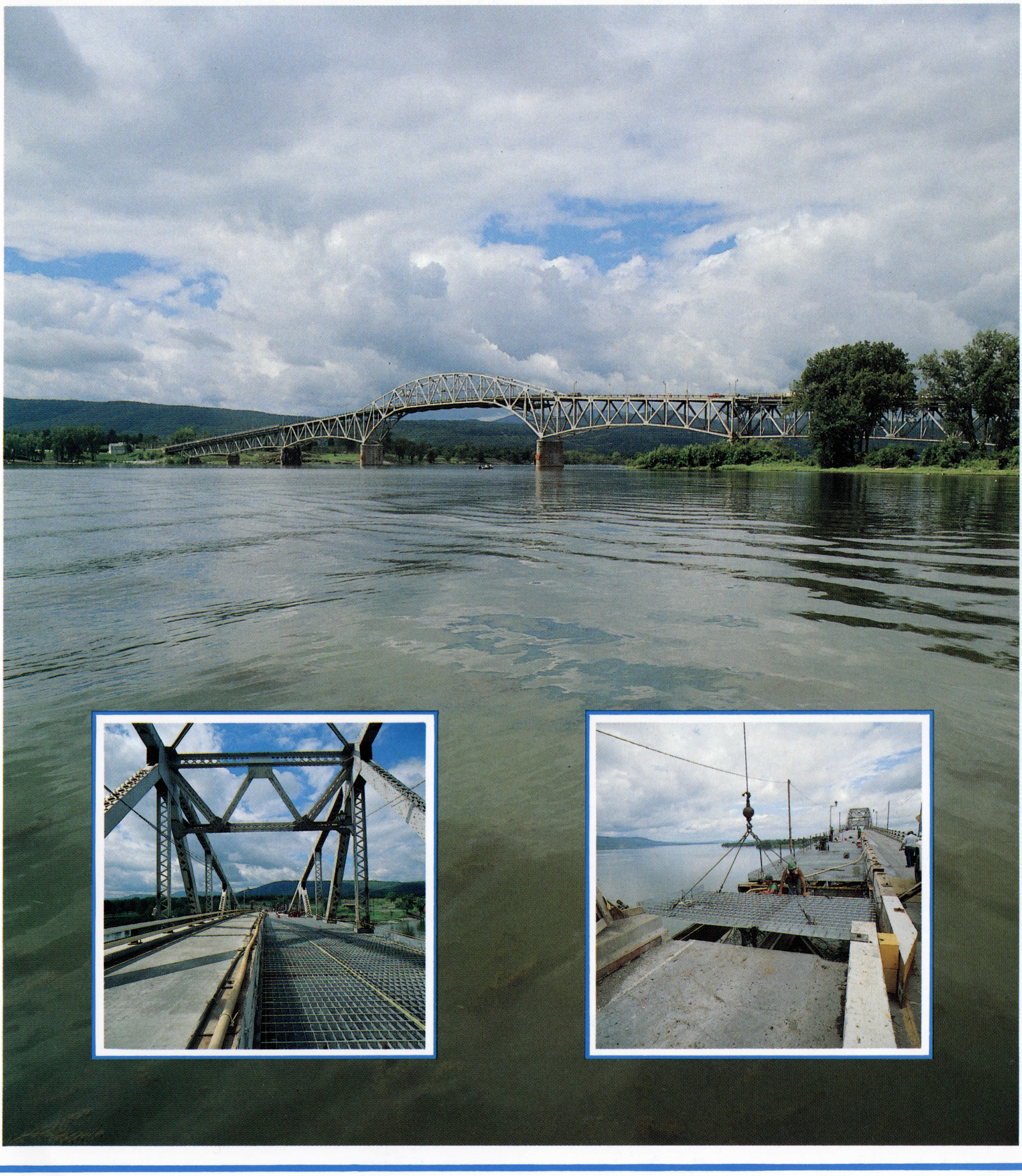
05380/IKH

BuyLine 2301

Bridge Flooring Systems



IKG GREULICH®

50 Years and Counting!

Grid Reinforced Concrete and Greulich

Grid reinforced concrete bridge decks have a long history dating from the construction of the Oakland Bay Bridge in the early 1930's. This first grid reinforced concrete deck was developed to provide a strong, yet relatively light weight deck compared to other alternatives available at the time. It employed standard 3-inch structural tees as the bearing members of the grid, these being the only workable section made at the time.

Gerald G. Greulich, a young engineer who had been involved in the Oakland Bay Bridge project, saw that such a deck could be made even lighter with the design of a more efficient I-beam section specially created to meet the particular load requirements of a grid used as a bridge floor.

He came up with a design for a new, slimmer, more efficient, 5-inch I-beam section which he presented to Carnegie-Illinois Steel Company in 1931. He was subsequently hired by Carnegie, and they began to produce his new section and manufacture lightweight grid reinforced concrete bridge flooring. During the 1930's numerous major new bridges were decked with grid reinforced concrete.

Fifty years and still counting

The importance of this history to engineers today is that most of the grid reinforced concrete decks installed in the 1930's are still in service today (complete listing available on request), located in some of the most severely corrosive environments in the country. These decks have withstood the pounding of billions of vehicles yearly.

Moreover, in most cases where decks installed in the 1930's have been replaced, the problems have been in the bridge structure **under** the deck, not the deck itself.

Common rebar reinforced slab decks come and go, sometimes with life cycles of less than 20 years, while the upper limits of service of grid reinforced concrete decks have not yet been reached. It is currently well over fifty years, and we are still counting.

Fifty years and still improving

A lot has happened since Carnegie Illinois began making Gerald Greulich's first new I-beams, including numerous changes in ownership of the early tooling and technology.

Gerald Greulich himself became associated with various other corporations during his career, designing a number of other grid deck systems, including the well-known Greulich "5-Inch 4-Way" steel grid bridge deck system. Three refinements of the original I-beam section designed in the '30s by Gerald Greulich are the basis for many Greulich grid bridge decks today.

Eventually, through a rather roundabout route, the legacy, tooling and manufacturing rights for Greulich Bridge Flooring Systems ended up with a company owned by Thomas A. Greulich, son of the original designer.

In 1986, the Greulich operation was purchased by IKG Industries, a division of Harsco Corporation. Harsco is one of the 300 largest industrial companies in the U.S.

Under the management of Harsco, Greulich has continued to advance the technology of grid bridge decks through extensive, new, and ongoing research, development, and testing. This catalog contains the most up-to-date test data available at press time. However, since a number of tests were still in progress, please call or write to obtain the very latest data.

Bronx-Whitestone Bridge; NY, NY, circa 1937. Original deck was 212,400 square feet of 4¼" I-Beam Lok that is still in service today.

Table of Contents

Why Use Grid Reinforced Concrete Deck?

Advantages of grid-reinforced concrete decks.

Lightweight, high strength

One square foot of conventional, eight-inch, rebar reinforced concrete bridge deck slab weighs about 96 lbs. A square foot of grid reinforced concrete deck that will do the same job weighs-in at about half that, between 43 to 49 lbs. In weight savings alone, a grid-reinforced concrete deck can have a major beneficial effect on the overall design of a new bridge, and can actually be the salvation of a deteriorated bridge in need of renovation.

Composite function

A number of different attachment methods are shown in this catalog, one of which should be suited to your particular bridge design. All result in composite function between the deck and supporting members, further contributing to the structural efficiency of the overall design of the bridge.

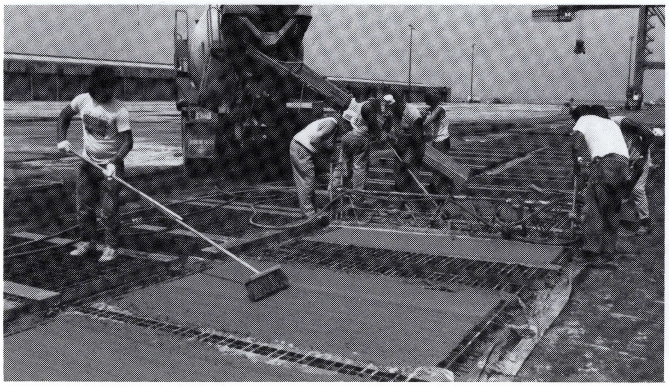
No formwork

Grid panels are delivered with steel form pans, tack welded in place, to contain the concrete within the grid. Once a panel is correctly fastened in place on the bridge, it is ready to be filled with concrete. All the labor, stiff backs, plywood, shoring and other materials normally associated with cast-in-place rebar reinforced concrete slabs simply are eliminated.

Precastability

For installations where traffic interruption must be minimized, making speed of installation critical, concrete pre-casting off site is often the answer. Greulich grids are as easily cast off site as they are in place. Since they are their own forms, no formwork of any kind need be constructed. As the photo on this page illustrates, they are simply placed on any level surface, filled, and screeded.

Moreover, precast panels of grid reinforced concrete are far lighter and much stiffer than equivalent rebar reinforced slabs, making them easier to handle and install after precasting, using lighter equipment, with less possibility of damage to the panels during shipment.



