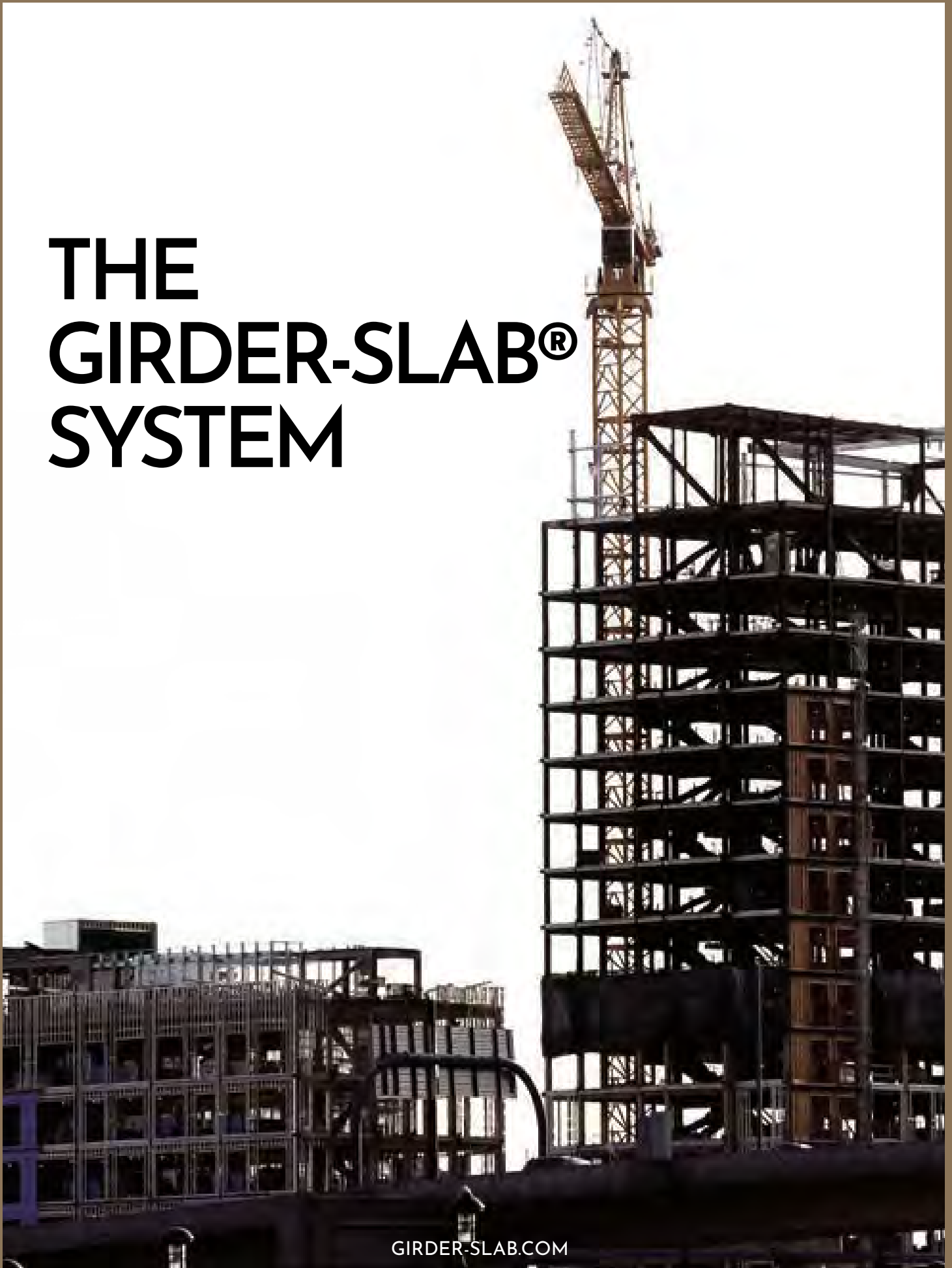
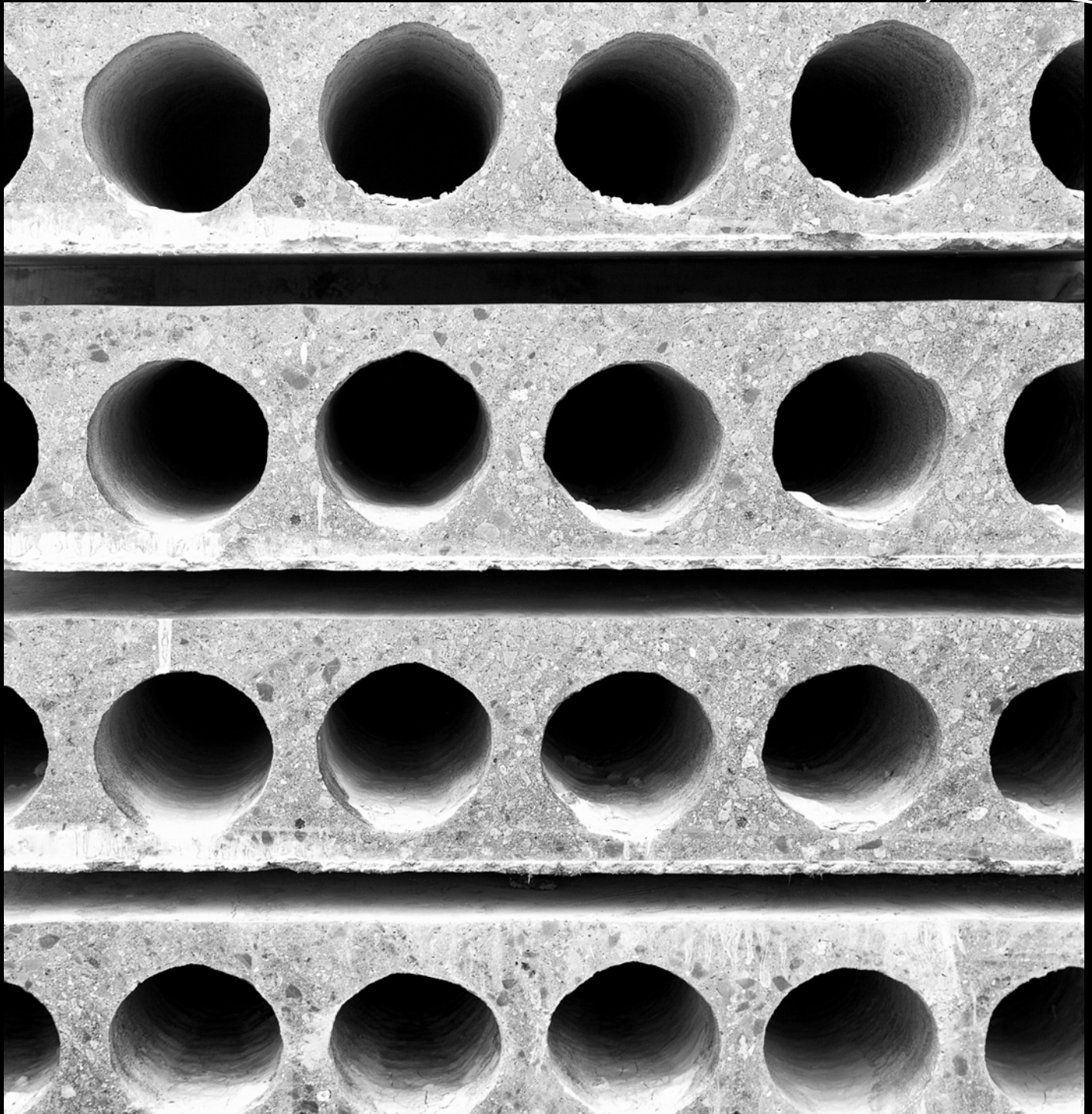


THE GIRDER-SLAB® SYSTEM





// The GIRDER-SLAB® System Design Guide v3.5 //

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Composite Structural Steel Systems (CS3) is a marketing and engineering consultancy company. We inform design and construction professionals, supply design tools and details and assist the engineer of record on an as needed basis. Composite Structural Steel Systems (CS3) can help you determine whether or not the GIRDER-SLAB® system will add value to your project.



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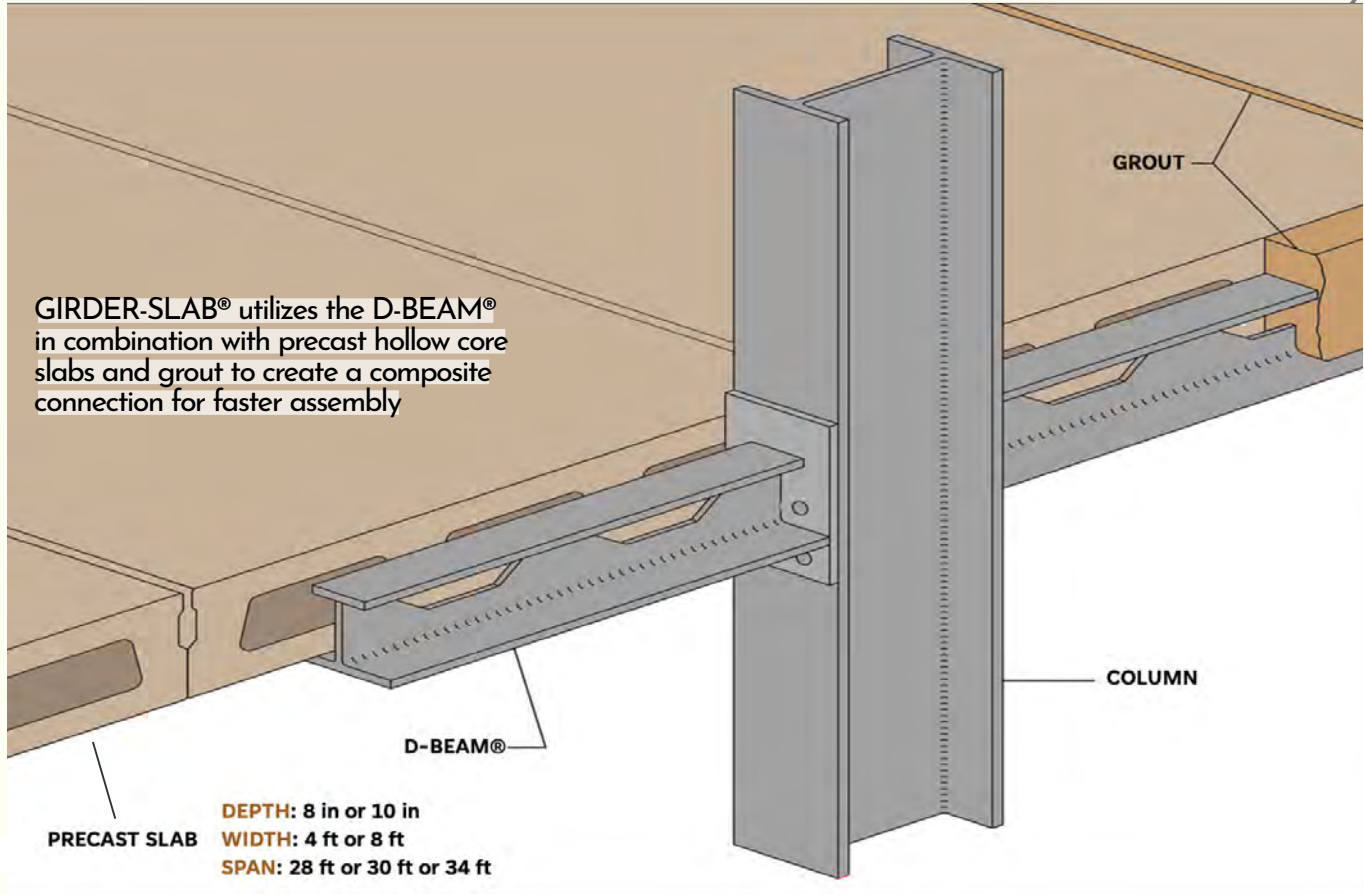
DESIGN GUIDE

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THE GIRDER-SLAB® SYSTEM

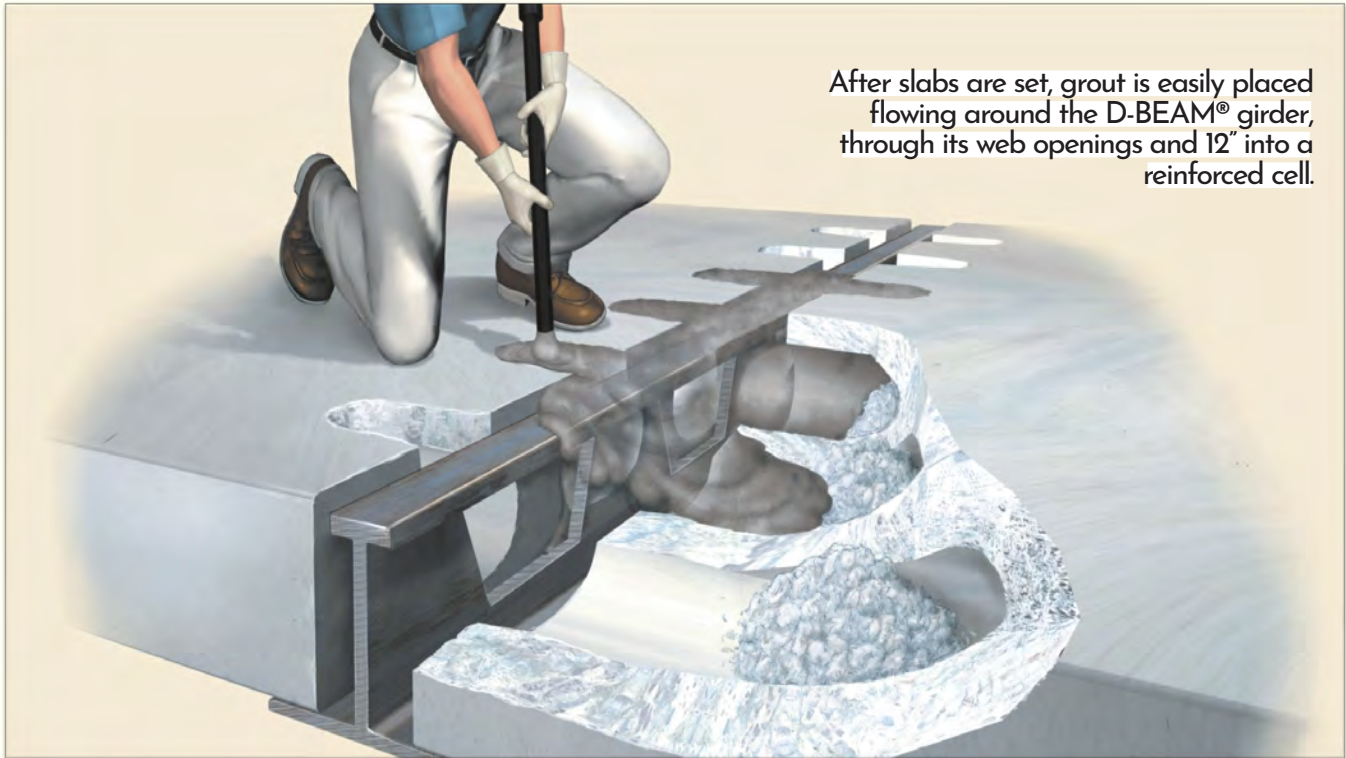


The GIRDER-SLAB® system is a structural steel and precast hybrid, using precast hollowcore slabs with an integral steel girder to form a monolithic slab assembly. This proven technology is the standard for achieving low floor-to-floor heights with structural steel in multi-story residential buildings.

