pounds per square foot for uniformly distributed loading. Non-uniform loading conditions resulting from point loads, line loads, openings and cantilevers require special design consideration. The allowable load is usually governed by the ultimate capacity of the section. As a design aid, the ultimate moment capacities in governing criterion for short spans may be the horizontal shear stress between the plank and the topping. Allowable live loads for long-span, heavily reinforced sections are limited to loads that result in a bottom-tension stress equal to the cracking stress. Loads beyond this limit may result in deflections that exceed the allowable value set forth in the ACI code. The load tables are based on a plank concrete strength of 6,000 psi. Tables for topped sections are based on a topping strength of 4,000 psi and minimum thickness of 2 inches. Maximum spans and loads shown are not absolutes. Longer spans or heavier loads may be achieved under certain conditions or different criteria than assumed in the tables. Contact us if you need assistance.

Plank Design Considerations

The following items will affect the selection of appropriate plank sizes and should be carefully reviewed by the Architect/Engineer while developing the plans and specifications for a project:

Fire Rating

- The fire rating requirement should be clearly specified in the contract documents.

Loading Conditions

- Specify all uniform loading requirements on structural plans.
- Identify line and point loads resulting from bearing walls, masonry walls, face brick, columns, mechanical equipment, etc.
- Identify diaphragm forces and lateral loads resulting from wind or earth pressures.
- Review roof plans for vertical protrusions such as parapets, penthouses and adjacent buildings that could require designing for snow drift loads.
- Plank supporting stairs require special loading considerations.
- Large openings or closely spaced groups of smaller openings will reduce the plank load carrying capacity.

Topping

- Specify whether concrete topping is to be composite. Composite action requires the topping to be bonded to the top surface of the plank. Topping separated by a vapor barrier or insulation is non-composite and must be considered a superimposed load.
- Large cambers resulting from long spans and/or heavy loads will affect the quantity of topping, assuming a level floor is required. Two inches of composite topping at mid span is minimal, and additional thickness at the ends of the plank may be required to maintain level floor elevations.

Surface Finish

- If the final top surface is un-topped, a leveling compound can be used for finishing the joints and any unevenness between the slabs.
- Specify if composite bonding is required. If the topping acts as a structural slab with the HollowCore members – a light broom finish is applied to the top surface of each plank.
- The underside can be used as a finished ceiling as installed and either left unfinished, painted, or coated with acoustical spray.

Camber

- Camber is inherent in all prestressed products. It is the result of the eccentric prestress force required to resist design loads, and cannot be designed in, out, or to an exact number. The amount of camber will depend upon the span, design loads and thickness of plank. Planks stored in the yard for more than 6 weeks, usually due to construction schedule changes, will experience more camber growth.

  - Prestressed Concrete has an internal force that counteracts the self-weight and loads that are applied to the concrete element. This creates a more efficient and effective design/system over conventional reinforcement methodology.

- Adjacent plank of dissimilar length, strand pattern or with openings will have inherent camber differences.
- Calculation of topping quantities should also recognize the imprecision of camber calculations.

Fire Rating

Fire rating specifications are as important as all other design parameters. Plank rating requirements are determined by the Architect or Engineer of Record, who is also responsible for establishing the fire rating criteria for the total project. Three methods generally used in the Midwest for determining HollowCore plank fire-resistive ratings are:

1. International Building Code (IBC)
2. Rational analysis as defined by PCI-124-18, *"Design for Fire Resistance of Precast Concrete"*
3. Underwriters Laboratories Fire Resistive Ratings

International Building Code “IBC” Fire Rating

The IBC code prescribes fire ratings to any hollow-core plank section. Since 2000, the IBC code has replaced the BOCA, SBC and UBC model codes in many states. The two criteria that are measured to determine the fire rating are:

1. Equivalent concrete thickness – 4.6" inches is required for 2 hrs.
2. Bottom strand cover – ¾" cover is required for 2 hrs. (restrained condition)

Underwriters Laboratories Fire Resistive Ratings

Prior to codes including prescriptive fire-endurance rating methods, fire tests provided the primary source of ratings classifications. While some plank sections were fire tested, others can be evaluated by UL to qualify for existing UL numbers.