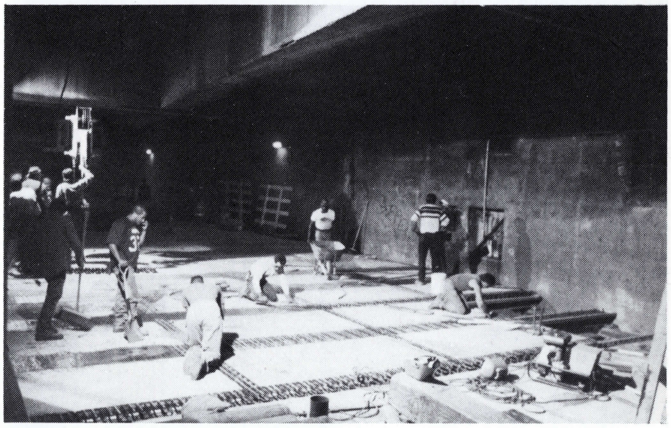
Precasting panels offsite.

Highest cost/performance ratio

Given the fact that experience shows us that it is reasonable to expect at least a fifty-year life from a properly installed grid reinforced concrete deck, these decks offer far and away the best combination of price and performance of any deck in use today. The initial in-place cost of a grid reinforced concrete deck is usually slightly more than a rebar reinforced slab deck (sometimes less, due to labor and other savings), and it can be expected to last two to three times as long.

Fast installation

Because much of the labor that goes into a grid reinforced deck occurs at the factory, well before the material arrives at the jobsite, it can be laid in a fraction of the time it takes to form, reinforce, and pour a cast-in-place slab deck.



Overnight installation of precast panels.
Roadway reopened at 6:00 a.m. each day.

Deck forms a work platform as it is laid

Because the steel grid itself contains load bearing members, the deck becomes its own work platform as it is laid. Cranes and other work vehicles can proceed right across the bridge as they lay the deck, instead of having to work from alongside and below the bridge. This method speeds erection and greatly reduces the size and cost of cranes required, while avoiding costly disruption of traffic.

Maximum quality control

All Greulich grids are manufactured to the highest standards, with the tightest possible quality control. The IKG Greulich plant is certified by the American Institute of Steel Construction in Category 1 fabrication of Conventional Steel Structures. Because the manufacturing and fabrication are performed in a factory setting, adherence to tolerances can be far more rigid than it is possible to achieve under jobsite conditions.

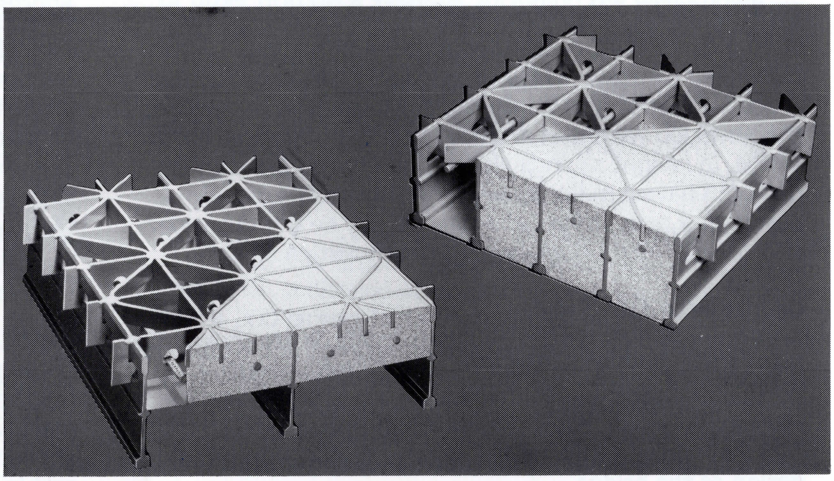
NOTE ON ALL STYLES OF CONCRETE-FILLED FLOORS:
Since form pans are only tack-welded to the beams, there will be some grout seepage. Seepage can be removed by cleaning with a high pressure water hose.

5INCH 4WAY™ Half & Full Depth

5-Inch 4-Way may be Concrete-Filled to half-depth, 2½ inches (left) or to full-depth, 5 inches (right).

When concrete is added to the unique 5-Inch 4-Way Steel Grid, the result is a Bridge Flooring System that offers all of the Open Grid System's benefits plus maximum load-carrying capacity, rigid construction and economy. The system, with 2½ inches of concrete, weighs less than one-half that of a conventional reinforced concrete floor of equal strength.

5-Inch 4-Way Concrete-Filled may be used in conjunction with 5-Inch 4-Way Open in a combination grid bridge floor system, or where no wearing surface is to be provided.

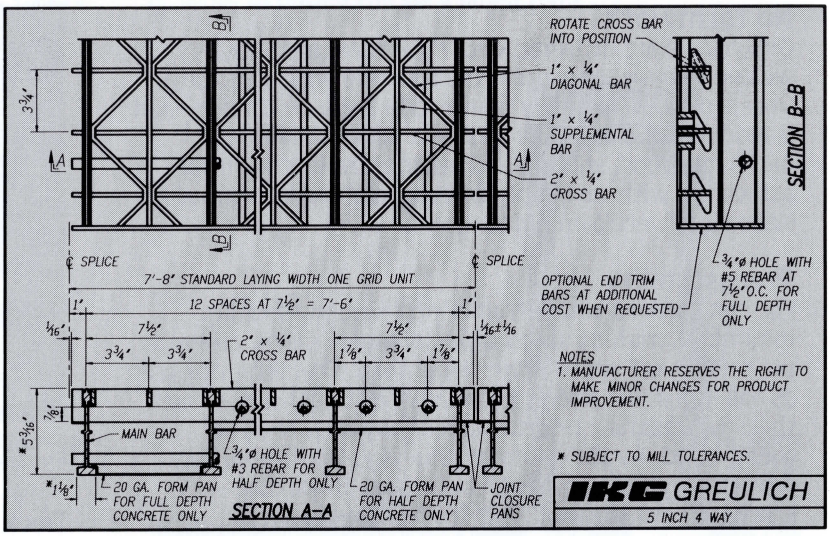


Finish

A.S.T.M. A-36 steel—areas of panel not in contact with concrete shall have a prime coat, shop applied. A.S.T.M. A-588 steel requires no painting. (Any approved finish may be specified and shop applied).

Concrete Requirements

Standard Class concrete with 3/8″ maximum aggregate size.



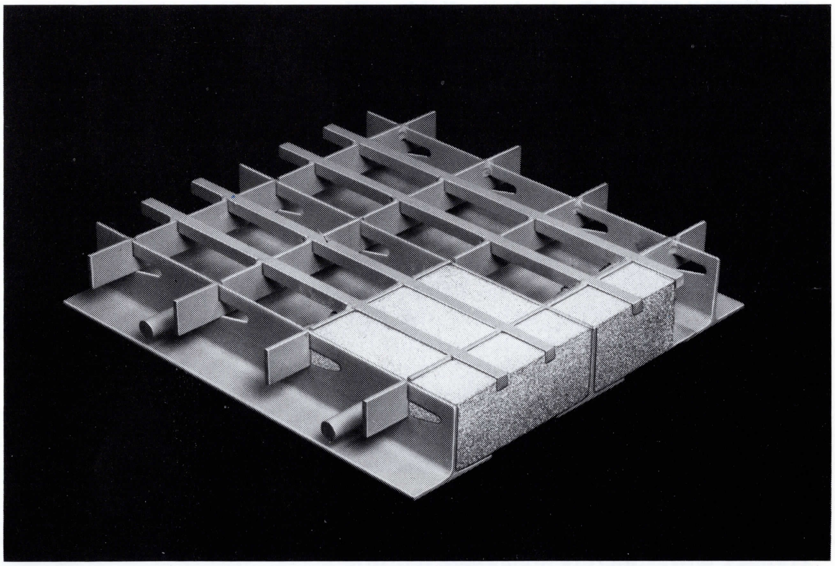
HS20 Load Tables

	MAIN BAR SPACING (in)	SECTIONAL PROPERTIES (in³/ft)						MAXIMUM CONTINUOUS CLEAR SPAN (ft)				APPROXIMATE WEIGHT (lb/sf)	
		STEEL ONLY		COMPOSITE SECTION				TRANSVERSE		PARALLEL		STEEL ONLY	STEEL & CONCRETE
		TOP STEEL	BOTTOM STEEL	POSITIVE S_{conc}	POSITIVE S_{steel}	NEGATIVE S_{conc}	NEGATIVE S_{steel}	A36	A588	A36	A588		
FULL DEPTH	7½	5.735	4.106	75.271	4.304	76.229	6.232	10.15	13.65	7.20	9.55	20.1	77.9

	MAIN BAR SPACING (in)	TOP STEEL	BOTTOM STEEL	POSITIVE S_{conc}	POSITIVE S_{steel}	NEGATIVE S_{conc}	NEGATIVE S_{steel}	TRANSVERSE OR PARALLEL A36	TRANSVERSE OR PARALLEL A588	STEEL ONLY	STEEL & CONCRETE
HALF DEPTH	7½	5.735	4.535	77.414	4.780	4.564	5.735	7.05	9.45	18.4	49.3

ArmaDek™ 3 Inch T

The ArmaDek-T designs have long been a GREULICH Standard and are popular because of their low profile, strength and durability. These decks incorporate the economy of standard rolled beams and bar stocks with the strength of interlocked joints and concrete filling. The lower Cross Bars provide excellent transverse load distribution and the extra wide bottom flanges provide positive support of concrete fill. This results in an inexpensive, rugged bridge deck.