Mid to high-rise residential structures often use a cast-in-place reinforced concrete structural system which can deliver low floor-to-floor height and fireproof construction. With similar benefits, low to mid-rise residential buildings can be designed to utilize bearing wall systems supporting precast hollow core slabs. Both of these structural systems are expensive, time consuming, weather sensitive and labor intensive.

Utilizing proven materials that have long been used by the construction industry, the GIRDER-SLAB® system brings the advantages of structural steel to multi-story residential buildings, offering a low floor-to-floor height alternative to cast-in-place reinforced concrete. It is designed by the owner's architect and structural engineer in combination with a structural steel frame.

The components of the system, structural steel (including the unique D-BEAM® girder) and precast, prestressed hollow core slabs, are manufactured and supplied by the builder's customary subcontractors, guaranteeing the owner competitive procurement of the building's superstructure.



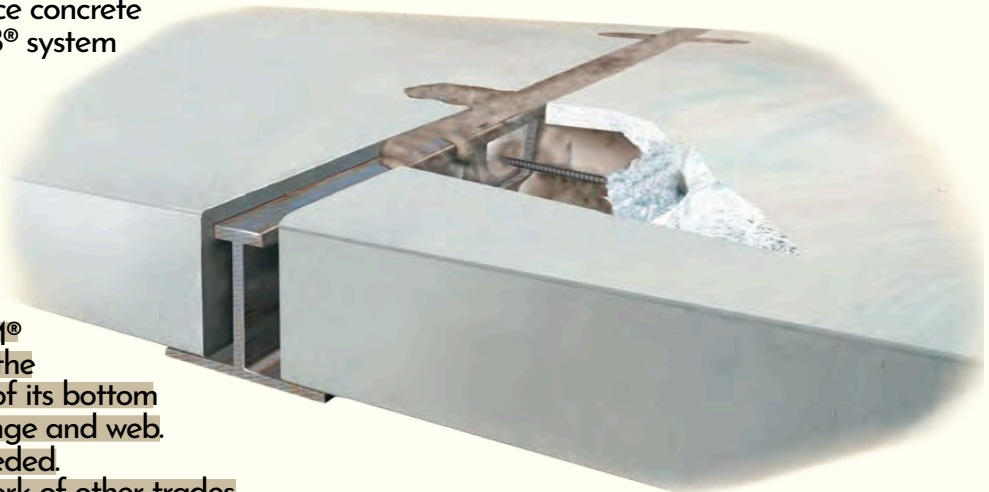
After slabs are set, grout is easily placed flowing around the D-BEAM® girder, through its web openings and 12" into a reinforced cell.

The GIRDER-SLAB® system consists of an interior steel girder known as an open-web dissymmetric beam (or D-BEAM® girder), and precast, prestressed hollow core slabs connected by cementitious grout. This lightweight assembly develops composite action enabling the system to carry significant loads. An eight-inch or ten-inch thick precast hollow core slab provides for low floor-to-floor heights, is non-combustible, and the underside of the slab with its smooth form finish is ready-made for ceiling finish. The D-BEAM® girder is a fabricated inverted tee assembly contained within the plane of the floor that eliminates issues associated with a standard wide flange beam sitting below the slab.

The GIRDER-SLAB® system is ideal for use in mid to high-rise residential structures such as apartments, condominiums, hotels, student housing and senior living developments. The system is fire rated for use in residential buildings when constructed in accordance with Underwriters Laboratories, Inc. Floor Ceiling Design No. K912, also Certified for Canada.

And unlike cast-in-place concrete structures, the GIRDER-SLAB® system uses off site prefabricated components that are quickly erected on site by one trade-Ironworkers. The system is low cost, lightweight and offers rapid assembly and construction.

The innovative D-BEAM® girder was designed to allow the precast slab to sit on the top of its bottom flange concealing the top flange and web. No formwork or shoring is needed. Allows faster access for the work of other trades. Coring of slabs for utilities is easier and permits final adjustment.



STRUCTURAL DEVELOPMENT



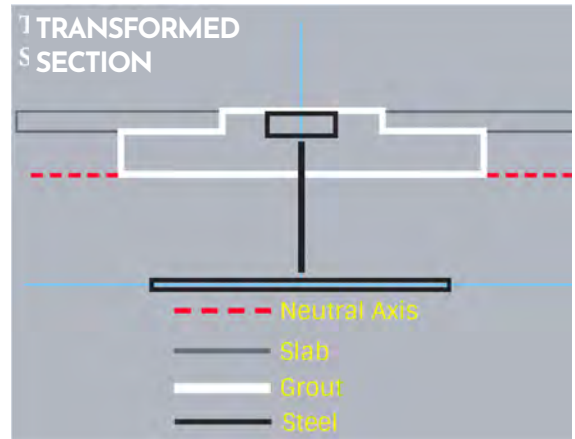
HOLLOW CORE TEST ASSEMBLY (VILLANOVA UNIVERSITY)

In order to solve the floor-to-floor and interference problems, Girder-Slab Technologies, LLC implemented a research and development program. We wanted an interior structural steel girder to be placed within the plane of the precast slab units, thereby producing a thin floor construction (akin to flat-plate) with a minimum floor to ceiling height. The GIRDER-SLAB® system and the open web D-BEAM® girder technology are the result of nearly thirty years of research and development.

Early testing produced an ASD approach for a rational design of the GIRDER-SLAB® system. In order to develop a rational analysis that would maximize the use of the technology, extensive laboratory testing and analysis was undertaken. This included both small-scale specimens and full-scale assemblies in order to simulate actual bays. Each assembly was load tested well above code required residential live loads. The D-BEAM® girder performed without failure even at these higher loads. Recent, more sophisticated testing enabled us to develop an LRFD approach to the GIRDER-SLAB® system, improving upon the system's previously established structural and economic benefits.

Buildings constructed using the GIRDER-SLAB® system can be built as high as any other structural steel building. The D-BEAM® girder and the precast hollow core slab support gravity loads. The GIRDER-SLAB® system is easily integrated with lateral resisting steel braced frames and concrete or masonry shear walls.

The GIRDER-SLAB® system is available for use by industry professionals. Application and use of the information published by Girder-Slab Technologies, LLC requires design by a registered professional structural engineer. Fabrication, construction and assembly of the GIRDER-SLAB® system and D-BEAM® girder shall be in conformance with the GIRDER-SLAB® system Design Guide v3.5.



CLT TEST ASSEMBLY (AUBURN UNIVERSITY)

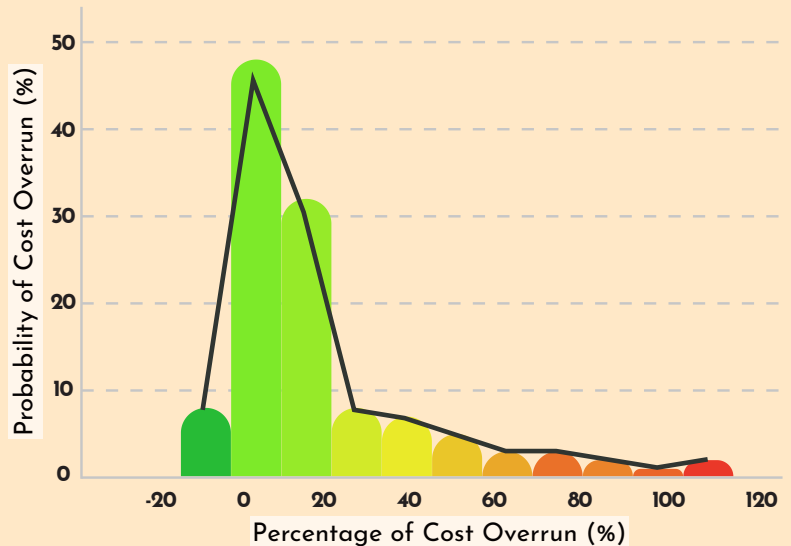
THE GIRDER-SLAB® ADVANTAGE

SPEED	SLIM FLOOR PROFILE	LESS LABOR	YEAR-ROUND CONSTRUCTION	COST SAVINGS
<ul style="list-style-type: none"> Construction becomes assembly No Shoring High quality prefabricated materials 	<ul style="list-style-type: none"> Eliminates wasted space Creates additional floor(s) versus conventional steel 	<ul style="list-style-type: none"> Less workers on site Safer work environment Single trade dependency 	<ul style="list-style-type: none"> Build in all conditions Eliminates heating and hoarding Assemble 3-4 floors before grouting 	<ul style="list-style-type: none"> Faster completion Reduce materials Lighter structure Reduced workforce Reduction of structural system cost by 25-30%

← COMPLETE PROJECTS FASTER, SAFER AND UNDER BUDGET →

Construction projects are notorious for being over budget and behind schedule. A construction survey from KPMG found just 31% of projects were within 10% of their original budget, and only 25% were within 10% of their original deadline. Additional findings indicate average overrun rates ranging from 17% to 122%, depending on the type of project being studied. But while the median cost overrun is actually fairly low (just above 0%), projects were more than 10 times as likely to be over budget than under budget, and much more likely to be far above budget than far below budget. Not surprisingly, the perception that cost overruns are a systemic inevitability can jeopardize developers' ability to secure adequate financing which in turn can strain profitability.

For the past five years, Girder-Slab® projects have achieved, on average, a 17% capital cost saving specific to the structure AND a total of 4 months trimmed off conventional construction schedule (1 month in design + 3 months in construction). This compounding effect of lower construction (and borrowing) cost and faster speed to market has meant earlier revenue generation and a predictably higher IRR for project stakeholders.



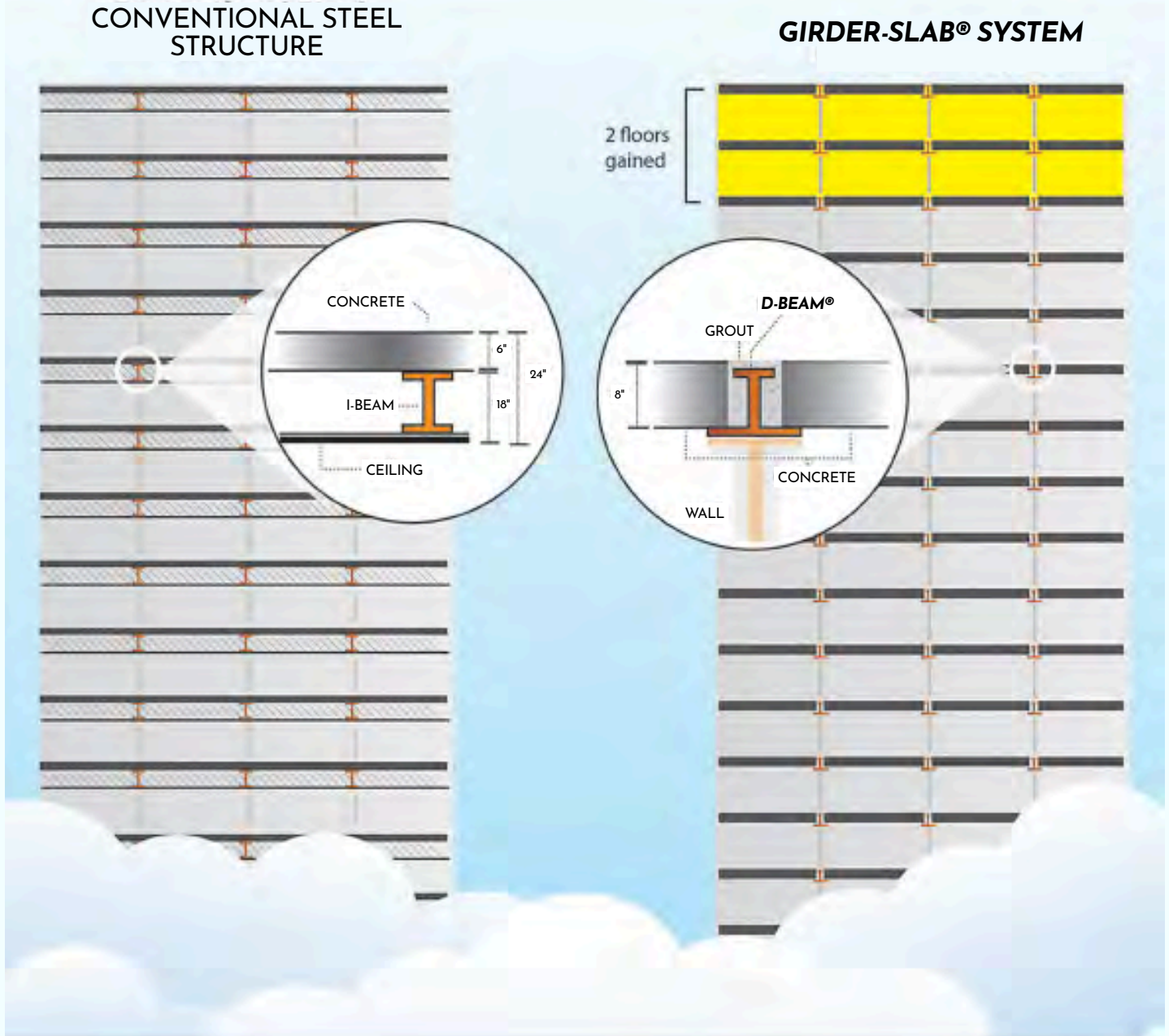
What this means is what everyone who works in construction already knows intuitively - a project that goes extremely well might come in 10 or 20% under budget. But a project that goes badly could be 100% over budget or more.