The table below lists the UL ratings available with Elematic ® plank. Note that these ratings are dependent upon whether the ends of the planks are restrained. Determination of the restraint must be made by the Architect or the Engineer of Record, as it is primarily a function of the support structure.

UL Number	Rating (Hrs.)		Plank Thickness (in.)	Topping Thickness (in.)
	Restrained	Unrestrained		
J994	1.5	1.5	8, 10, 12	0
J994	2	1.5	8, 10, 12	0-1/2" Gypcrete
J994	3	1.5	8, 10, 12	2-1/8" Topping
J994	4	1.5	8, 10, 12	3-1/8" Topping

Fire Ratings by Rational Analysis

PCI-124-18 defines the “rational analysis” method for determining the fire rating of precast, prestressed members. It is useful to use when a fire rating cannot be obtained by either of the two previous methods. Actual practice has shown that this method is very conservative and that the span of the hollow-core plank will have to be reduced (approx. 10% to 20%) to achieve the same fire rating from both IBC and UL. In using this method, the reduced strength of the prestressed strands at elevated temperatures is determined and the resulting moment capacities are compared to that required for service loads. Strand temperatures are based on the amount of concrete cover and the standard fire exposure as defined by the time-temperature relationship specified in ASTM E119. Fire ratings will also be improved if the plank assembly is restrained against thermal expansion. It should be noted that the only universally accepted definition of full restraint is an interior bay of a multi-bay building.

Sound Ratings

The following tables contain values for the Sound Transmission Class (STC) and the Impact insulations Class (IIC) of various floor systems utilizing Elematic ® hollow-core plank.

Sound Transmission Class (STC)

The values for the Sound Transmission Class were determined by tests which were in accordance
with ASTM E90. The STC is a measure (in decibels) of the ease at which air-borne sound is transmitted through a floor system. The larger the value of the STC for a given system, the greater the sound insulation.

Sound Transmission Class (STC)	
6" Elematic ®	49
6" Elematic® + 2" Topping	53
8" Elematic ®	51
8" Elematic® + 2" Topping	54
H8" Heavy Elematic ®	51
H8" Heavy Elematic® + 2" Topping	55
10" Elematic ®	52
10" Elematic ® + 2” Topping	56
12" Elematic ®	54
12" Elematic ® + 2" Topping	57
16" Elematic ®	56
16" Elematic ® + 2" Topping	59

Impact Insulation Class (IIC)

The values for the Impact Insulation Class (IIC) were determined by tests which were in accordance with ASTM ES492. The Impact Insulation Class is the resistance to impact noise transmission and is highly dependent on the floor surface and structural connection details. As with the STC, the higher IIC values are more desirable.

Impact Insulation Class (IIC)	
Types of Floor Systems	**Rating**
8" Hollow-core Plank	28
8" Hollow-core Plank + ½" wood block flooring adhered directly	47
8" Hollow-core Plank + 0.058" vinyl tile 50	50
8" Hollow-core Plank + quarry tile w/reinforced mortar bed with 0.4” nylon and carbon black spinneret matting.	54
8" Hollow-core Plank + pad & carpet	73
Add Acoustical Ceiling	6

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Specifications for Precast, Prestressed HollowCore Plank

Section 03400

1. General
    a. Description
        i. Work Included:
            1. These specifications cover manufacture, transportation, and erection of precast, prestressed, concrete, HollowCore plank, including grouting of joints between adjacent units.
        ii. Related Work Specified Elsewhere:
            1. Cast-in-Place Concrete: Section_____________
            2. Architectural Precast Concrete: Section_____________
            3. Precast Structural Concrete: Section_____________
            4. Underlayments (Floor and/or Roof Leveling): Section_____________
            5. Caulking and Sealants: Section_____________
            6. Small Holes for Mechanical/Plumbing: Section_____________
            7. Cast-in-Place Embedments: Section_____________
            8. Steel Bearing Lintels: Section_____________
            9. Insulation in Plank Cores: Section_____________
    b. Quality Assurance
        i. Manufacturer Qualifications: The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute (PCI) Plant Certification Program prior to the start of production. Manufacturer shall be certified in category C2.