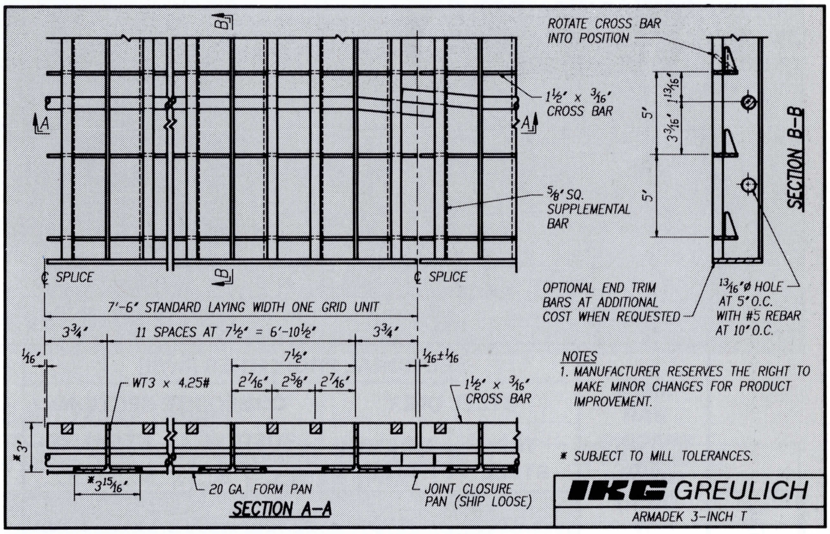
Finish

A.S.T.M. A-36 steel—areas of panel not in contact with concrete shall have a prime coat, shop applied. ASTM A588 steel requires no painting. (Any approved finish may be specified and shop applied).

Concrete Requirements

Standard Class concrete with 3/8″ maximum aggregate size.

Note: Due to excessive distortion it is suggested that this style flooring NOT BE SPECIFIED as Hot Dipped galvanized.



HS20 Load Tables

MAIN BAR SPACING (in)	SECTIONAL PROPERTIES (in³/ft)						MAXIMUM CONTINUOUS CLEAR SPAN (ft)				APPROXIMATE WEIGHT (lb/sf)	
	STEEL ONLY		COMPOSITE SECTION				TRANSVERSE		PARALLEL			
	TOP STEEL	BOTTOM STEEL	POSITIVE		NEGATIVE						STEEL ONLY	STEEL & CONCRETE
			S_{conc}	S_{steel}	S_{conc}	S_{steel}	A36	A588	A36	A588		
7½	2.852	3.132	35.870	3.188	36.403	2.853	6.70	7.15	4.95	5.10	14.9	47.1

NOTE ON ALL STYLES OF CONCRETE-FILLED FLOORS:
Since form pans are only tack-welded to the beams, there will be some grout seepage. Seepage can be removed by cleaning with a high pressure water hose.

5 Inch RB/Half Depth

The GREULICH RB Series is available with Main Bars on center at 3 Inches, 3¾ Inches, 4 Inches, 6 Inches, 7½ Inches, 8 Inches and 10 Inches.

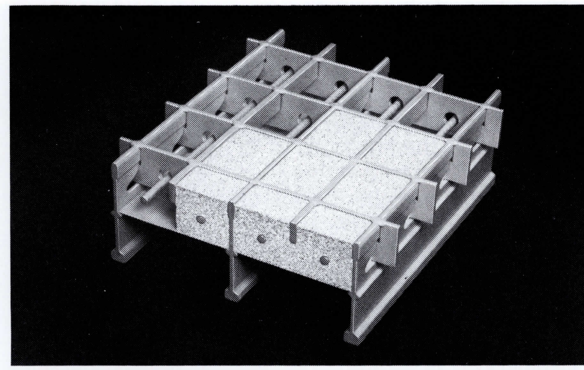
These systems provide the maximum in concrete loading capacity for top-filled concrete decks. Rigidity and strength levels are determined by the distance between Main Beams which vary from 3″ up to 10″. These GREULICH Bridge Flooring Systems are recommended where the strength of a Special Rolled Beam is desirable and the economy of the rectangular configuration is acceptable. The strength and durability of the RB Series approaches that of 5-Inch 4-Way, when these decks are concrete-filled, and they offer greater economy, too.

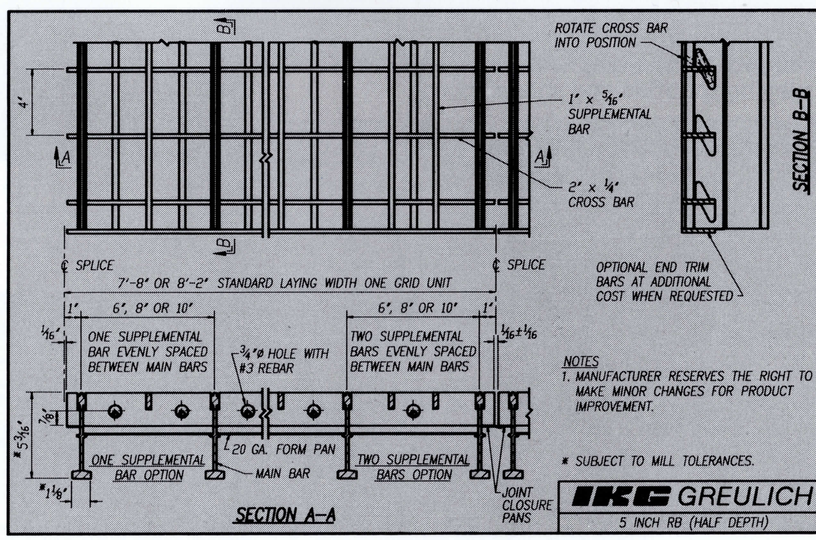
Finish

A.S.T.M. A-36 steel—areas of panel not in contact with concrete shall have a prime coat, shop applied. A.S.T.M. A-588 steel requires no painting. (Any approved finish may be specified and shop applied).

Concrete Requirements

Standard Class concrete with 3/8″ maximum aggregate size.



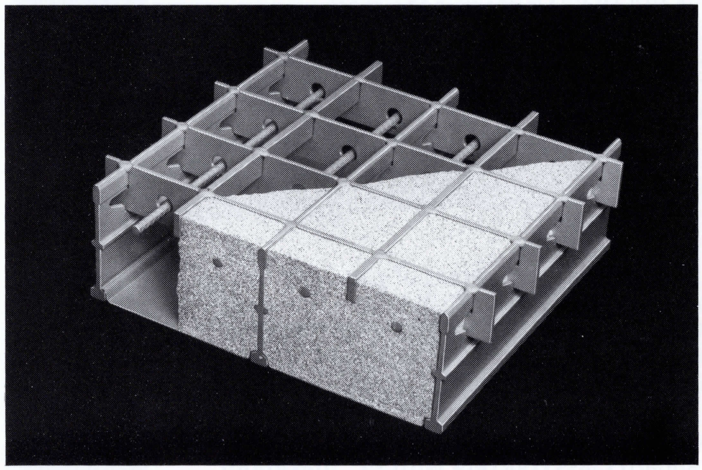


HS 20 Load Tables

	MAIN BAR SPACING (in)	SECTIONAL PROPERTIES (in³/ft)						MAXIMUM CONTINUOUS CLEAR SPAN (ft)		APPROXIMATE WEIGHT (lb/sf)	
		STEEL ONLY		COMPOSITE SECTION				TRANSVERSE OR PARALLEL			
				POSITIVE		NEGATIVE					
		TOP STEEL	BOTTOM STEEL	S_{conc}	S_{steel}	S_{conc}	S_{steel}	A36	A588	STEEL ONLY	STEEL & CONCRETE
ONE SUPPLEMENTAL BAR	6	5.726	4.984	80.138	5.638	4.940	5.726	7.60	10.15	20.4	49.9
	8	4.294	3.738	67.274	4.330	3.705	4.294	5.75	7.70	17.1	46.2
	10	3.435	2.990	59.146	3.529	2.964	3.435	4.65	6.20	14.2	44.0
TWO SUPPLEMENTAL BARS	6	6.956	5.443	87.546	5.826	5.450	6.956	8.35	11.15	22.1	51.2
	8	5.217	4.082	72.715	4.443	4.087	5.217	6.35	8.50	18.4	47.2
	10	4.174	3.266	63.419	3.604	3.270	4.174	5.10	6.85	15.3	44.9

5 Inch RB/Full Depth

These systems provide the maximum in loading capacity for grid reinforced concrete decks. Rigidity and strength levels are determined by the distance between Main Beams which vary from 3″ up to 10″. These GREULICH Bridge Flooring Systems are recommended where the strength of the Special Rolled Beams is desirable and the dead load restriction is not as severe to require the use of a HALF DEPTH bridge deck. The strength and durability of the RB Series approaches that of 5-Inch 4-Way, when these decks are concrete-filled and they offer greater economy, too.

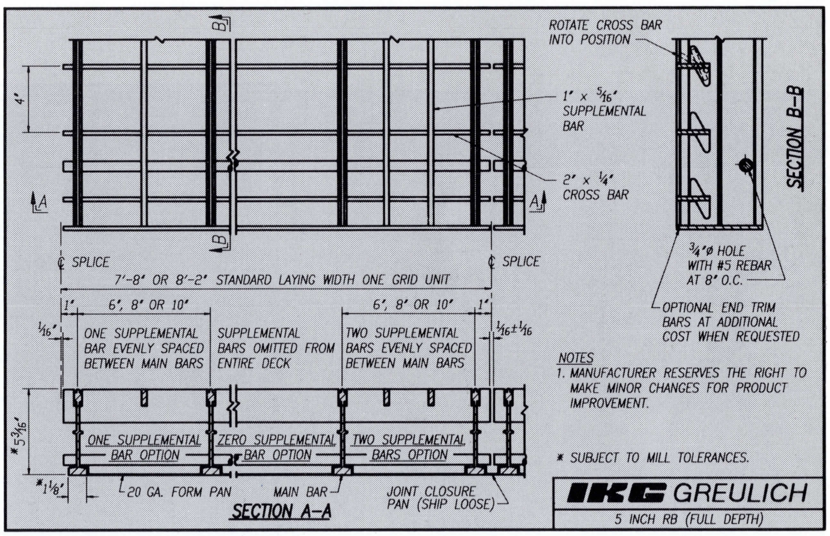


Finish

A.S.T.M. A-36 steel—areas of panel not in contact with concrete shall have a prime coat, shop applied. A.S.T.M. A-588 steel requires no painting. (Any approved finish may be specified and shop applied).