SO, WHAT EXACTLY DOES THIS CHART SHOW US?

LOW FLOOR-TO-FLOOR HEIGHTS WITH STRUCTURAL STEEL

CONVENTIONAL STEEL STRUCTURE

GIRDER-SLAB® SYSTEM



On Troy Boston, two additional floors were constructed that would not normally have been built in a conventional steel structure of its height. Troy Boston owner Gerding Edlen said the system shaved several months off the construction schedule for the \$185 million, 378 - unit campus. "Sometimes things are faster but they cost more, sometimes they cost less but take more time," Gerding Edlen President Kelly Saito told us. **"In this particular case we were able to get a win-win."**

The Suffolk Blog, Fast and furious: Girder-Slab erects Troy Boston at speedy pace

THOSE WHO KNOW...



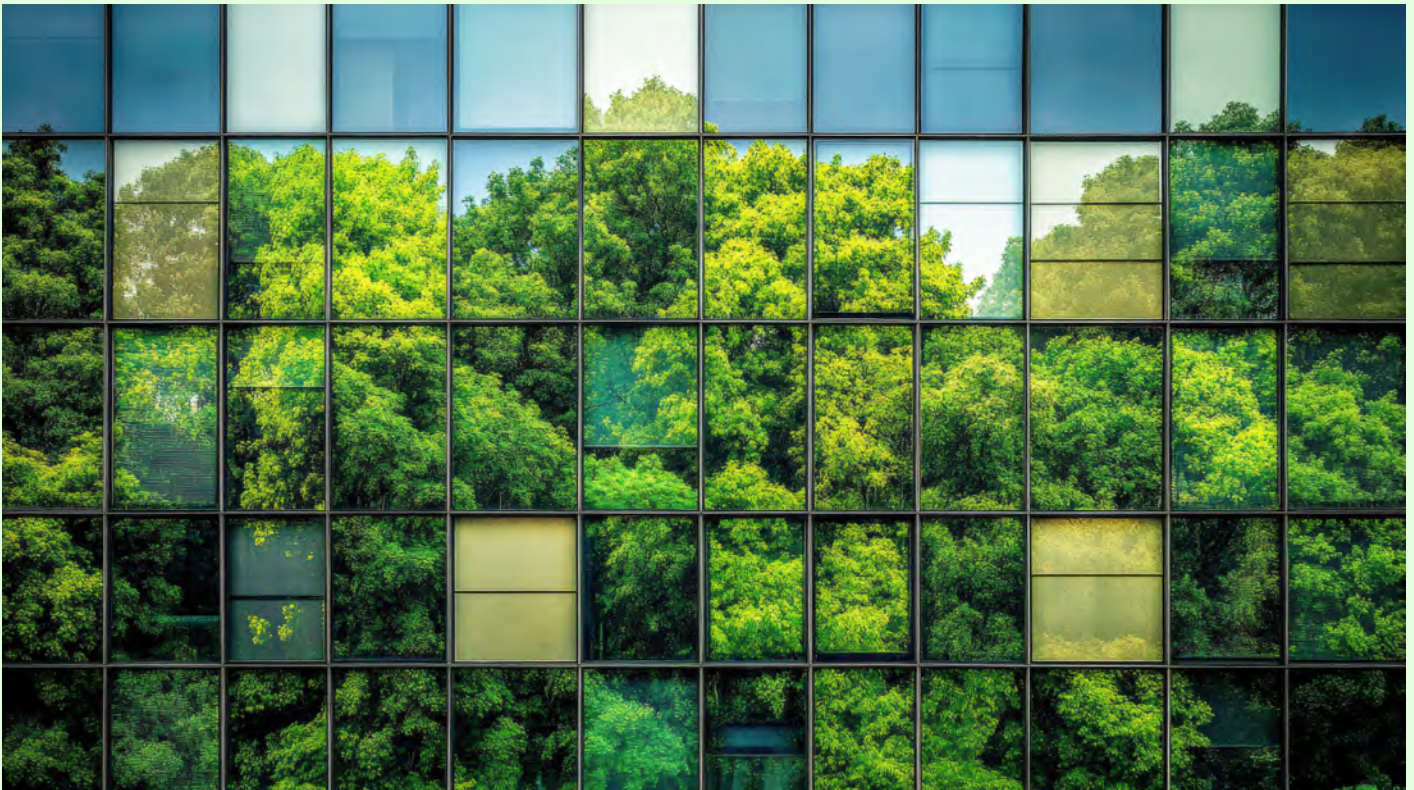
...KNOW GIRDER-SLAB®

The GIRDER-SLAB® system has been utilized in HUNDREDS of completed buildings in The United States, Canada and India by the most recognized companies, brands and universities in the world. 73% of the completed projects have been designed by repeat architects and structural engineers.

GOING GREEN

Concerns about climate change and diminishing natural resources place increased pressure on the construction industry to build green and reduce environmental impact. By conservative estimates, the construction industry is responsible for 30% of the world's natural resource extraction and 25% of the solid waste generated. (This climbs to 50% when sand and aggregates are used on building sites).

Structural steel is the premier GREEN building component, and the multi-cycled rate exceeds that of ANY OTHER CONSTRUCTION MATERIAL. It contains 93+ percent recycled product and can be recycled endlessly. We are fully committed to the principles of sustainable development and our system reduces environmental impact for every project by maximizing efficiency and minimizing consumption.

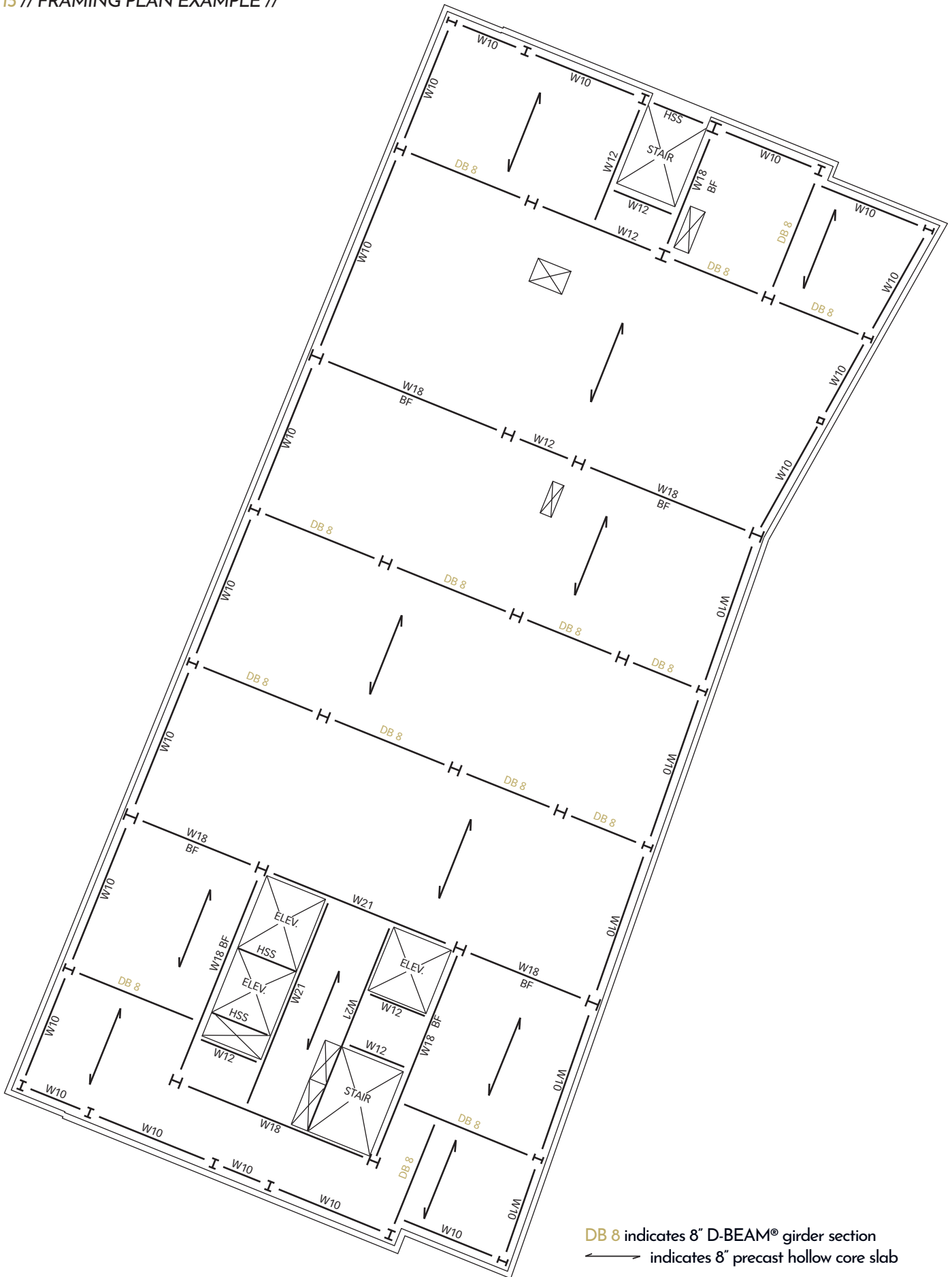


Studies of the embodied energy and subsequent carbon amounts released during construction comparing the Girder-Slab® System and cast-in-place (CIP) building methodologies consistently demonstrate a notable improvement in the measurements of carbon released for both materials and processes during construction. And while each building environment is unique, statistically speaking, it is estimated that the average net embodied carbon of a Girder-Slab® project is 30% - 50% less than that of comparable CIP building design.