            The Manufacturer shall retain a registered structural engineer to certify that the manufacturing is in accordance with design requirements; or

            The manufacturer shall, at his expense, meet the following requirements:

            1. The basis of inspection shall be the Prestressed Concrete Institute's "*Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products*", MNL-116, and the criteria for acceptance shall be the same as the Plant Certification Program.
        ii. Erector Qualifications: PCI Qualified and regularly engaged for at least 5 years in the erection of precast structural concrete like the requirements of this project. Retain a registered structural engineer to certify that erection is in accordance with design requirements.
        iii. Welder Qualifications: In accordance with AWS D1.1.
        iv. Testing: In general compliance with applicable provisions of Prestressed Concrete Institute MNL-116, "*Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products*".
        v. Requirements of Regulatory Agencies: All local codes plus the following specifications, standards and codes are a part of these specifications:
            1. ACI 318 – Building Code Requirements for Reinforced Concrete.
            2. AWS D1.1 – Structural Welding Code-Steel.
            3. AWS D1.4 – Structural Welding Code-Reinforcing Steel.
            4. ASTM Specifications – As referred to in Part 2-Products, of this Specification.
    c. Submittals and Design
        i. Shop Drawings
            1. Erection Drawings:
                a. Plans locating and defining all hollow-core planks furnished by the manufacturer, with all major openings shown.
                b. Sections and details showing connections, weld plates, edge conditions and support conditions of the HollowCore plank units.
                c. All dead, live, and other applicable loads used in the design.
                d. Fire rating.
            2. Approvals:
                a. Submit _______ copies of erection drawings for approval prior to fabrication. Fabrication not to proceed prior to receipt of approved drawings.
            3. Product Design Criteria:
                a. Loadings for Design
                    i. Initial handling and erection stresses.
                    ii. All dead and live loads as specified on the contract documents.

iii. All other loads specified for hollow-core plank where applicable.

b. Fire rating shall be _________ hour(s).

c. Design steel plank support headers when such headers are determined necessary by the manufacturer's engineer.

d. Design calculations shall be performed by an engineer, registered in the state that the project is located in, and experienced in precast prestressed concrete design. Design calculations to be submitted for approval upon request.

e. Design shall be in accordance with ACI 318 and applicable codes.

4. Permissible Design Deviations:

a. Design deviations will be permitted only after the Architect/Engineer's written approval of the manufacturer's proposed design supported by complete design calculations and drawings.

b. Design deviations shall provide an installation equivalent to the basic intent without incurring additional cost to the owner.

5. Test Reports: Test reports on concrete and other materials shall be submitted upon request.

d. Products

i. Materials

1. Portland Cement:

a. ASTM C150 – Type I or III.

2. Admixtures:

a. Water Reducing, Retarding, Accelerating, High-Range Water Reducing Admixtures: ASTM C494

3. Aggregates:

a. ASTM C33 or C330

4. Water: Potable or free from foreign materials in amounts harmful to concrete and embedded steel.

5. Reinforcing Steel:

a. Bars:

Deformed Billet Steel: ASTM A615

Deformed Rail Steel: ASTM A616

Deformed Axle Steel: ASTM A617

Deformed Low Alloy Steel: ASTM A706

b. Wire: Cold Drawn Steel: ASTM A82.

6. Prestressing Strand:

a. Uncoated, 7-Wire, Low Lax strand: ASTM A416 (including supplement) – Grade 270K.

7. Welded Studs: In accordance with AWS D1.1.
8. Structural Steel Plates and Shapes: ASTM A36.
9. Grout:
    a. Cement grout: Grout shall be a mixture of not less than one-part Portland cement to three parts fine sand, and the consistency shall be such that joints can be filled but without seepage over adjacent surfaces. The grout shall achieve a minimum 28-day compressive strength of 2,000 psi. Any grout that seeps from the joint shall be completely removed before it hardens.
10. Bearings Strips:
    a. Plastic: Multi-monomer plastic strips shall be non-leaching and support construction loads with no visible overall expansion.

ii. Concrete Mixes

1. 28-day compressive strength: Minimum of 5,000 psi
2. Release strength: Minimum of 3,000 psi
3. Use of calcium chloride or admixtures containing chlorides is not permitted.