Concrete Requirements

Standard Class concrete with 3/4″ maximum aggregate size.



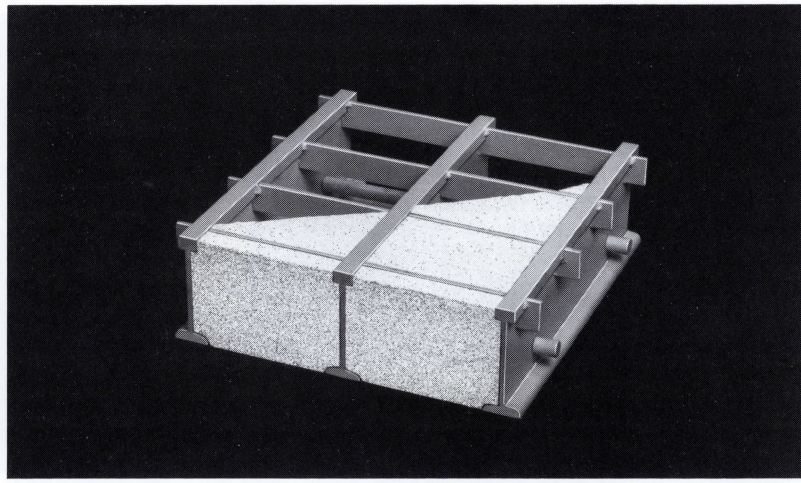
HS 20 Load Tables

	MAIN BAR SPACING (in)	SECTIONAL PROPERTIES (in³/ft)								MAXIMUM CONTINUOUS CLEAR SPAN (ft)				APPROXIMATE WEIGHT (lb/sf)	
		STEEL ONLY		COMPOSITE SECTION						TRANSVERSE		PARALLEL		STEEL ONLY	STEEL & CONCRETE
		TOP STEEL	BOTTOM STEEL	POSITIVE		NEGATIVE									
				S_{conc}	S_{steel}	S_{conc}	S_{steel}			A36	A588	A36	A588		
ZERO SUPPLEMENTAL BAR	6	2.761	4.319	64.936	5.031	60.370	2.935			7.05	9.70	5.34	7.04	18.2	75.0
	8	2.071	3.239	56.379	3.868	50.525	2.236			5.14	7.28	4.18	5.48	15.6	73.1
	10	1.657	2.592	50.729	3.154	44.280	1.182			3.94	5.73	3.47	4.53	14.0	72.0
ONE SUPPLEMENTAL BAR	6	4.678	4.795	74.383	5.182	74.579	4.976			12.09	14.44	8.59	10.13	20.3	76.5
	8	3.508	3.596	63.058	3.957	63.071	3.793			9.24	12.39	6.72	8.74	17.2	74.3
	10	2.807	2.877	55.808	3.212	55.714	3.075			7.40	10.14	5.56	7.30	15.3	73.0
TWO SUPPLEMENTAL BARS	6	6.480	5.056	83.556	5.295	83.448	6.926			12.82	16.00	9.08	11.22	22.4	78.5
	8	4.860	3.792	69.560	4.027	71.108	5.286			9.83	13.18	7.10	9.31	18.8	75.8
	10	3.889	3.034	60.760	3.259	63.180	4.289			7.89	10.75	5.87	7.69	16.6	74.2

NOTE ON ALL STYLES OF CONCRETE-FILLED FLOORS:
Since form pans are only tack-welded to the beams, there will be some grout seepage. Seepage can be removed by cleaning with a high pressure water hose.

4¼ Inch Interlock

This GREULICH system is the most economical concrete-filled deck and, has gained wide acceptance as an efficient bridge flooring system. It is recommended for major highway bridges that carry intense traffic. GREULICH 4¼-Inch Interlock is an ideal floor for replacing existing concrete slabs or widening existing bridges.

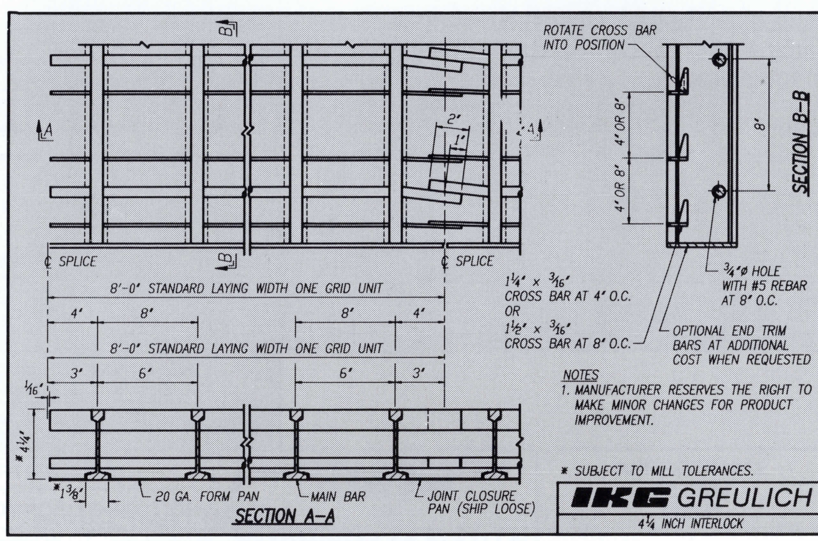


Finish

A.S.T.M. A-36 steel—areas of panel not in contact with concrete shall have a prime coat, shop applied. A.S.T.M. A-588 steel requires no painting. (Any approved finish may be specified and shop applied).

Concrete Requirements

Standard Class concrete with ¾″ maximum aggregate size.

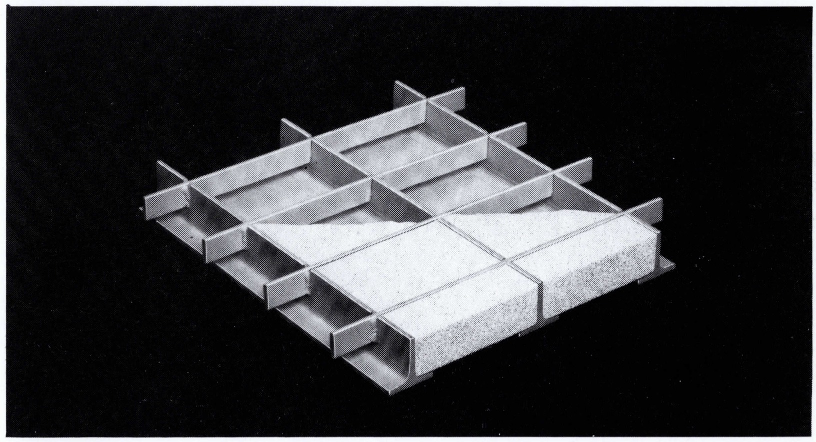


HS20 Load Tables

MAIN BAR SPACING (in)	SECTIONAL PROPERTIES (in³/ft)						MAXIMUM CONTINUOUS CLEAR SPAN (ft)				APPROXIMATE WEIGHT (lb/sf)	
	STEEL ONLY		COMPOSITE SECTION									
	TOP STEEL	BOTTOM STEEL	POSITIVE		NEGATIVE		TRANSVERSE		PARALLEL		STEEL ONLY	STEEL & CONCRETE
			S_{conc}	S_{steel}	S_{conc}	S_{steel}	A36	A588	A36	A588		
6	2.924	3.348	50.275	3.568	50.095	3.055	7.48	10.05	5.58	7.15	15.3	61.8
8	2.193	2.511	42.820	2.719	42.145	2.322	5.45	7.70	4.35	5.71	12.8	60.0

ArmaDek™ 2 Inch T (Sidewalk Flooring)

ArmaDek Sidewalk Flooring is made of steel grid panels which are concrete-filled to create a lightweight, economical, and permanent bridge sidewalk. ArmaDek Sidewalk Flooring is 2 inches deep and made in panels up to 24 feet long. It is a strong and rigid sidewalk flooring capable of handling normal foot traffic and occasional overloads, ArmaDek sidewalks may also be utilized for selected industrial applications.

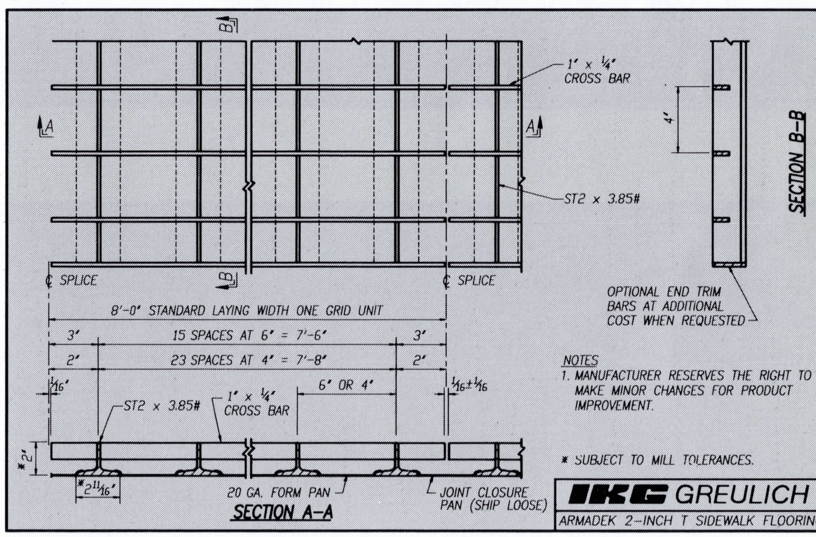


Finish

A.S.T.M. A-36 steel—areas of panel not in contact with concrete shall have a prime coat, shop applied. ASTM A588 steel requires no painting. (Any approved finish may be specified and shop applied).