LESS LABOR = SAFER JOBSITE = GREATER PROFIT



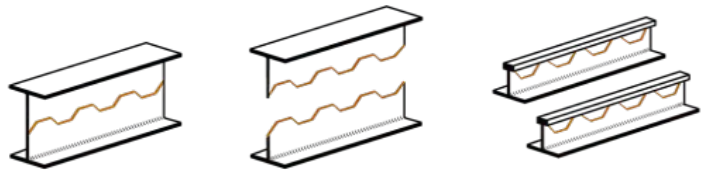




DB 8 indicates 8" D-BEAM® girder section
↔ indicates 8" precast hollow core slab

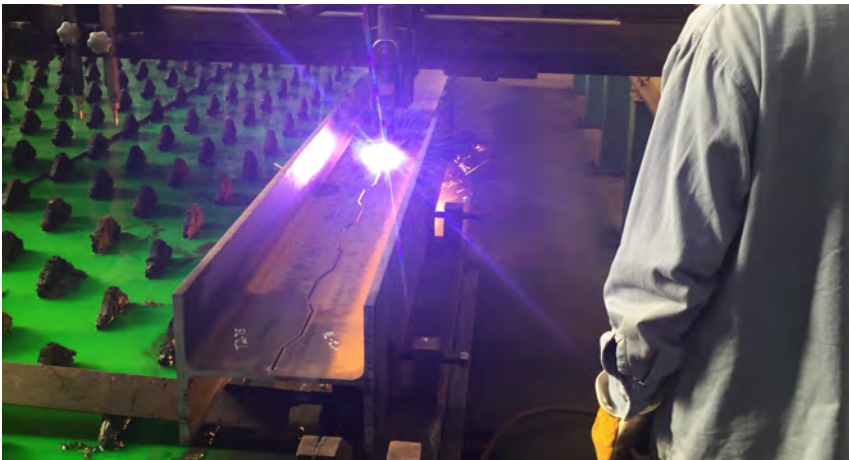


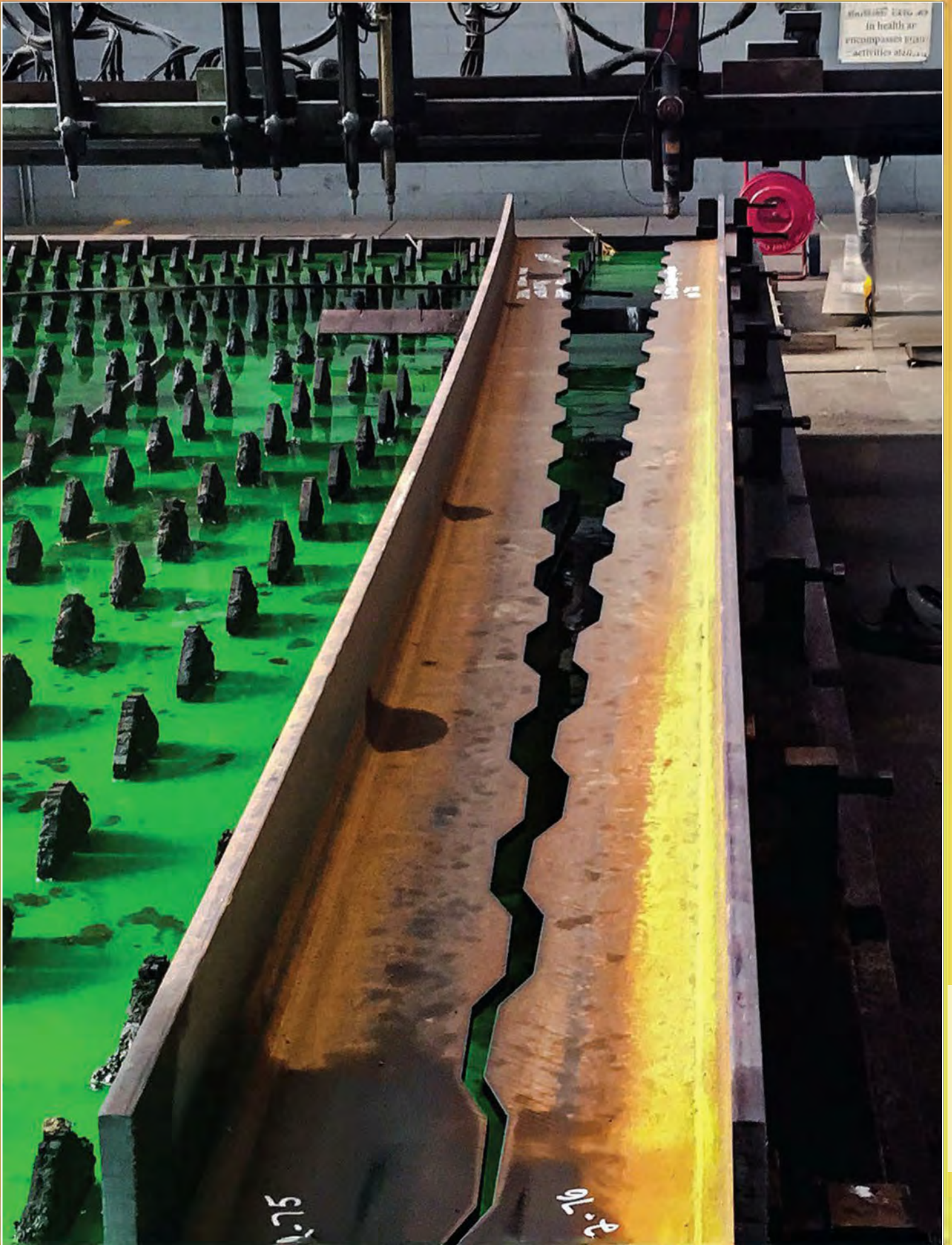
THE D-BEAM® GIRDER



With practically an unlimited source of supply, the D-BEAM® Girder is manufactured by a local steel fabricator of your choosing, via a competitive bidding process, and as part of a complete structural steel package.

The D-BEAM® Girder fabrication process begins with a standard wide flange section that when uniquely cut through the web, produces two identical tee sections. The fabricator then welds a flat bar to the top of the remaining web creating the narrow top flange of the D-BEAM® Girder. Two D-BEAM Girders are fabricated from one parent beam without waste.



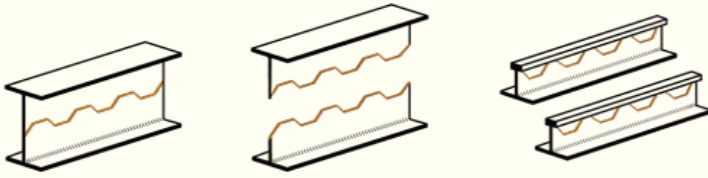


Simplicity and no waste

D-BEAM® GIRDER DIMENSIONS

Designation	Web Included Weight (lb/ft)	Average Area (in ²)	Depth (d) (in)	Parent Beam Size	Web Thickness (t _w) (in)	Flange Thickness (t _f) (in)	Flange Width (b _f) (in)	a (in)	b (in)	w (in)	t (in)
DB 8 x 37	36.7	10.8	8	12 x 53	3/8	9/16	10	2	5	3	1
DB 8 x 39	39.2	11.5	8	12 x 58	3/8	5/8	10	1 3/4	5 1/4	3	1
DB 8 x 42	41.8	12.3	8	12 x 53	3/8	9/16	10	1	5 1/2	3	1 1/2
DB 8 x 45	44.3	13.0	8	12 x 58	3/8	5/8	10	3/4	3/4	3	1 1/2
DB 8 x 57	56.5	16.6	8	12 x 79	1/2	3/4	12 1/4	1 5/8	5 3/8	5	1
DB 8 x 61	60.8	17.9	8	12 x 79	1/2	3/4	12 1/4	1 5/8	5 5/8	5	1 1/4
DB 9 x 41	40.7	12.0	9 5/8	14 x 61	3/8	5/8	10	3 3/8	5 1/4	3	1
DB 9 x 45	44.2	13.0	9 3/4	14 x 68	7/16	3/4	10	3 1/2	5 1/4	3	1
DB 9 x 46	45.8	13.5	9 5/8	14 x 61	3/8	5/8	10	2 3/8	5 3/4	3	1 1/2
DB 9 x 48	47.2	13.9	9 13/16	14 x 74	7/16	13/16	10 1/4	3 1/2	5 5/16	3	1
DB 9 x 49	49.3	14.5	9 3/4	14 x 68	7/16	3/4	10	2 1/2	5 3/4	3	1 1/2
DB 9 x 52	52.3	15.4	9 13/16	14 x 74	7/16	13/16	10 1/4	2 1/2	5 13/16	3	1 1/2
DB 9 x 57	56.5	16.6	9 3/4	12 x 79	1/2	12 1/4	12 1/4	5 1/4	3 3/8	5	1
DB 9 x 65	65.0	19.1	9 3/4	12 x 79	1/2	3/4	12 1/4	4 1/4	4 1/4	5	1 1/2

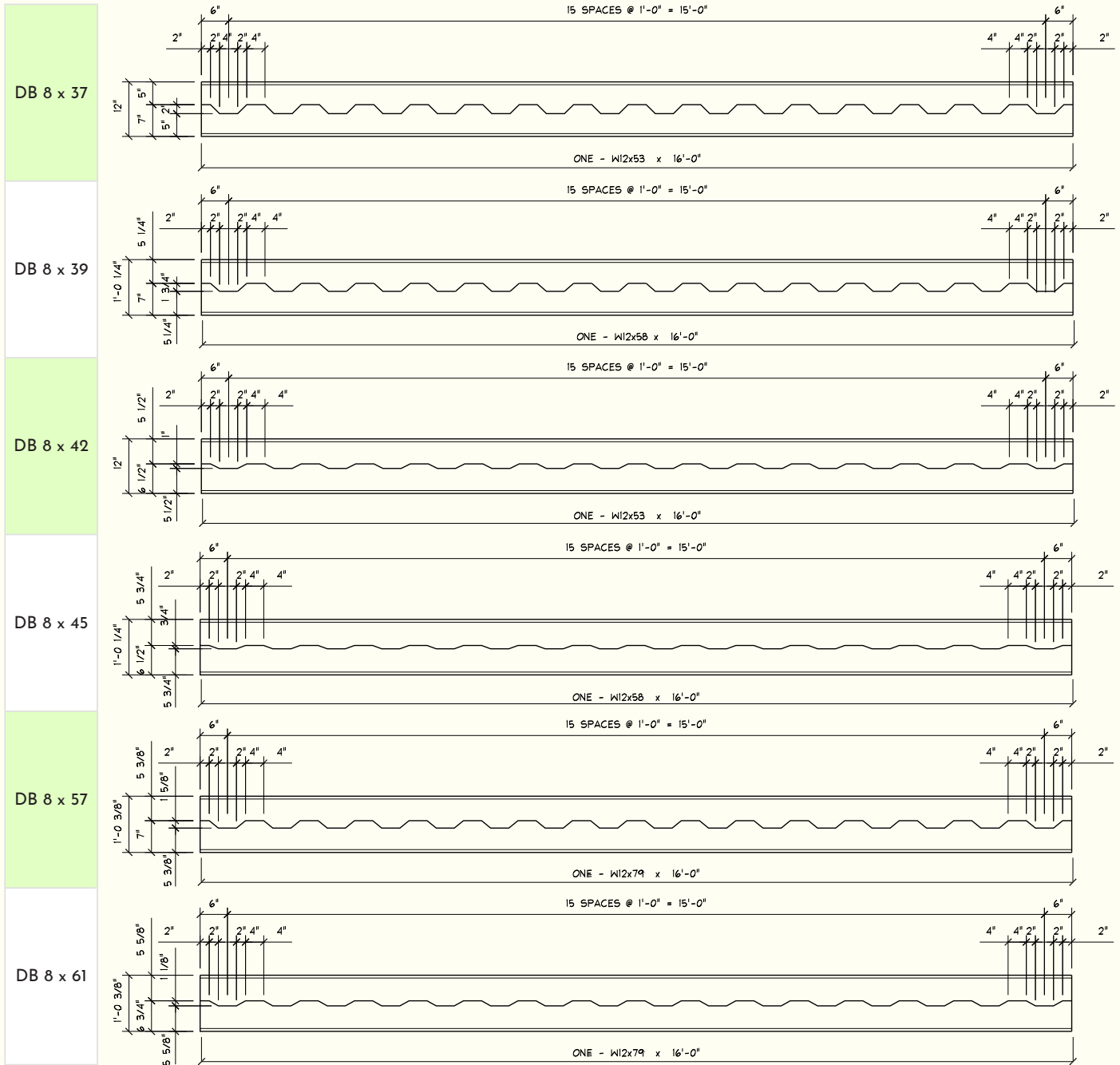
D-BEAM® GIRDER PROPERTIES



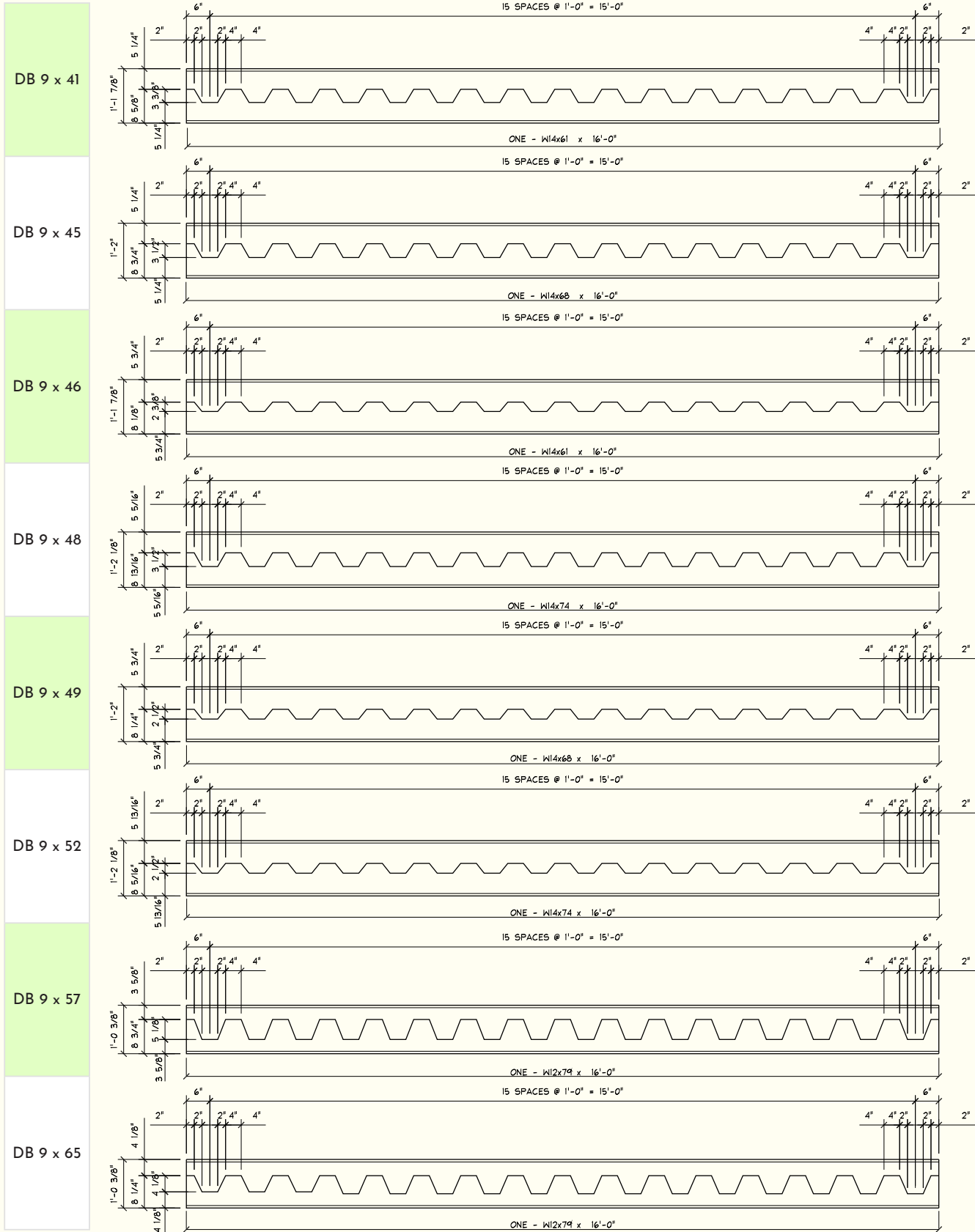
Designation	I_x (in ⁴)	$NA_{bot DB}$ (in)	S_{bot} (in ³)	S_{top} (in ³)	$Q_{top bar}$ (in ³)	$PNA_{bot DB}$ (in)	Z (in ³)
DB 8 x 37	105	2.79	37.7	20.2	14.1	0.51	26.1
DB 8 x 39	108	2.69	40.3	20.4	14.4	0.55	26.5
DB 8 x 42	126	3.32	38.0	27.0	17.7	1.53	35.9
DB 8 x 45	131	3.21	40.8	27.4	18.2	0.85	36.7
DB 8 x 57	169	2.93	57.7	33.3	22.9	0.68	42.4
DB 8 x 61	188	3.22	58.2	39.2	26.0	0.73	50.8
DB 9 x 41	161	3.13	51.4	24.8	18.0	0.55	31.4
DB 9 x 45	173	2.92	59.1	25.3	19.0	0.62	32.6
DB 9 x 46	198	3.79	52.2	33.9	22.9	0.85	44.0
DB 9 x 48	179	2.83	63.1	25.6	19.5	0.65	33.0
DB 9 x 49	215	3.55	60.6	34.7	24.5	0.71	45.4
DB 9 x 52	224	3.44	65.0	35.2	25.3	0.74	45.9
DB 9 x 57	258	3.40	76.0	40.7	29.3	0.64	47.8
DB 9 x 65	314	4.10	76.6	55.7	36.7	0.84	68.1