iii. Manufacture

1. Hollow-core plank shall be machine cast in 48-inch widths under the trade name Elematic® as manufactured by TaraCon Precast Building Systems.
2. Manufacturing procedures and tolerances shall be in general compliance with PCI MNL 116.
3. Openings: Manufacturer shall provide for rectangular openings 12 inches or larger on all sides and as clearly shown on the architectural and structural drawings. They shall be located by the trade requiring them and then field cut. Round and small openings (less than 12 inches) shall be drilled or cut by the respective trades after grouting. Openings requiring cutting of prestressing strand shall be approved by the precast plank manufacturer before drilling or cutting.
4. Finishes: Bottom surface shall be flat and uniform as resulting from an extrusion process, without major chips, spalls, and imperfections. Top surface shall be machine troweled.
5. Patching: Will be acceptable providing the structural adequacy of the hollow core unit is not impaired.

e. Execution

i. Product Delivery, Storage and Handling

1. Delivery and Handling
    a. Hollow-core plank shall be lifted and supported during manufacturing, stockpiling, transporting and erection operations only at the lifting or supporting points designated by the manufacturer.
    b. Transportation, site handling and erection shall be performed by qualified personnel with acceptable equipment and methods.
2. Storage
    a. Store all units off ground on firm, level surfaces with dunnage placed at bearing points.
    b. Place stored units so that identification marks are discernible.
    c. Separate stacked units by dunnage across full width of each plank.

ii. Erection

1. Site Access: Erection access suitable for cranes and trucks to move unassisted from public roads to all crane working areas as required by erector, or otherwise indicated herein, will be provided, and maintained by the general contractor. Obstructing wires shall be shielded or removed and, when applicable, snow removal and winter heat will be provided by the general contractor.
2. Preparation: The general contractor shall be responsible for:
    a. Providing true, level, bearing surfaces on all field-placed bearing walls and other field placed supporting members. Masonry wall bearing surfaces shall be bond beams with properly filled and cured concrete.
    b. All pipes, stacks, conduits, and other such items shall be stubbed off at a level lower than the bearing plane until after the plank are set. Masonry, concrete, or steel shall not be installed above plank-bearing surface until after the plank is in place.
3. Installation: Installation of hollow-core slab units shall be performed by the manufacturer. Members shall be lifted with slings at points determined by the manufacturer. Bearing strips shall be set where required. Grout keys shall be filled. Openings shall be field cut only after grout has cured, unless authorized by the manufacturer’s engineer.
4. Alignment: Members shall be properly aligned. Variations between adjacent members shall be reasonably leveled out by jacking, bolting or any other feasible method as recommended by the manufacturer.

iii. Field Welding

1. Field welding is to be done by qualified welders using equipment and materials compatible to the base material.

iv. Attachments and Small Holes

1. Subject to approval of the Architect/Engineer, hollow-core plank units may be drilled or “shot” provided no contact is made with the prestressing steel. Round holes and those less than 8 inches on any side shall be drilled or cut by the respective trades. Should spalling occur, it shall be repaired by the trade doing the drilling, shooting, or cutting.

v. Clean up

1. Remove rubbish and debris resulting from hollow-core plank work from premises upon completion.

vi. Safety

1. The general contractor will provide and maintain all safety barricades, rebar caps and opening covers required for plank in accordance with current industry safety standards.

Production & Erection Tolerances:

Product Tolerances – HollowCore Slabs

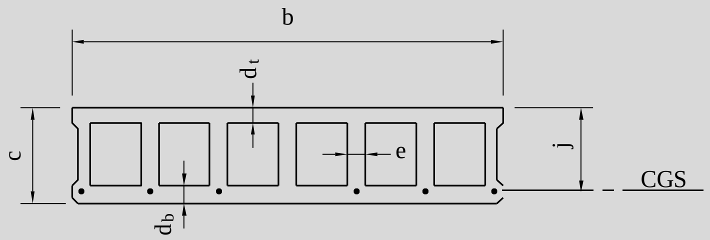
(Reprinted from PCI Manual for the Design of Hollow-core Slabs)