Concrete Requirements

Standard Class concrete with 3/8″ maximum aggregate size.

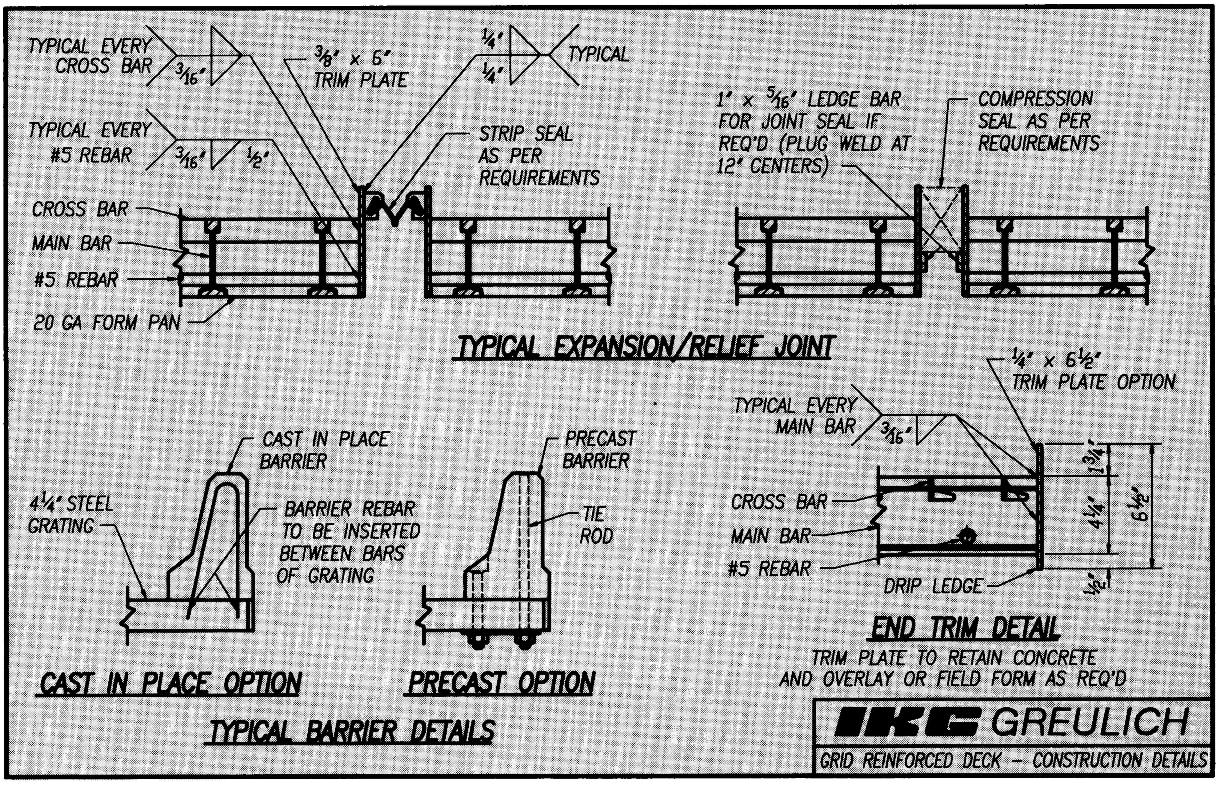


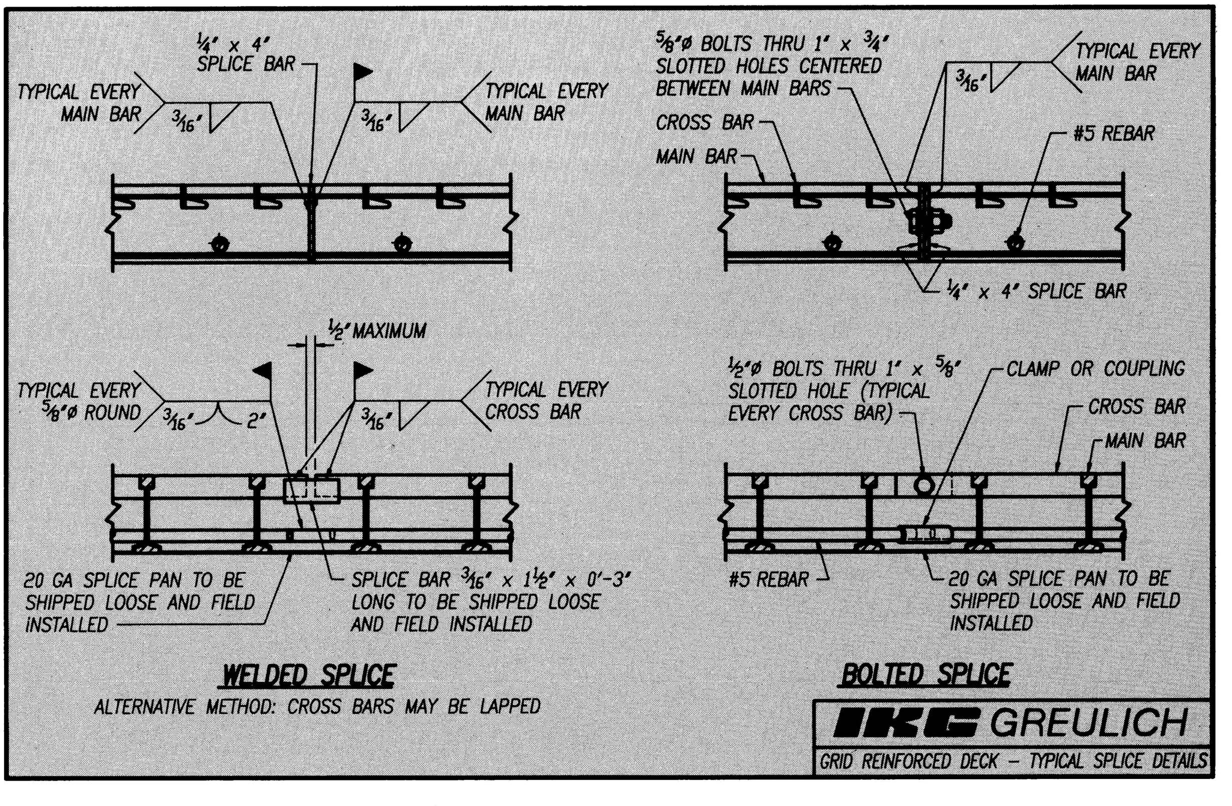
Load Tables

MAIN BAR SPACING (in)	SECTIONAL PROPERTIES (in³/ft)						MAXIMUM SIMPLE CLEAR SPAN (ft)				APPROXIMATE WEIGHT (lb/sf)	
	STEEL ONLY		COMPOSITE SECTION				LIVE LOAD (lb/sf)					
	TOP STEEL	BOTTOM STEEL	POSITIVE		NEGATIVE						STEEL ONLY	STEEL & CONCRETE
			S_{conc}	S_{steel}	S_{conc}	S_{steel}	85	100	125	150		
4	0.612	2.143	14.252	2.850	18.076	0.615	7.93	7.51	6.97	6.56	13.9	35.3
6	0.408	1.429	12.244	2.007	12.787	0.413	7.34	6.95	6.45	6.07	10.1	32.6