$F_y = 50$ ksi		
ASD 9 TH EDITION	ASD 14 TH EDITION	LRFD 14 TH EDITION
M_{allow} (kip-ft)	M_n/Ω_b (kip-ft)	$\phi_b M_n$ (kip-ft)
50.4	65.0	97.7
51.0	66.2	99.5
67.6	89.6	134.6
68.5	91.5	137.5
83.2	105.9	159.2
98.1	126.6	190.3
62.0	78.4	117.8
63.3	81.3	122.2
84.8	109.7	164.9
63.9	82.4	123.8
86.8	113.2	170.2
87.9	114.5	172.0
101.7	119.3	179.4
139.2	170.0	255.5

8" D-BEAM® GIRDER CUTTING PATTERNS



9" D-BEAM® GIRDER CUTTING PATTERNS



8" D-BEAM® GIRDER WITH 8" HOLLOW CORE LRFD

D-BEAM® girder

D-BEAM® girder = **DB 8x61**
 Parent Beam Yield Stress (F_y) = 50 ksi
 Top Bar Yield Stress (F_y) = 50 ksi

Span Information

D-BEAM® girder Span = **25** ft
 Composite Section Effective Width = **6.25** ft
 Total Tributary Width for Load = **28** ft

Precast Slab

Nominal Slab Thickness = **8 in.**
 Precast Slab Weight = 56 psf

Grout

Unit Weight of Grout = **140** lb/ft³

Unfactored Loads

Basic Dead Load (D-BEAM® girder + Slab + Grout) = 59.0 psf
 Add'l Composite Dead Load (e.g. topping) = **0** psf
 Partition Live Load = **15** psf
 Basic Floor Live Load = **40** psf
 Consider Floor Live Load Reduction (IBC 2009/2012) = **Yes**
 Floor Live Load Reduction = 34.9%
 Reduced Floor Live Load = 26.0 psf

Factored Moments

	<u>1.4D</u>	<u>1.2D+1.6L</u>	
Basic Dead Load Moment =	180.54	154.75	kip-ft
Add'l Composite Dead Load Moment =	0.00	0.00	kip-ft
Partition Live Load Moment =	0.00	52.50	kip-ft
Floor Live Load Moment =	0.00	91.12	kip-ft
Total Factored Moment =	180.54	298.37	kip-ft

Factored Shears

	<u>1.4D</u>	<u>1.2D+1.6L</u>	
Basic Dead Load Shear =	28.89	24.76	kips
Add'l Composite Dead Load Shear =	0.00	0.00	kips
Partition Live Load Shear =	0.00	8.40	kips
Floor Live Load Shear =	0.00	14.58	kips
Total Factored Shear =	28.89	47.74	kips

Deflections (negative values indicate downward deflection)

(optional) D-BEAM® girder Camber = **2.50** in
 Basic Dead Load Deflection = -2.67 in
 Net Basic Dead Load Deflection including Camber = -0.17 in
 Add'l Composite Dead Load Deflection = 0.00 in
 Partition Live Load Deflection = -0.31 in
 Floor Live Load Deflection = -0.53 in (=L/565)
 Total (Net) Deflection due to all loads = -1.00 in (=L/299)

Design Checks - Noncomposite

Noncomposite Moment **OK**
 $M_u = 180.5$ kip-ft
 $\phi_b M_n = 190.3$ kip-ft

Horizontal Shear **OK**
 $V_u = 28.9$ kips
 $\phi V_n = 33.5$ kips

Design Checks - Full Composite

Floor LL Deflection **OK**
 Allow. $\Delta_{LL} = L/360$
 $\Delta_{LL} = -0.53$ in
 $L/360 = -0.83$ in

Full Composite Moment **OK**
 $M_u = 298.4$ kip-ft
 $\phi_b M_n = 299.7$ kip-ft

Flexural Ductility Check **OK**
 $\epsilon_{web/flange\ intersection} = 0.009698$
 $2\epsilon_y = 0.003448$

Shear **OK**
 $V_u = 47.7$ kips
 $\phi_v V_n = 75.9$ kips

CROSS SECTION ANALYSIS IS VALID

➔

RUN

Section Properties **

		Noncomposite		Full Composite
<i>Gross Section Properties</i>				
$N_{A_{bot\ DB}}$	in	3.22		4.09
I_g	in ⁴	188		476
$S_{bot\ DB}$	in ³	58.2		116.5
$S_{top\ DB}$	in ³	39.2		121.7
$Q_{top\ bar}$	in ³	26.0		---
<i>Elastic (Cracked) Section Properties</i>				
$N_{A_{bot\ DB}}$	in	---		5.13
I_{cr}	in ⁴	---		356
$S_{bot\ DB}$	in ³	---		69.4
$S_{top\ DB}$	in ³	---		124.0
<i>Effective Moment of Inertia (for deflection calculations)</i>				
I_{eff}	in ⁴	188		416
<i>Effective Plastic Section Properties</i>				
$PNA_{bot\ DB}$	in	0.73		6.86
Z	in ³	50.75		79.92
Load Resisted by Each Cross Section		Basic DL (B+S+G)		Add'l Comp. DL Partition LL Floor LL

** Elastic and plastic section moduli (S and Z, respectively) are based on entire cross section being transformed into the parent beam (D-BEAM® girder bottom tee) material.

NOTE: GRAPHICAL REPRESENTATION ONLY

The online D-BEAM® girder Calculator Reference Tool v3.5 is intended for use only with assemblies identical to S1, S2 & S3 in the GIRDER-SLAB® system Design Guide v3.5.

9" D-BEAM® GIRDER WITH 10" HOLLOW CORE LRFD

D-BEAM® girder

D-BEAM® girder = **DB 9x65**
 Parent Beam Yield Stress (F_y) = 50 ksi
 Top Bar Yield Stress (F_y) = 50 ksi

Span Information

D-BEAM® girder Span = **21** ft
 Composite Section Effective Width = 5.25 ft
 Total Tributary Width for Load = **34** ft

Precast Slab

Nominal Slab Thickness = **10 in.**
 Precast Slab Weight = 68 psf

Grout

Unit Weight of Grout = **140** lb/ft³

Unfactored Loads

Basic Dead Load (D-BEAM® girder + Slab + Grout) = 70.8 psf
 Add'l Composite Dead Load (e.g. topping) = **0** psf
 Partition Live Load = **15** psf
 Basic Floor Live Load = **40** psf
 Consider Floor Live Load Reduction (IBC 2009/2012) = **Yes**
 Floor Live Load Reduction = 35.3%
 Reduced Floor Live Load = 25.9 psf

Factored Moments

	<u>1.4D</u>	<u>1.2D+1.6L</u>	
Basic Dead Load Moment =	185.76	159.22	kip-ft
Add'l Composite Dead Load Moment =	0.00	0.00	kip-ft
Partition Live Load Moment =	0.00	44.98	kip-ft
Floor Live Load Moment =	0.00	77.60	kip-ft
Total Factored Moment =	185.76	281.81	kip-ft

Factored Shears

	<u>1.4D</u>	<u>1.2D+1.6L</u>	
Basic Dead Load Shear =	35.38	30.33	kips
Add'l Composite Dead Load Shear =	0.00	0.00	kips
Partition Live Load Shear =	0.00	8.57	kips
Floor Live Load Shear =	0.00	14.78	kips
Total Factored Shear =	35.38	53.68	kips

Deflections (negative values indicate downward deflection)

(optional) D-BEAM® girder Camber = **0.75** in
 Basic Dead Load Deflection = -1.16 in
 Net Basic Dead Load Deflection including Camber = -0.41 in
 Add'l Composite Dead Load Deflection = 0.00 in
 Partition Live Load Deflection = -0.11 in
 Floor Live Load Deflection = -0.20 in (=L/1278)
 Total (Net) Deflection due to all loads = -0.72 in (=L/352)

** Elastic and plastic section moduli (S and Z, respectively) are based on entire cross section being transformed into the parent beam (D-BEAM® girder bottom tee) material.

Design Checks - Noncomposite

Noncomposite Moment **OK**
 $M_u = 185.8$ kip-ft
 $\phi_b M_n = 255.5$ kip-ft

Horizontal Shear **OK**
 $V_u = 35.4$ kips
 $\phi_v V_n = 39.7$ kips

Design Checks - Full Composite

Floor LL Deflection **OK**
 Allow. $\Delta_{LL} = L/360$
 $\Delta_{LL} = -0.20$ in
 $L/360 = -0.70$ in

Full Composite Moment **OK**
 $M_u = 281.8$ kip-ft
 $\phi_b M_n = 370.6$ kip-ft

Flexural Ductility Check **OK**
 $\epsilon_{web/flange\ intersection} = 0.010889$
 $2\epsilon_y = 0.003448$

Shear **OK**
 $V_u = 53.7$ kips
 $\phi_v V_n = 55.7$ kips

CROSS SECTION ANALYSIS IS VALID

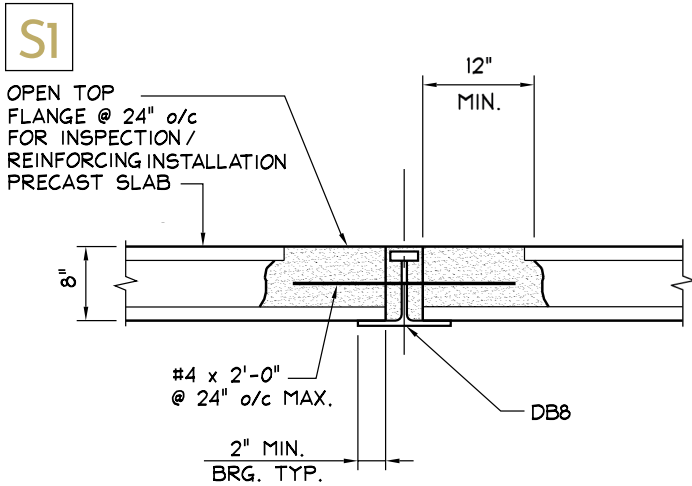
RUN

Section Properties **

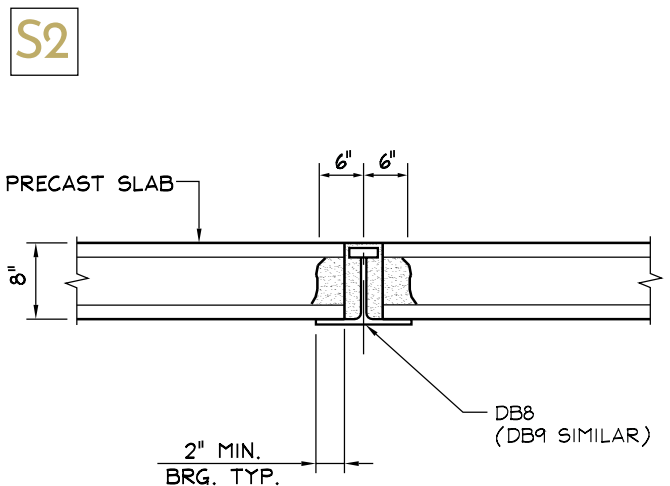
		Noncomposite		Full Composite
Gross Section Properties				
$NA_{bot\ DB}$	in	4.10		5.05
I_g	in ⁴	314		781
$S_{bot\ DB}$	in ³	76.6		154.7
$S_{top\ DB}$	in ³	55.7		166.2
$Q_{top\ bar}$	in ³	36.7		---
Elastic (Cracked) Section Properties				
$NA_{bot\ DB}$	in	---		6.42
I_{cr}	in ⁴	---		566
$S_{bot\ DB}$	in ³	---		88.1
$S_{top\ DB}$	in ³	---		169.9
Effective Moment of Inertia (for deflection calculations)				
I_{eff}	in ⁴	314		674
Effective Plastic Section Properties				
$PNA_{bot\ DB}$	in	0.84		8.59
Z	in ³	68.13		98.82
Load Resisted by Each Cross Section		Basic DL (B+S+G)		Add'l Comp. DL Partition LL Floor LL

DOWNLOAD INFORMATION:

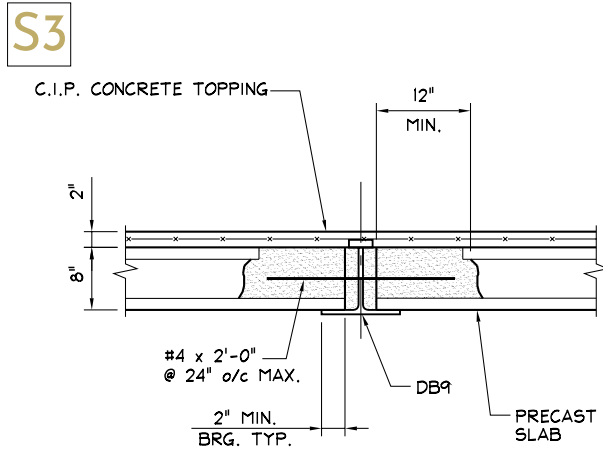
The GIRDER-SLAB® system D-BEAM® girder Calculator Reference Tool v3.5 is available for free at www.girder-slab.com.