a = Length .... $\pm 1/2$ in
b = Width .... $\pm 1/4$ in
c = Depth .... $\pm 1/4$ in
d_t = Top flange thickness
Top flange area defined by the actual measured values of average d_t x b shall not be less than 85% of the nominal area calculated by d_t nominal x b nominal.
d_b = Bottom flange thickness
Bottom flange area defined by the actual measured values of average d_b x b shall not be less than 85% of the nominal area calculated by d_b nominal x b nominal.
e = Web thickness
The total cumulative web thickness defined by the actual measured value Σe shall not be less than 85% of the nominal cumulative width calculated by Σe nominal.
f = Blockout location .... ±2 in
g = Flange angle .... $1/8$ in per 12 in, $1/2$ in max.
h = Variation from specified end squareness
or skew .... $\pm 1/2$ in
i = Sweep (variation from straight line parallel to centerline of member) .... $\pm 3/8$ in

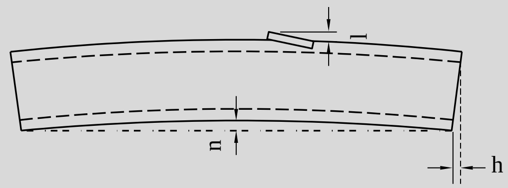
j = Center of gravity of strand group
The CG of the strand group relative to the top of the plank shall be within $\pm 1/4$ in of the nominal strand group CG. The position of any individual strand shall be within $\pm 1/2$ in of nominal vertical position and $\pm 3/4$ in of nominal horizontal position and shall have a minimum cover of $3/4$ in.
k = Position of plates .... ±2 in
l = Tipping and flushness of plates .... $\pm 1/4$ in
m = Local smoothness .... $\pm 1/4$ in in 10 ft
(does not apply to top deck surface left rough to receive a topping or to visually concealed surfaces)

Plank weight
Excess concrete material in the plank internal features is within tolerance as long as the measured weight of the individual plank does not exceed 110% of the nominal published unit weight used in the load capacity calculation.

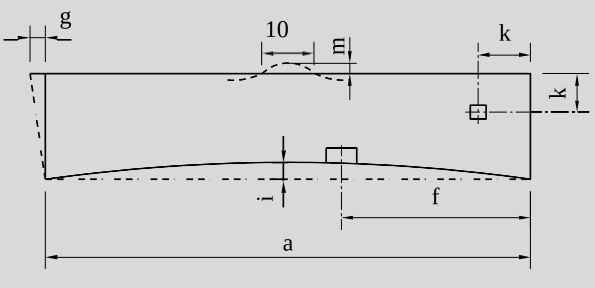
n = Applications requiring close control of differential camber between adjacent members of the same design should be discussed in detail with the producer to determine applicable tolerances.



CROSS SECTION



ELEVATION



PLAN

Erection tolerances - HollowCore Floor and Roof Members

(Reprinted from PCI Manual for the Design of Hollow-core Slabs)

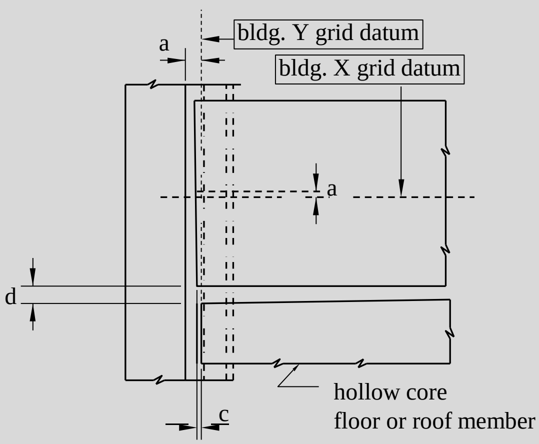
a	=	Plan location from building grid datum	± 1 in
a_1	=	Plan location from centerline of steel*	± 1 in
b	=	Top elevation from nominal top elevation at member ends	
		Covered with topping	± 3/4 in
		Untopped floor	± 1/4 in
		Untopped roof	± 3/4 in
c	=	Maximum jog in alignment of matching edges (both topped and untopped construction)	1 in
d	=	Joint width	
		0 to 40 ft member length	± 1/2 in
		41 to 60 ft member length	± 3/4 in
		61 ft plus	± 1 in
e	=	Differential top elevation as erected	
		Covered with topping	3/4 in
		Untopped floor	1/4 in
		Untopped roof**	3/4 in
f	=	Bearing length*** (span direction)	± 3/4 in
g	=	Differential bottom elevation of exposed hollow-core slabs****	1/4 in

* For precast concrete erected on a steel frame building, this tolerance takes precedence over tolerance on dimension "a".