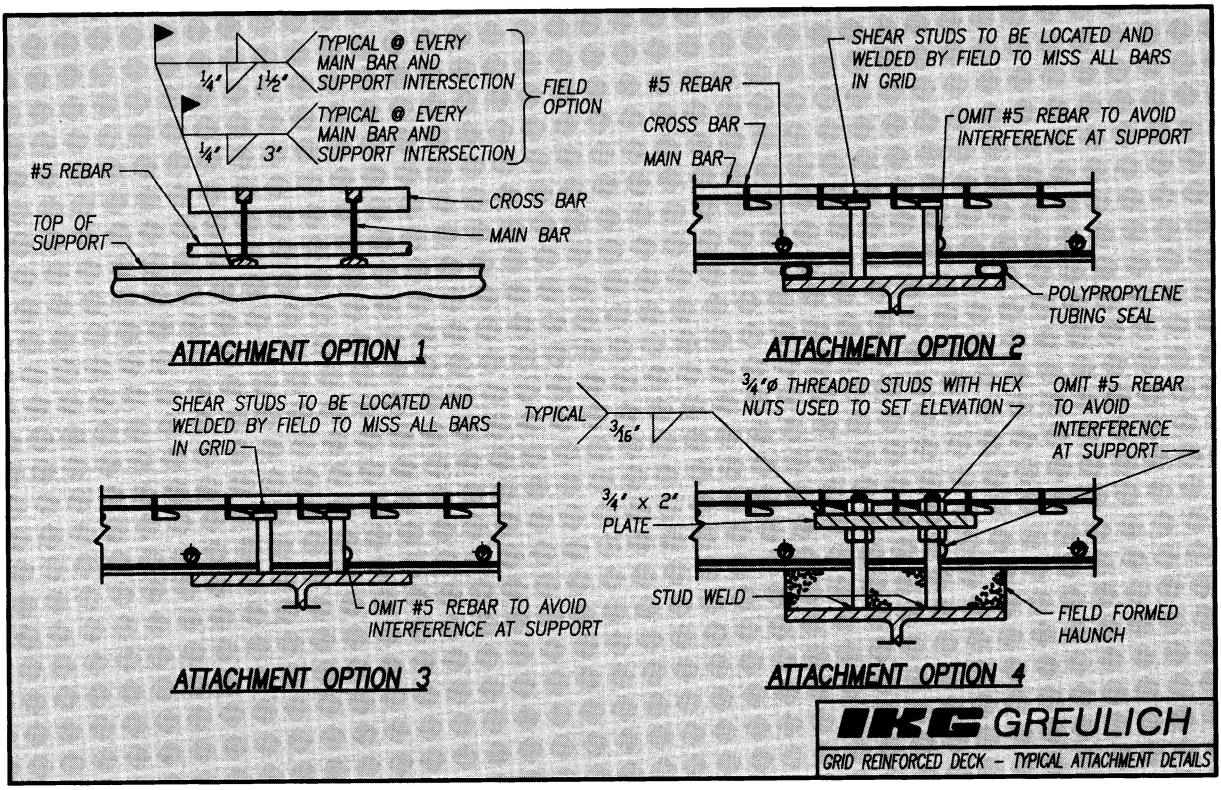
NOTES:
- Spans are identical for A588 or A36 steel.
- Design based on maximum allowable deflection of L/800.

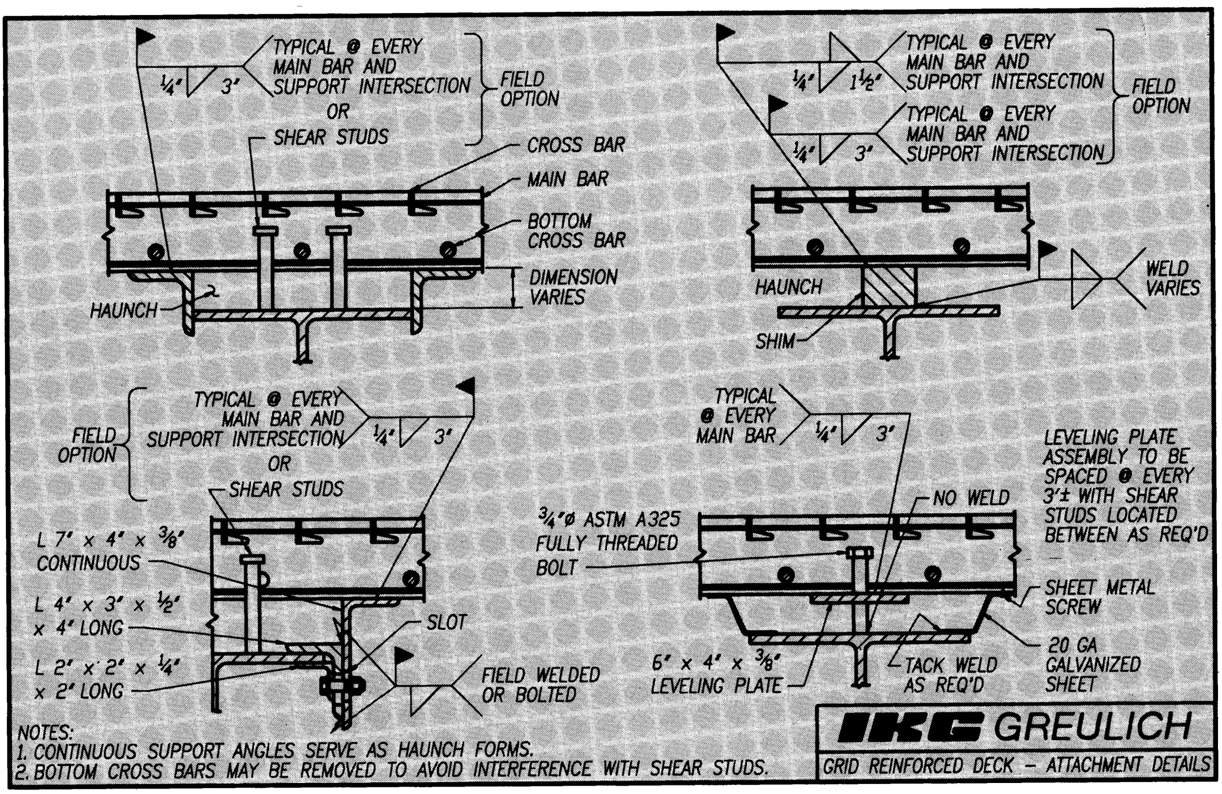
NOTE ON ALL STYLES OF CONCRETE-FILLED FLOORS:
Since form pans are only tack-welded to the beams, there will be some grout seepage. Seepage can be removed by cleaning with a high pressure water hose.





Engineering Data
Grid Reinforced Deck





Engineering Data
Grid Reinforced Deck

Design Criteria and Assumptions

- AASHTO 1985 Interim
- Transformed Area (3.27.2.2)
- f'_c = 4000 psi   n = 8 (10.38.1.3)
- A36 f_y = 20 ksi
- A588 (or A572 gd. 50) f_y = 27 ksi (10.32.1)
- Continuity 0.8 positive and negative dead and live load (3.24.3.1)
- Impact 30%
- Concrete weight = 144 lb./cu.ft.
- Steel weight — 490 lb/cu.ft
- Live load composite positive and negative moment.
- Dead load steel alone positive and negative moment.
- Wearing surface considered in design examples only.
- Span Length — S equals distance between edges of stringer flanges plus ½ flange width (3.24.1.2.b)
- Transverse Distribution — full depth

$$M_{LL} = \left(\frac{S + 2}{32}\right)P \qquad (3.24.3.1)$$

- Transverse and Longitudinal Distribution — half depth
  E = 4 ft.

$$M_{LL} = \frac{16000 \times S}{4} \times \frac{1}{E} = 1000S \qquad (3.24.3.2)$$

- Spans shown = Clear Span + ½ Flange (Assuming Flange = 12″)

Design Examples — Half and Full Depth Systems

Due to weight considerations, let us design for a Half-Depth Grid Reinforced Deck in ASTM A36 steel with a 1¾″ wearing surface (for corrosion protection and superior rideability).

The bridge has typical stringer spacings at 7′-0″ c/c. The stringer flange width is 12″. Considering that the effective clear span is 6′-6″ (7′-0″-6″) by AASHTO 3.24.1.2 we select a 5-Inch 4-Way, 5.51# beam Half-Depth Grid Reinforced Deck, which has a maximum allowable clear span of 7.05 ft. We then proceed to check the design.

Given:
- — f_c = 1.6 ksi
- — HS20-44 live load
- — continuous span
- — deck dead load = 49.3 lb/sf
- — main bar spacing = 7½″
- — wearing surface dead load = 21 lb/sf

The net section properties in (in^3/ft) are:

Top Steel = 5.735 (Neg.)   Bottom Steel = 4.535 (Pos.)

The composite section properties in (in^3/ft) are:

Positive: S_{conc} = 77.414 S_{steel} = 4.780
Negative: S_{conc} = 4.564 S_{steel} = 5.735

M_{LL+I} = 1000 (6.5)/1000 × 1.3 × .8 = 6.760 k-ft/ft
M_{DL} = (0.0493 × 6.5²/8) 0.8 = 0.208 k-ft/ft
M_{WS} = (0.021 × 6.5²/8) 0.8 = 0.089 k-ft/ft

The stresses are calculated as follows:

Positive:

Steel: f_{LL+I} = 6.760 × 12/4.780 = 16.971
f_{DL} = 0.208 × 12/4.535 = 0.550
f_{WS} = 0.089 × 12/4.780 = 0.223
f_{st} = 17.744 ksi

Concrete: f_{LL+I} = 6.760 × 12/77.414 = 1.048
f_{WS} = 0.089 × 12/77.414 = 0.014
f_{conc} = 1.062 ksi

Negative:

Steel (top): f_{LL+I} = 6.760 × 12/5.735 = 14.145
f_{DL} = 0.208 × 12/5.735 = 0.435
f_{WS} = 0.089 × 12/5.735 = 0.186
f_{st} = 14.766 ksi

Steel (Bottom): f_{LL+I} = 6.760 × 12/4.564 = 17.774
f_{DL} = 0.208 × 12/4.564 = 0.547
f_{WS} = 0.089 × 12/4.564 = 0.234
f_{st} = 18.555 ksi

Total stresses are under allowable stress limitations for A36 steel and for concrete. The design is therefore satisfactory.

For improved durability with weight considerations not as severe, let us design for a Full-Depth Grid Reinforced Deck in ASTM A36 steel with a 1¾" wearing surface (for corrosion protection and superior rideability).

The bridge has typical stringer spacings at 9′-0″ c/c. The stringer flange width is 12″. Considering that the effective clear span is 8′-6″ (9′-0″-6″) by AASHTO 3.24.1.2 we select a 5-Inch RB8, 5.51# beam with one supplemental bar, Full-Depth Grid Reinforced Deck, which has a maximum allowable clear span of 9.24 ft. for transverse traffic. We then proceed to check the design.