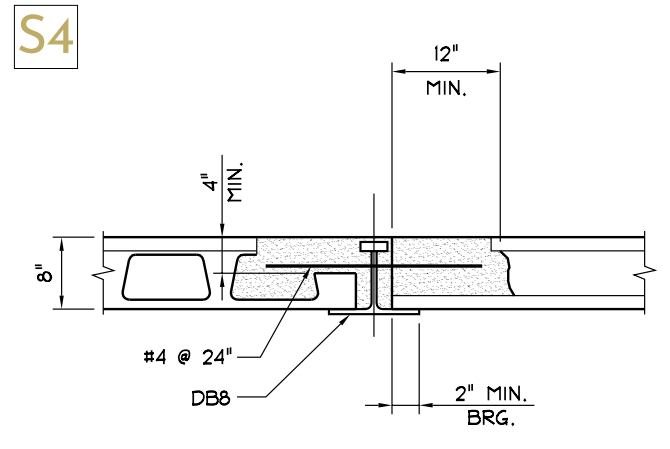
TYPICAL GIRDER-SLAB® SYSTEM SECTION @ REINFORCED CORE
NOTE: VERIFY REINFORCING FOR ACTUAL LATERAL LOADS



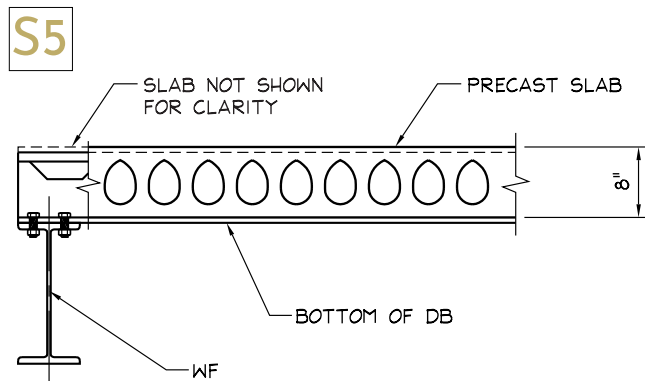
TYPICAL GIRDER-SLAB® SYSTEM SECTION @ NON-REINFORCED CORE
NOTE: DB9 TOP FLANGE WILL BE ABOVE THE SLAB AND WITHIN DEPTH OF TOPPING



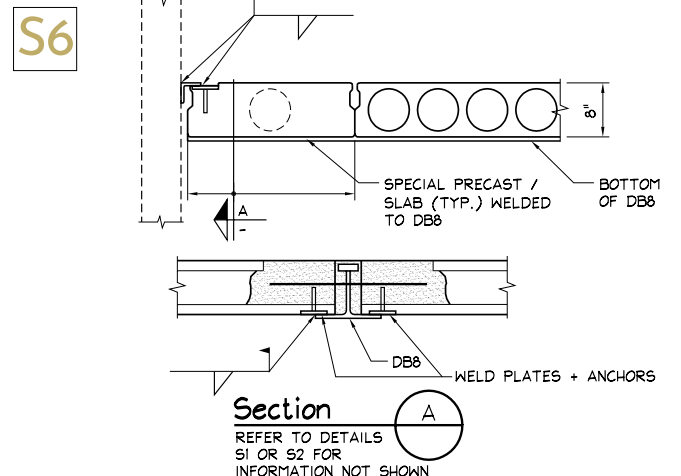
TYPICAL SECTION: REINFORCED CORE WITH 2" CONCRETE TOPPING
NOTE: GROUT TO ATTAIN 4,000 PSI PRIOR TO TOPPING
(DETAILS S4, S5 & S6 ARE SIMILAR FOR DB9)



TYPICAL SECTION: 8" GIRDER-SLAB® SYSTEM ALTERNATE SLAB BEARING
NOTE: DB9 TOP FLANGE WILL BE ABOVE THE SLAB AND WITHIN DEPTH OF TOPPING
STABILIZE BEAMS AND SLABS UNTIL ALL GROUTING AND WELDING IS COMPLETE

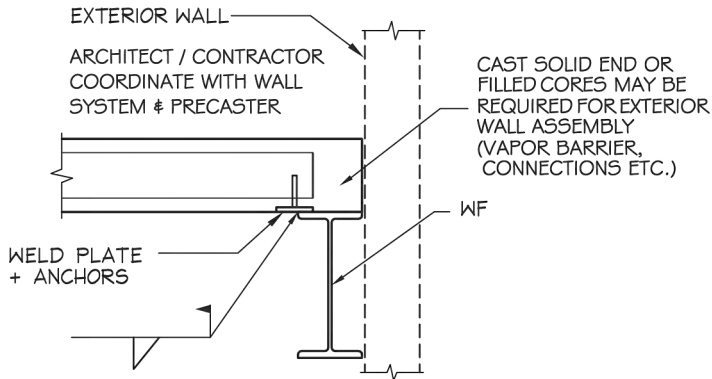


TYPICAL SECTION: 8" GIRDER-SLAB® SYSTEM BEARING ON WF BEAM
REVIEW UNBRACED LENGTH OF BEAM & CHECK WEB FOR SHEAR REINFORCEMENT



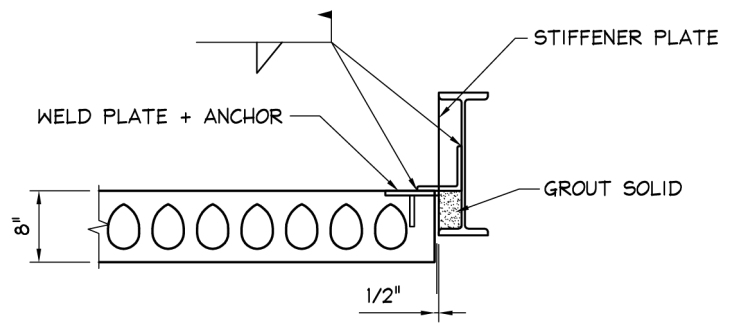
TYPICAL SECTION: 8" GIRDER-SLAB® SYSTEM WITHOUT WF SPANREL BEAM
TO BE USED WHEN NO SPANREL BEAM AND SLAB DIAPHRAGM SPAN ≥ 30'-0"
SPECIAL PLANK ACTING AS DIAPHRAGM CHORD

S7



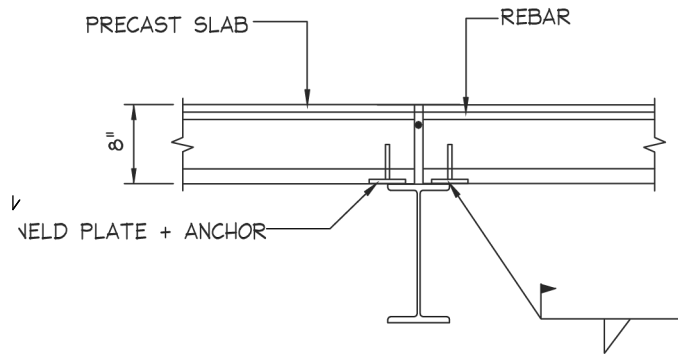
TYPICAL SECTION: 8" PRECAST SLAB END BEARING ON WF SPANDREL BEAM
STABILIZE BEAMS & SLABS UNTIL ALL GROUTING AND WELDING IS COMPLETE

S8



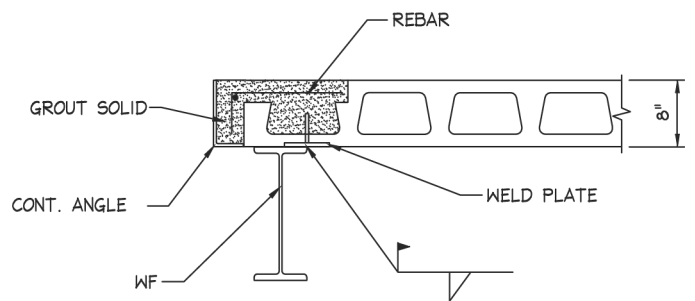
TYPICAL SECTION: 8" PRECAST SLAB UPSET LONGITUDINAL SPANDREL BEAM

S9



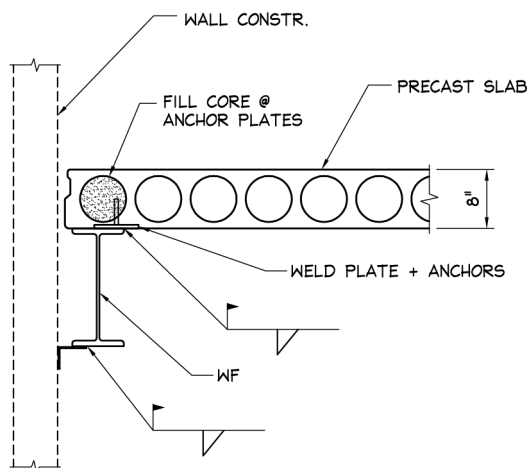
TYPICAL SECTION: 8" PRECAST SLAB END BEARING ON WF INTERIOR BEAM
STABILIZE BEAMS AND SLABS UNTIL ALL GROUTING AND WELDING IS COMPLETE

S10



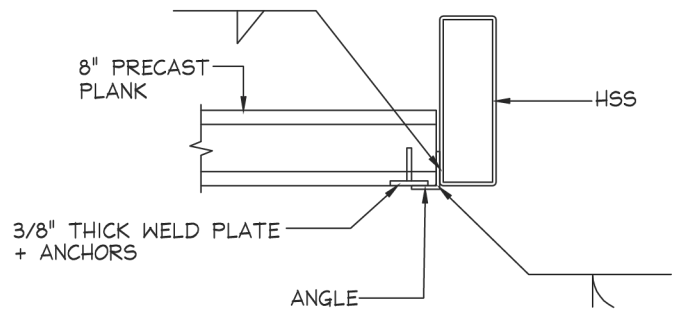
TYPICAL SECTION: 8" PRECAST SLAB AT ELEVATOR DOOR SILL

S11



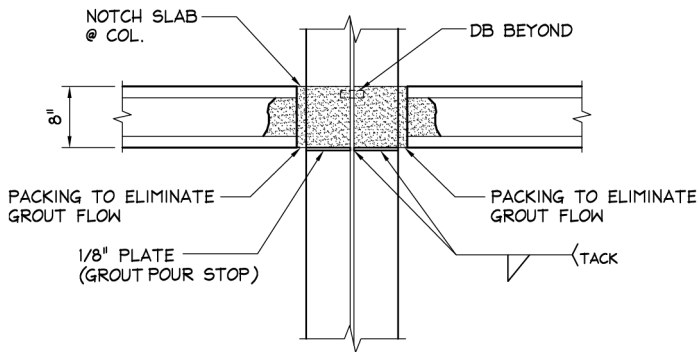
TYPICAL SECTION: 8" PRECAST SLAB LONGITUDINAL BEARING ON WF
SPANDREL BEAM

S12



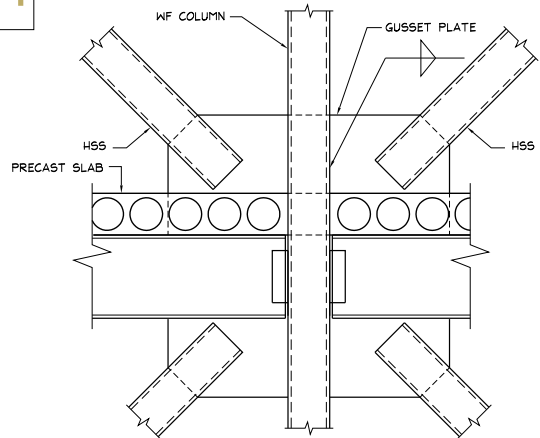
PRECAST SLAB SUPPORT DETAIL

S13



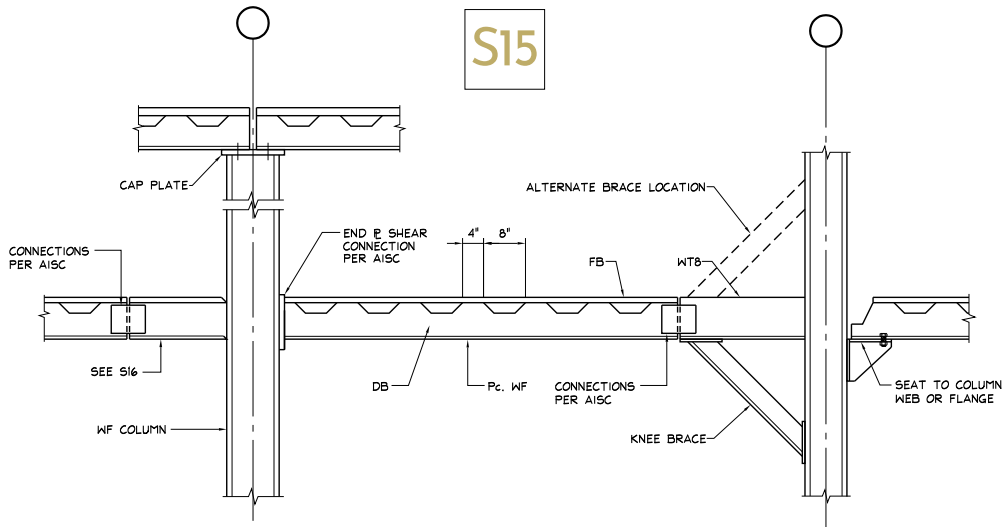
TYPICAL SECTION THRU WF COLUMN AT GROUT POUR STOP

S14



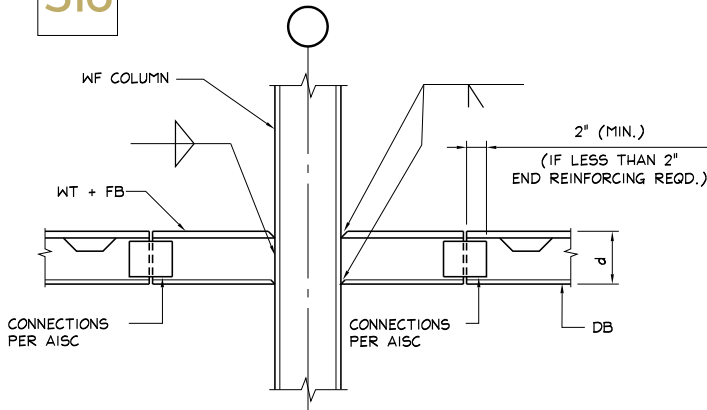
TYPICAL BRACE CONNECTION CLEAR OF PLANK

S15



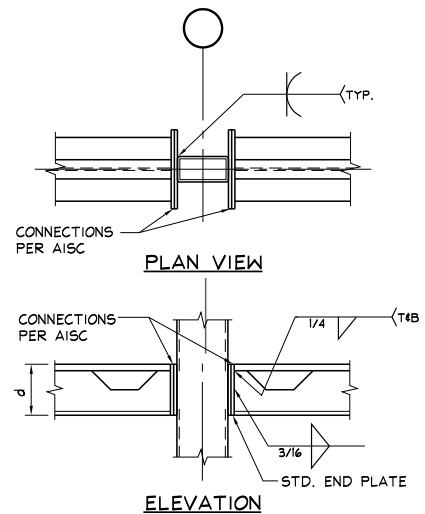
EXAMPLES OF D-BEAM® GIRDER CONNECTIONS TO WF COLUMNS
NOTE: CHECK WEBSITE FAQs ON CONNECTION DESIGN