** It may be necessary to feather the edges to ± 1/4 in to properly apply some roof membranes.

*** This is a setting tolerance and should not be confused with structural performance requirements set by the architect/engineer.

****Untopped installation will require a larger tolerance here.



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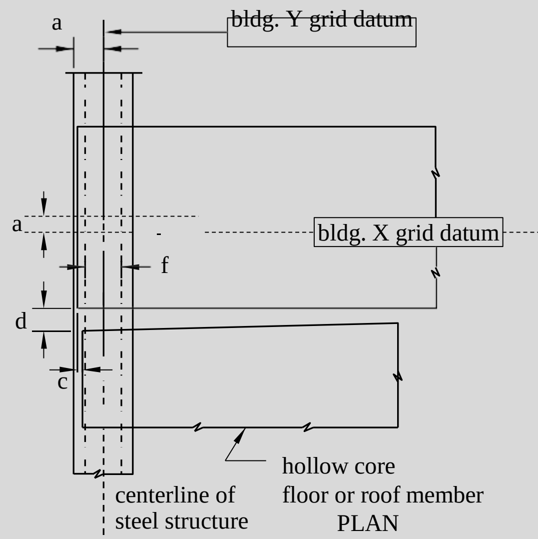
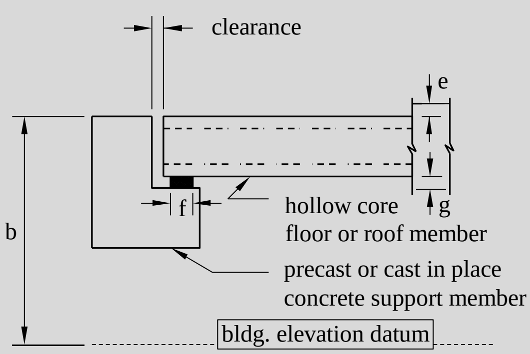
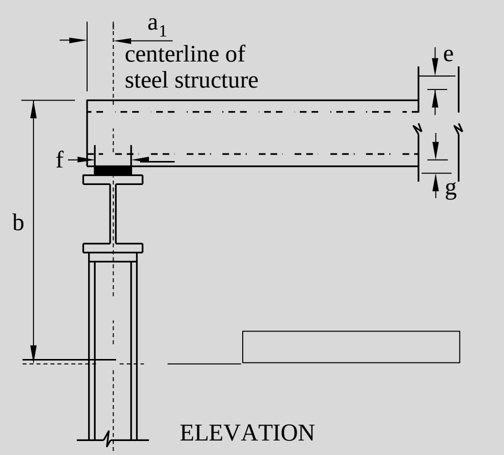




ELEVATION

Precast element to precast or
cast-in-place concrete or masonry



ELEVATION

Precast element to structural steel

Preliminary Design:

Span Depth Ratios

The PCI Design Handbook recommends limits on span-depth ratios for HollowCore systems. For roof members, a span-depth ratio limit of 50 is suggested. In practice, a span-depth ratio of 45 is common for floors and roofs where fire endurance, openings, or heavy/sustained live loads do not control a design. Structural topping plays an important role in the span-depth ratio.

The design recommendations for span lengths vary slightly from cross section to cross section, but the following are general rules to consider in the preliminary design. Assuming a uniform superimposed load of 100 pounds per square foot, and an un-topped system, these guidelines apply:

Depth	Span
8 Inches	33 Feet
10 Inches	40 feet
12 Inches	50 feet

Typical Design Loads

Design loads are determined by applicable building codes, engineering judgement, and building use. The following guidelines may be used:

Building Use	Dead Load (psf)	Live Load (psf)
Residential Floors	10-15	40-50
Residential Garage Floors	10-15	80
Office	20-30	50-80
Office Assembly Space		100
Storage		125-150
Mezzanine		125

Minimum Bearing

HollowCore units require a minimum of 2″ of bearing. They are typically designed and detailed with a 1/8″ thick continues bearing material. Often, as the slab gets longer, additional bearing length is detailed. This additional bearing length may be as large as 2", for a combined total of 4". For steel, bearing of 2" is recommended and for concrete surfaces, 3" is recommended.