Given:
- — f_c = 1.6 ksi
- — HS20-44 live load
- — continuous span
- — deck dead load = 74.3 lb/sf
- — main bar spacing = 8″
- — wearing surface dead load = 21 lb/sf

The net section properties in (in^3/ft) are:

Top Steel = 3.508 (Neg.)   Bottom Steel = 3.596 (Pos.)

The composite section properties in (in^3/ft) are:

Positive: S_{conc} = 63.058 S_{steel} = 3.957
Negative: S_{conc} = 63.071 S_{steel} = 3.793

$$M_{LL+I} = \frac{(8.5 + 2)}{32} 16 \times 1.3 \times 0.8 = 5.460 \text{ k-ft/ft}$$

M_{DL} = (0.0743 × 8.5²/8) 0.8 = 0.537 k-ft/ft
M_{WS} = (0.021 × 8.5²/8) 0.8 = 0.152 k-ft/ft

The stresses are calculated as follows:

Positive:

Steel: f_{LL+I} = 5.460 × 12/3.957 = 16.558
f_{DL} = 0.537 × 12/3.596 = 1.792
f_{WS} = 0.152 × 12/3.957 = 0.461
f_{st} = 18.811 ksi

Concrete: f_{LL+I} = 5.460 × 12/63.058 = 1.039
f_{WS} = 0.152 × 12/63.058 = 0.029
f_{conc} = 1.068 ksi

Negative:

Steel: f_{LL+I} = 5.460 × 12/3.793 = 17.274
f_{DL} = 0.537 × 12/3.508 = 1.837
f_{WS} = 0.152 × 12/3.793 = 0.481
f_{st} = 19.592 ksi

Concrete: f_{LL+I} = 5.460 × 12/63.071 = 1.039
f_{WS} = 0.152 × 12/63.071 = 0.029
f_{conc} = 1.068 ksi

Total stresses are under allowable stress limitations for A36 steel and for concrete. The design is therefore satisfactory.

Why Use Open Grid Deck?

Lightest Weight Bridge Deck
Open grid decks weigh as little as 14 lbs per square foot. No other commercial weight flooring can compare. When dead load reduction can save structural rehabilitation dollars, open grid decks are the most cost effective bridge flooring products.

High Durability
With more than fifty years of documented service, open grid decks have been exposed to some of the most brutal traffic and corrosive environments. These decks have shown superior performance, with minimal maintenance.

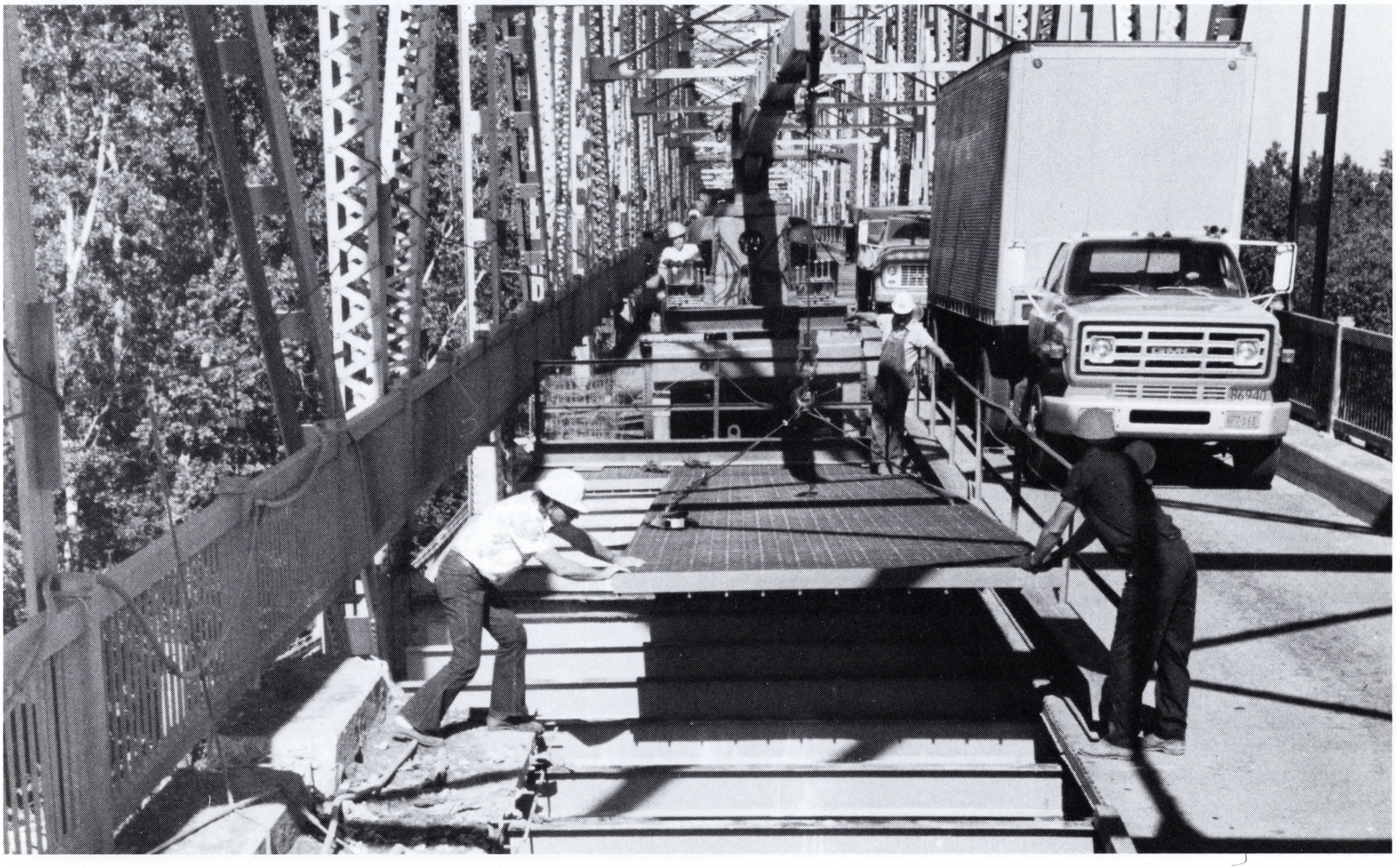
Unparalleled Strength
Open grid decks have enormous redundancy. Independent laboratory tests have proven open grid's effective load distribution, and excellent recovery capability. The unique diagonal design of 5-Inch 4-Way decking provides even greater strength, which contributes to added lateral stability in most structures. Additional testing of this feature will begin in the fall of 1990. Results will be available upon request, sometime in 1991.

Quick Installation
The vast majority of the labor that goes into an open grid deck occurs at the plant. The material arrives at the bridge in prefabricated panels ready for installation. The only labor performed by the contractor is to lay the panels in place and attach them to the bridge. Installation of most decks can be completed in a matter of days.

Ease of Design
With an open grid deck, there is no need to design for a drainage or expansion joint system. Specifications and construction are greatly simplified. There is no need for asphalt or concrete — the traditional deck materials.

Minimum Traffic Disruption
Open grid decks do not require expensive scaffolding or the use of adjoining lanes for installation. As soon as a panel of grid deck is placed on its supports, it is capable of handling construction traffic and crane loading to facilitate further installation of decking without disruption of other lanes of traffic.

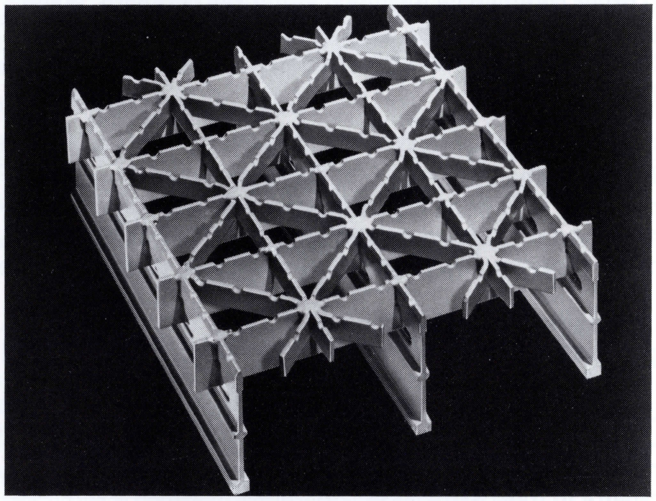
Maximum Quality Control
All Greulich grids are manufactured to the highest standards, with the tightest possible quality control. Because the manufacturing and fabrication are performed in a factory setting, adherence to tolerances can be far more rigid than it is possible to achieve under jobsite conditions.



SQ. FT. WEIGHTS SHOWN IN CATALOG ARE THEORETICAL. FOR ACTUAL WEIGHTS CONTACT IKG/GREULICH ENGINEERING DEPT.