S16

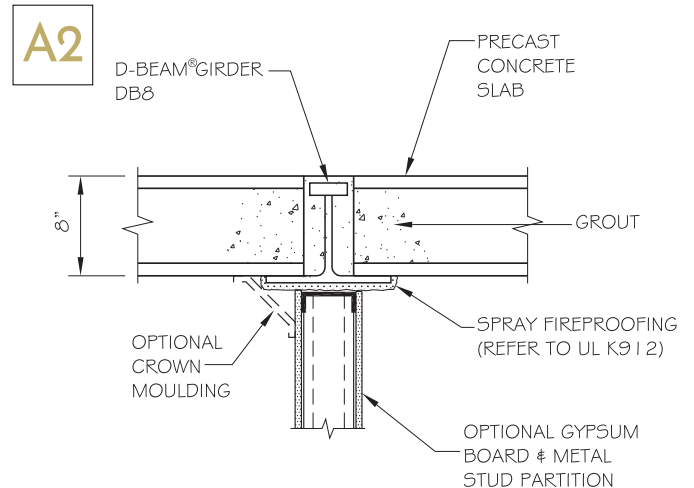
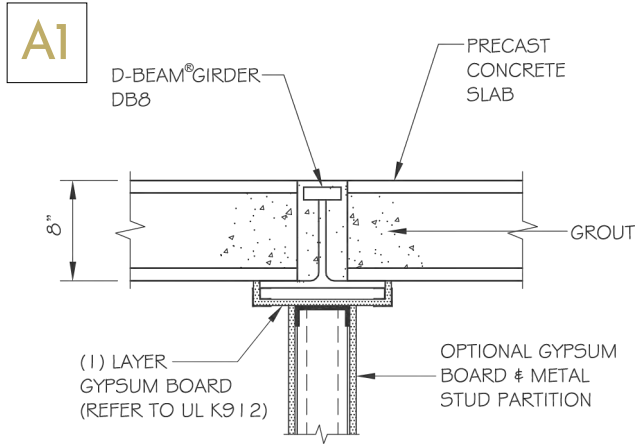


TYPICAL "TREE" COLUMN ELEVATION
NOTE: STABILIZE BEAMS AND SLAB UNTIL ALL GROUTING & WELDING IS COMPLETE

S17

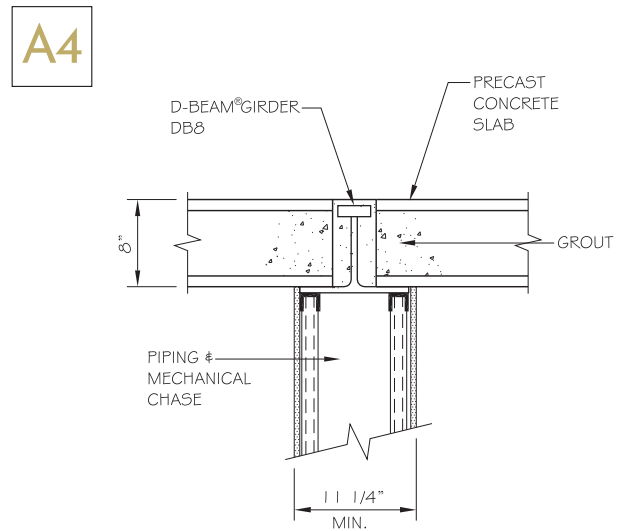
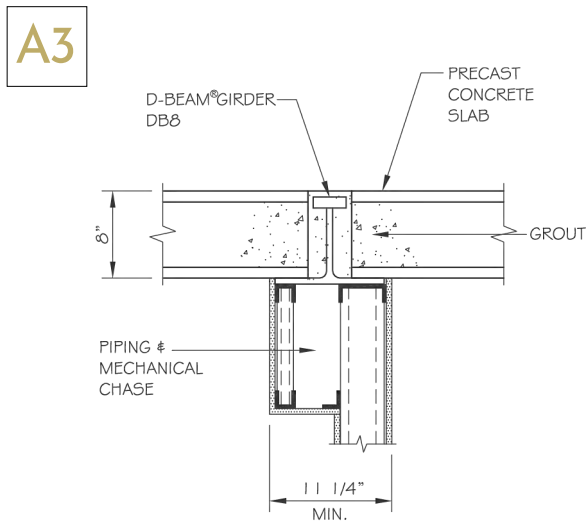


TYPICAL PLAN/ELEVATION: 8" D-BEAM® GIRDER CONNECTION TO HSS COLUMN
USED AT EXPOSED COLUMNS WITH CONCEALED CONNECTIONS
MUST NOTE TO STABILIZE ALL D-BEAM® GIRDERS
MODIFY WITH BOLTS "OUTSIDE" OF D-BEAM® GIRDER FOR NORMAL CONNECTION



TYPICAL SECTION: GIRDER-SLAB® SYSTEM WITH RATED DRYWALL SOFFIT ENCLOSURE
(OPTIONAL DRYWALL PARTITION) DETAILS ARE SIMILAR FOR DB9 WITH 2" CONCRETE TOPPING

TYPICAL SECTION: GIRDER-SLAB® SYSTEM WITH RATED SPRAY FIREPROOFING
(OPTIONAL DRYWALL PARTITION) DETAILS ARE SIMILAR FOR DB9 WITH 2" CONCRETE TOPPING



TYPICAL SECTION: GIRDER-SLAB® SYSTEM WITH DRYWALL SOFFIT / PARTITION ENCLOSURE
DETAILS ARE SIMILAR FOR DB9 WITH 2" CONCRETE TOPPING

TYPICAL SECTION: GIRDER-SLAB® SYSTEM WITH DRYWALL CHASE PARTITION ENCLOSURE
DETAILS ARE SIMILAR FOR DB9 WITH 2" CONCRETE TOPPING

THE PARTITION AND RATED PROTECTION DETAILS ARE PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY AND NOT INTENDED FOR ACTUAL USE. GIRDER-SLAB TECHNOLOGIES, LLC IS NOT RESPONSIBLE FOR DESIGN, MEANS, OR METHODS ASSOCIATED WITH THIS DETAIL.



AQUA ON THE OCEAN - LONG BEACH, NEW YORK

GIRDER-SLAB® SYSTEM SPECIFICATION GUIDE

The GIRDER-SLAB® system Design Guide v3.5 and technology is available for use by industry professionals. Application and use of this information requires design by a registered professional structural engineer.

Structural Engineers are asked to add the following GIRDER-SLAB® system Specification Guide to the General Notes section of their construction documents. The Specification Guide and the Typical System Structural and Architectural Details are available in both CAD and PDF formats on the Design page of the GIRDER-SLAB® system website www.girder-slab.com.

The GIRDER-SLAB® system and the D-BEAM® girder are available from your customary steel fabricators. Fabrication, construction and assembly shall be in conformance with the GIRDER-SLAB® system Design Guide v3.5 specifications and details.

1. The open web Dissymmetric Beam shall be fabricated from (ASTM A992/A572 Grade 50) standard steel wide flange sections with flat bar at top-flange and shall meet AISC standards (except for depth, tolerance $\pm 1/8"$), unpainted unless specified. The open web Dissymmetric Beam can be specified to include camber. Cambering can be built in during assembly of the girder.
2. If the structural engineer of record determines that shoring of the pre-composite assembly is needed, leave in place until grout attains required strength.
3. Precast prestressed concrete hollow-core slab units (min. 5,000 PSI) shall be in 4 or 8 foot widths and shall meet PCI standards and tolerances, 2" min. bearing unless specified otherwise.
4. Reinforcing steel (ASTM A615 Grade 60) shall be placed through the Dissymmetric Beam web openings and into slab cores.
5. Cementitious grout (min. 4,000 PSI) shall be placed monolithically around and through the Dissymmetric Beam web openings and into slab cores. When concrete topping is used, attain specified strength of grout prior to placement.
6. The GIRDER-SLAB® system shall be constructed in accordance with Underwriters Laboratories Inc., Floor-Ceiling Assembly Design No. K912 in order to meet fire classification standards and ratings set forth by BOCA and ICC codes.
7. The GIRDER-SLAB® system and D-BEAM® girders shall be provided by steel fabricators authorized by Girder-Slab Technologies, LLC of CA/NJ in conformance with its Design-Guide & Distribution requirements. Steel Fabricator/ Distributor contact information: 1-888-478-1100 or www.girder-slab.com.
8. The supplier of the GIRDER-SLAB® system shall provide to the Project Owner (or its representative) a GIRDER-SLAB® system Compliance Certificate for each project upon completion of system assembly and construction.
9. Comply with all applicable provisions of the following standards and codes:
 - Girder-Slab Technologies, LLC Design-Guide
 - American Institute of Steel Construction (AISC)
 - American Welding Society (AWS)
 - Precast Concrete Institute (PCI)
 - American Concrete Institute (ACI)
 - American Society of Testing and Materials (ASTM)
 - Underwriters Laboratories Inc. (UL) - Fire Resistance Directory UL K912
 - Building Officials & Code Administrators International Inc. (BOCA) - National Building Code
 - International Code Council Inc. (ICC) - International Building Code
 - Other applicable codes and standards

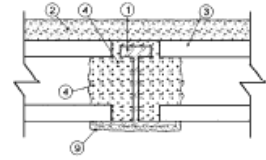
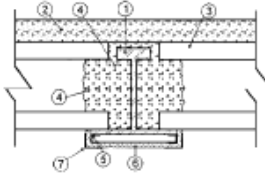
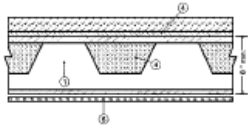
ASSEMBLY RATINGS

Design No. K912 (February 24, 2025)

Restrained Assembly Ratings - 2 or 3 Hr (See Item 2)

Unrestrained Assembly Ratings - 2 Hr

Unrestrained Beam Ratings - 2 Hr



BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States
BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

1. Steel Beam – Composite dissymmetric steel beam fabricated from structural steel members in accordance with the Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, published by the American Institute of Steel Construction. The castellated steel beam, with a partially open web consists of the bottom flange and partial web with a bar welded to the web that serves as the top flange and conforms to the following requirements on pages 12, 14 and 15 of this Design Guide.
2. Concrete Topping – (Optional for unrestrained rating) – 3000 psi compressive strength, 150 (+ or -) 3 pcf unit weight. Normal weight concrete. Min 1-1/8 in. thickness required for 3 hr Restrained Assembly Rating.
3. Precast Concrete Units* – Carbonate, siliceous or lightweight aggregate. Min 8 in. thick by 4 or 8 ft wide units with cross section similar to that shown for Design No. J952. Openings may be provided through the units for piping, ducts or similar services and should be suitably enclosed with constructions having at least equal resistance, acceptable to authorities having jurisdiction. Units have a min 1-1/2 in. bearing on the bottom flange of Item 1.
4. Grout – Sand-cement grout (3500 psi min compressive strength). Min avg thickness of 9/16 in. above top bar. Hollow cores in precast concrete units grouted 6 in. min from beam web.
5. Runner Channel – Fabricated from 25 MSG galv steel, min 1/2 in. deep, with 1 in. legs, fastened to steel beam with XZF powder actuated pins spaced 12 in. OC.
6. Gypsum Board* – 1/2 or 5/8 in. thick gypsum board fastened to runner channels with 1 in. long, 0.150 in. diam steel screws spaced 16 in. OC.
7. Corner Bead – Fabricated from min 28 MSG galv steel to form an angle with 1-1/4 in. legs. Legs perforated with 1/4 in. diam holes approximately 1 in. OC. Attached to runner channel through gypsum board with 1 in. long, 0.150 in. diam steel screws spaced 16 in. OC.
8. Joint Compound – (Not shown) 1/32 in. thick on bottom and sides of wallboard from corner beads and feathered out. Paper tape embedded in joint compound over joints with edges of compound feathered out.
9. As an alternate to Items 5 through 8, the bottom flange of

the steel beam may be protected with a spray applied fire resistive material. Applied in one coat to a final untamped thickness of 3/8 in. to steel surfaces which are free of dirt, oil or scale. Min avg untamped density of 13 pcf with min ind untamped density of 11 pcf for Types II and D-C/F. Min avg and min ind untamped densities of 22 and 19 pcf, respectively, for Type HP. For Type I, min avg density of 15 pcf with min ind value of 12 pcf.