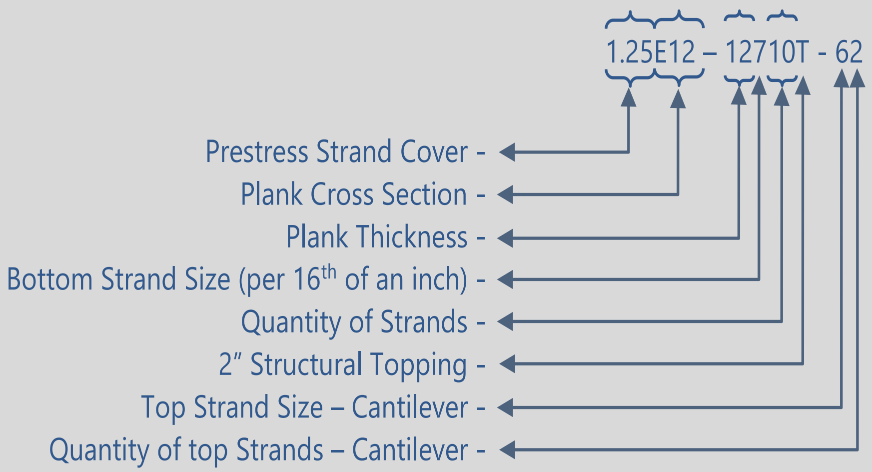
Load Tables – Cross Section Details

The following load tables are based on both topped (composite) and un-topped systems. Load spans are approximate and based on ACI 318-14. The values are assumed to service level live loads without the 1.6 multi-plier.

When the analysis of the section includes topping, the following parameters are used:

- 2" Composite thickness mid-span.
- An additional 25 psf dead load.
- 28-day topping strength of 3,000 psi.

Series Explanation Diagram for TaraCon Precast Load Tables



Section Properties

Section	Un-topped				2" Composite-Topped (f'_c topping= 4000)		
	Area (in^2)	Y_b (in)	I (in^4)	Wt (psf)	Y_b (in)	I (in^4)	Wt (psf)
E6	167	2.86	719	44	3.9	1,453	69
E8	196	4.08	1,587	51	5.17	2,655	76
E10	243	5.1	3,080	64	6.2	4,667	89
E12	291	6.1	5,063	76	7.2	7,307	101
H12	347	5.87	5,578	90	7.04	8,487	115
E16	346	8.33	11,339	90	9.53	14,971	115

Filled Cores

Many core ends are not filled, in multi-story construction it may be necessary to grout the cores to prevent crushing of the ends or to increase the shear capacity of the section. Filled cores are also common when longitudinal cuts leave large cantilevers of material.

Welded Connections

Most welded connections are used for steel beam stabilization during erection. Typically, this welded connection creates a laterally braced system which increases the design strength of the steel section. Long term movement is not uncommon in both beam and slab members; therefore, it is not recommended that welded connections exist on both ends of the same member.

Cross Section Details

The following detailed HollowCore cross sections are produced by TaraCon Precast and related companies.

E8 flowto.it/k5KS8HXV?fc=0

E10 flowto.it/k5KNueaU?fc=0

E12 flowto.it/k5puBhsU?fc=0

H12 flowto.it/k5p8C0fD?fc=0

E16 flowto.it/k5pjw8cR?fc=0

Common Details

The details on the following pages are non-cross section specific and are applicable in standard bearing and non-bearing conditions. These are not the only design options available. Often, they are used as starting points for job-specific section and detail requirements. Connection details will vary slightly depending on whether the slab was produced using a dry cast extrusion or a slip form technique.

Designers are strongly encouraged to discuss potential details with the fabricator during design development. Please scan code on following page to access common details in an interactive model:

flowcode.com/p/PgYxBMN2T?fc=0

Scan Code for Interactive TaraCon Hollowcore Details Mockup

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