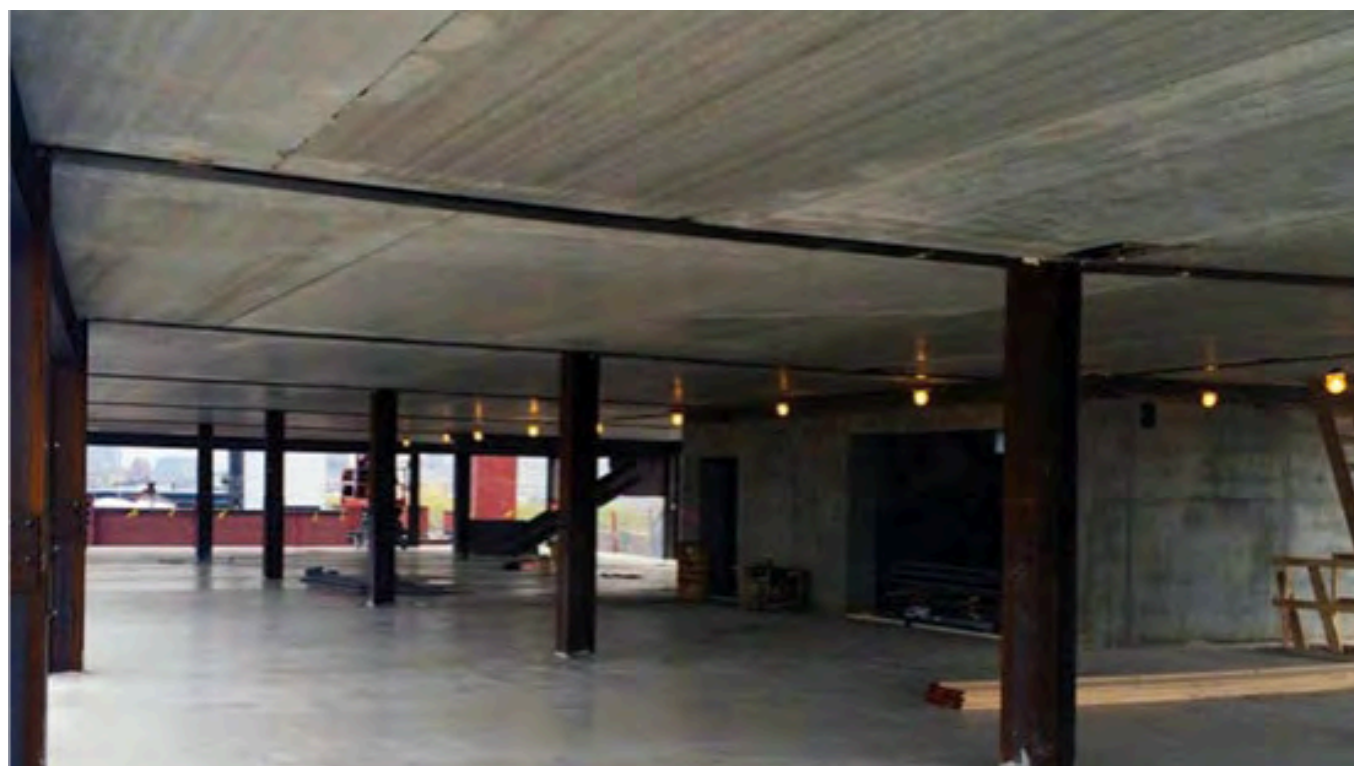
ISOLATEK INTERNATIONAL – Type D-C/F, HP, I or II, Type EBS or Type X Adhesive/Sealer optional*
 Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

- a. Spray-Applied Fire Resistive Material* – As an alternate to Items 5 through 9, the bottom flange of the steel beam and the flange tips may be protected with a spray applied fire resistive material. Applied in one coat to a final untamped thickness of 1/2 in. to steel surfaces which are free of dirt, oil or scale. Min avg and min ind density of 15/14 pcf respectively. For method of density determination, see Design Information Section.
 GCP APPLIED TECHNOLOGIES INC – Types MK6/HY, MK-6ES, MK-6s, MK-10HB, MK-1000HB, RG, Z-106, Z-106G, Z-106HY, Z-146, Z-146 PC, Z-146T, Z-156, Z-156 PC, and Z-156T.
- b. Spray-Applied Fire Resistive Material* – As an alternate to items 5 through 9A, the bottom flange of the steel beam and the flange tips may be protected with a spray applied fire resistive material. Applied in one coat to an untamped thickness of 1/2 in. to steel surfaces which are free of dirt, oil or scale. Min. avg and min ind density of 15/14 pcf respectively for types 5GP and 5MD. Min. avg and min ind density of 19/18 pcf respectively for types 7GP and 7HD.
 SOUTHWEST FIREPROOFING PRODUCTS CO – Types 5GP, 5MD, 7GP and 7HD

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.



(above) D-BEAM® girders spanning the length of the building between one interior column line



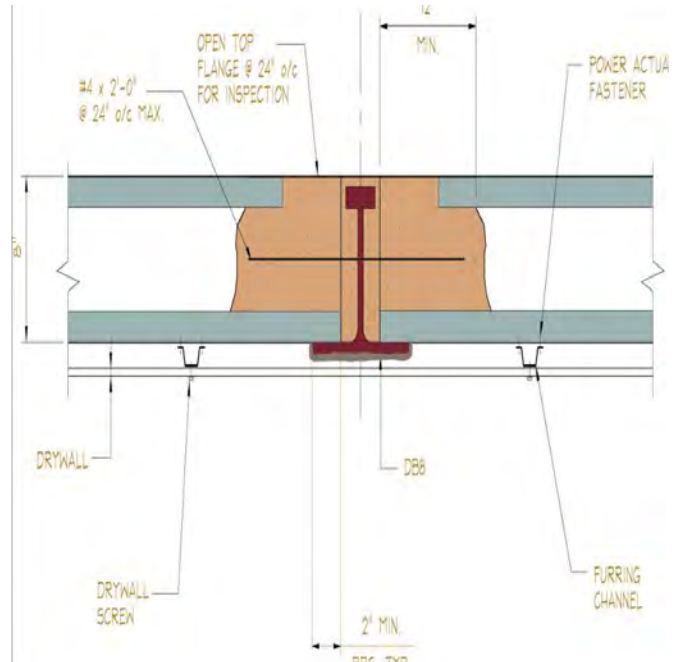
(above) D-BEAM® girders spanning the width of the building between multiple interior column lines

Single interior column

Multiple interior column lines



After grouting, the composite slab is complete and ready for use. The addition of any non-structural, lightweight leveling material (typically 3/4"-1") normally occurs after the building is closed and interior studs are installed.



The underside of the precast hollow core slab is often left unfinished, or a wall board ceiling can be used to conceal the bottom flange of the D-BEAM® girder.



Rebar is for shrinkage so it can be cut during coring. Plank pre-stressing strands are bonded so if cut, the pre-stressing force is not compromised.



A wide variety of opening sizes and configurations can be accommodated ranging from "large" openings (>10-inches) to small core drills. Most common large openings include: HVAC, plumbing and electrical chases, hatch access at roof, trash chutes and skylights.

INTERIOR FINISHES



UNFINISHED SLAB CEILING

UNFINISHED SLAB CEILING

THE HAMILTON - PHASE II



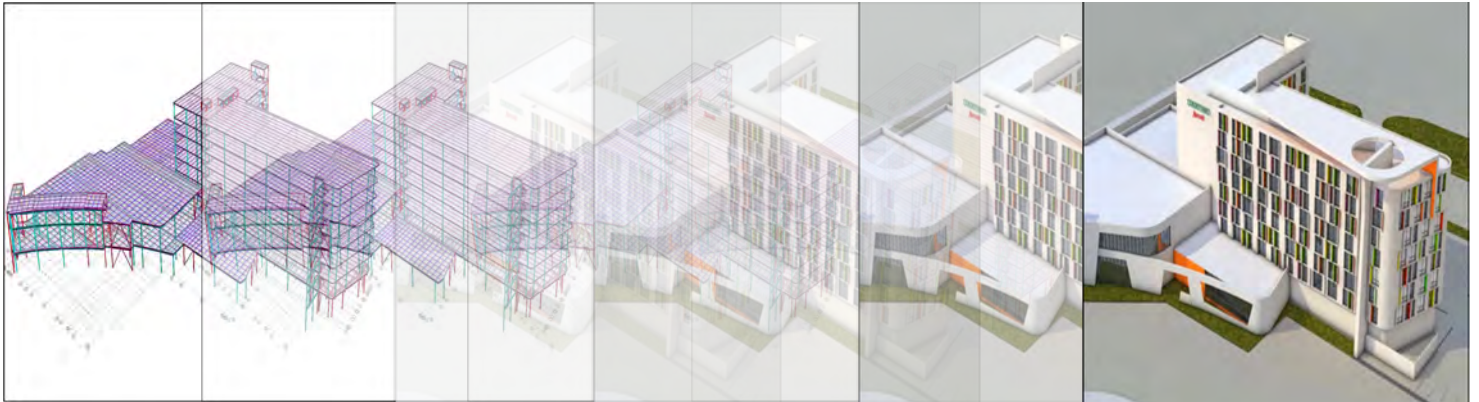
Phase II was fully completed in 15 months (during Covid) utilizing Girder-Slab®

It took twice as long (30 months!) and nearly double the on-site labor to complete Phase I using conventional steel

Project Details
Location: Philadelphia, PA
Height: 16 Stories
Size: 228,000 SF
Type: Mixed Use
Developer: Radnor Property Group
Architect: MY Architecture
Engineer: Harman Group
Builder: McDonald Building Co

“...a concise 15 weeks from setting the first steel column to setting the last beam today. That translates to a 4.5 day floor-to-floor cycle. Extremely efficient considering this was done in the middle of a pandemic.”
-McDonald Building Company

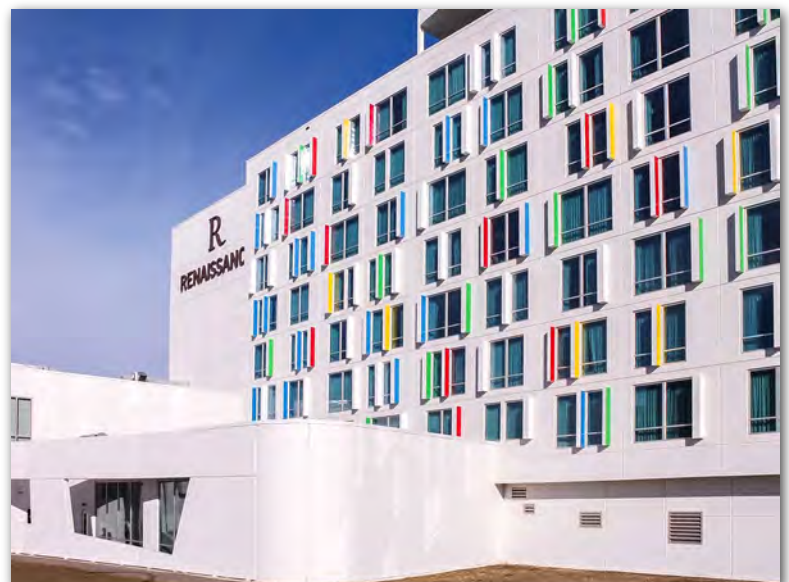
EDMONTON INTERNATIONAL AIRPORT HOTEL



There are numerous restrictions, such as building height (due to air traffic), which make designing and developing property in close proximity to an airport a uniquely challenging endeavor. Further complicating matters, winter weather conditions can negatively impact construction schedules AND can quickly decrease profitability, especially if heating/hoarding is required. So it came as no surprise when the original design scheme (traditional cast-in-place concrete) for the Edmonton International Airport (EIA) hotel, failed. Facing potentially catastrophic liquidated damages, the owner sought alternative construction methodologies to assist in value engineering the project.

From integrated design to integrated project delivery, the Girder-Slab® team worked with the structural engineer of record (SER) to review, optimize and model a new design scheme, specifying conventional steel and composite deck construction for first two floors and the Girder-Slab® System for the hotel tower (approximately 104,000 SF). The slim floor profile of the Girder-Slab® system allowed for the addition of an 8th floor, which was fundamental to securing financing.

Contract for construction was awarded in late July. Erection of 750 tons of steel commenced in December and the structure was completed in June. The revised construction schedule resulted in a reduction of 8 months (2 in design, 6 in construction) versus the original timeline and approximately 15% savings on capital cost of the structure was achieved, which allowed the development team to enhance finishes and ultimately upgrade from a Marriott Courtyard to a Renaissance. Notably, a comparative impact analysis of the original building design and the actual Girder-Slab® development indicated a reduction of embodied CO2 by 41.7%.



CASE STUDY

THE NEED FOR SPEED

Assembly of the GIRDER-SLAB® system is extremely fast with limited weather impact, including cold climates. This is accomplished with less workers on-site, leading to a safer, streamlined work environment and reduced labor dollars. The system components are prefabricated off-site guaranteeing both consistency and precision. This creates an advantageous and simplified process where construction becomes assembly and mistakes become a thing of the past. Plus, there is no shoring required and the installation of plank for subsequent floors can even proceed before grouting, providing faster access to the work of other trades, ensuring your project stays on or ahead of schedule.

This capability is highlighted here, as one crew of ironworkers simultaneously erected both the steel and the plank (two floors of steel, before the plank), completing roughly 40,000 (sf) of ungrouted steel/plank and 20,000 (sf) of fully finished steel/plank per week. Based on proven Girder-Slab® data and guidance, the GC confidently committed to an aggressive delivery schedule for its client, utilizing less labor and resources. Further, the combined benefit of reduced capital cost AND schedule savings meant decreased interest expense, resulting in a calculated 18% savings on cost of the structure. Time really is **MONEY**.



DAY 15



DAY 31



330 COOPER STREET - RUTGERS UNIVERSITY
12 STORIES - 161,653 SQUARE FEET



DAY 58

BEAUTIFUL BUILDINGS, IRRESISTIBLE SAVINGS

THE GIRDER-SLAB® SYSTEM



THE ALCOTT - PHILADELPHIA, PA



ONE SIMMONS - BOSTON, MA



PAULSON CENTER AT NYU- NEW YORK, NY



FAIRMONT MUMBAI - MUMBAI, INDIA



HYATT CENTRIC - PHILADELPHIA, PA



GRADUATE JUNCTION AT MIT - CAMBRIDGE, MA



HARD ROCK CASINO HOTEL - BRISTOL, VA





Experts in Building Solutions

THE GIRDER-SLAB® SYSTEM

GIRDER-SLAB.COM