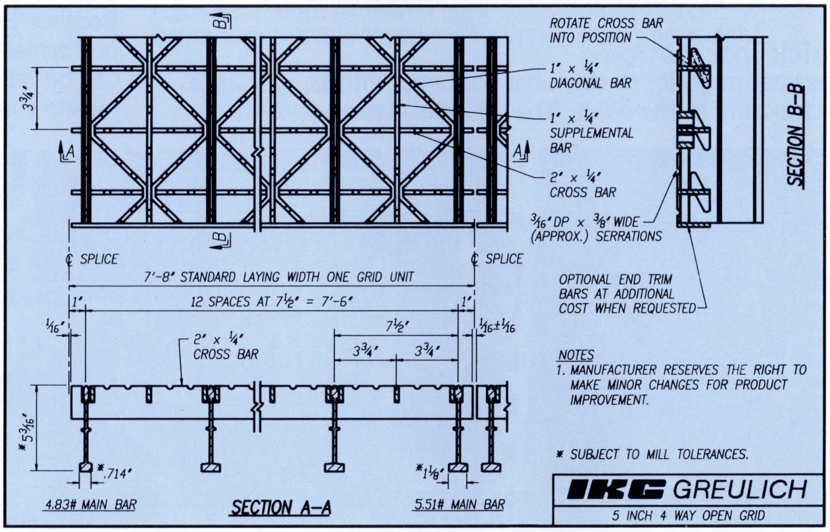
5INCH 4WAY™ (Standard)

This unique GREULICH design is the ultimate in steel grid design and construction. 5-inch 4-Way meets or exceeds all requirements for bridges carrying normal traffic loads. This Open Steel Grid Floor has nearly four times the fatigue life of other equal weight bridge flooring systems. 5-Inch 4-Way decks resist distortion and reinforce bridge spans against side-sway. This design also provides wider effective load distribution to more beams with minimal deflection and maximum recovery. 5-Inch 4-Way offers greater skid resistance in all directions and reduces the tracking effect on tires. The diagonals provide additional top flange area while increasing rigidity and strength at joint connections.



Finish

A.S.T.M. A-36 steel shall have a prime coat, shop applied. A.S.T.M. A-588 steel requires no painting. (Any approved finish may be specified and shop applied.)

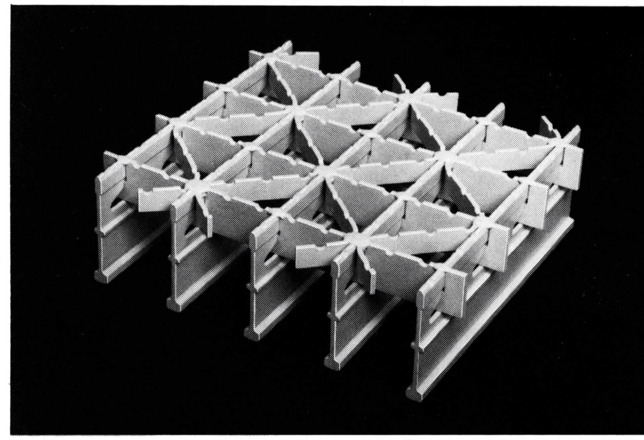


HS 20 Load Tables

	MAIN BAR SPACING (in)	SECTION MODULUS (in³/ft)		MAXIMUM CONTINUOUS CLEAR SPAN (ft)		APPROXIMATE WEIGHT (lb/sf)
		TOP STEEL	BOTTOM STEEL	A36	A588	
4.83 lb MAIN BAR	7½	3.268	3.196	4.54	5.83	17.2
5.51 lb MAIN BAR	7½	3.719	4.107	5.29	6.80	18.5

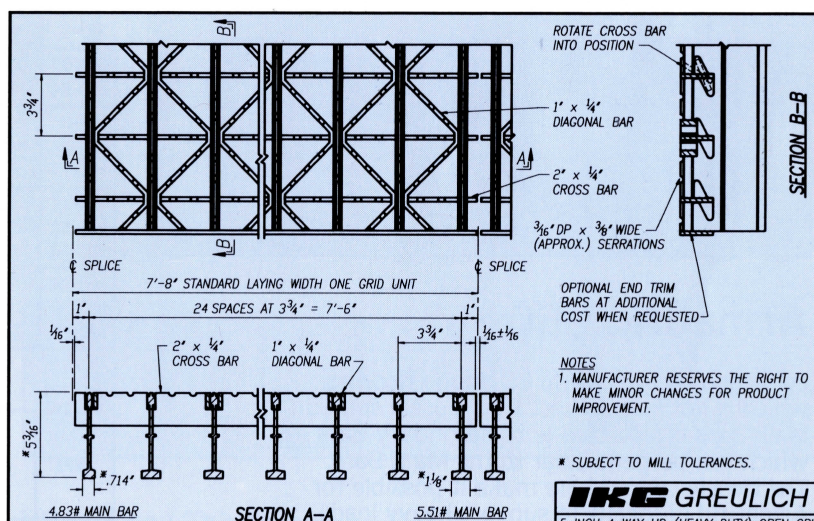
5INCH 4WAY™ HD (Heavy Duty)

5-Inch 4-Way HD is an improved open grid design which adds greater strength to the proven performance features of GREULICH designed 5-Inch 4-Way. This strength is achieved by having the 5" Special Rolled Main Beams spaced on 3¾" centers. **5-Inch 4-Way HD decks are capable of carrying the heaviest highway traffic loads** and of withstanding the impact of extremely heavy off-highway road building and industrial "super vehicle" equipment. Added strength also means added durability.



Finish

A.S.T.M. A-36 steel shall have a prime coat, shop applied. A.S.T.M. A-588 steel requires no painting. (Any approved finish may be specified and shop applied.)



HS 20 Load Tables

	MAIN BAR SPACING (in)	SECTION MODULUS (in³/ft)		MAXIMUM CONTINUOUS CLEAR SPAN (ft)		APPROXIMATE WEIGHT (lb/sf)
		TOP STEEL	BOTTOM STEEL	A36	A588	
4.83 lb MAIN BAR	3¾	4.541	5.522	4.71	6.04	23.31
5.51 lb MAIN BAR	3¾	6.471	7.333	7.10	9.61	25.75

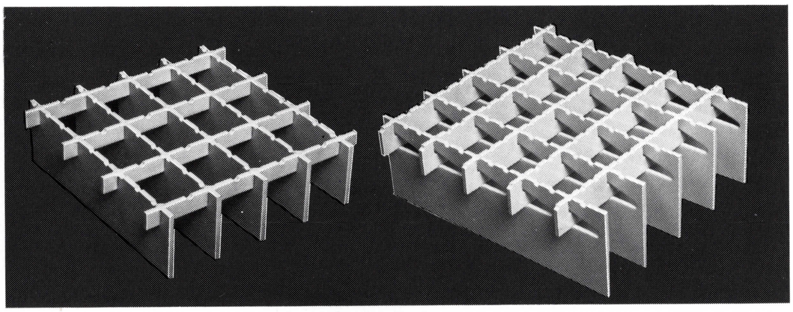
SQ. FT. WEIGHTS SHOWN IN CATALOG ARE THEORETICAL. FOR ACTUAL WEIGHTS CONTACT IKG/GREULICH ENGINEERING DEPT.

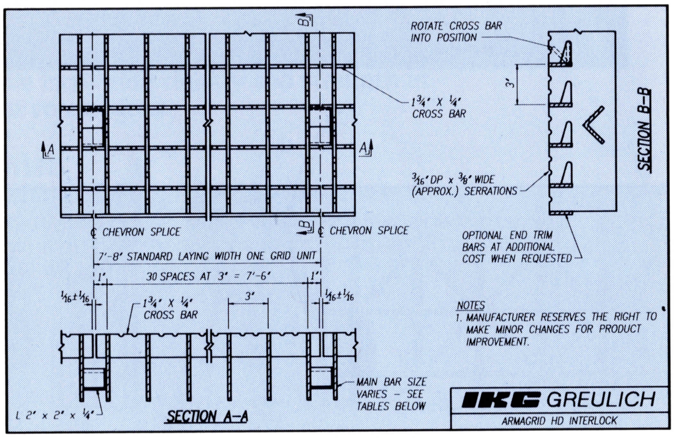
ArmaGrid™ HD

ArmaGrid EC and ArmaGrid HD Interlock decks are usually selected whenever deck elevation and/or deck economics does not permit the selection of an IKG/GREULICH deck utilizing the stronger and more durable Special Rolled Main Beams.

Finish

A.S.T.M. A-36 steel shall have a prime coat, shop applied. A.S.T.M. A-588 steel requires no painting. (Any approved finish may be specified and shop applied.)



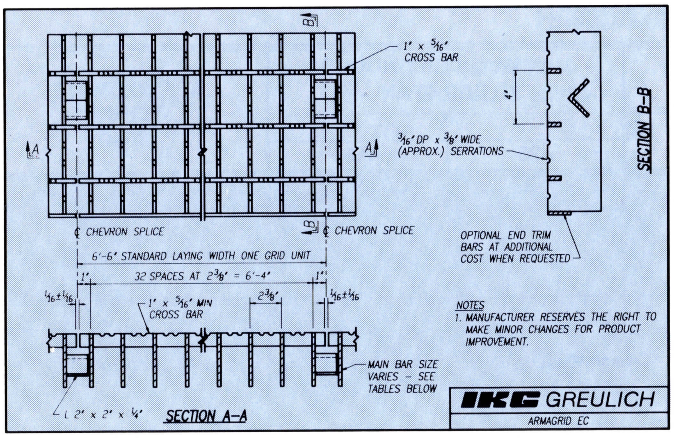


HS 20 Load Table/Armagrid HD

TYPE	MAIN BAR SIZE (in)	CROSS BAR SIZE (in)	MINIMUM SECTION MODULUS (in³/ft)	MAXIMUM CONTINUOUS CLEAR SPAN (ft) A36	MAXIMUM CONTINUOUS CLEAR SPAN (ft) A588	APPROXIMATE WEIGHT (lb/sf)
HD-1	3½ × ¼	1¾ × ¼	1.543	1.64	2.21	16.45
HD-2	3½ × ⅜	1¾ × ¼	2.314	2.46	3.32	21.67
HD-3	4 × ¼	1¾ × ¼	1.746	2.54	3.16	17.27
HD-4	4 × 5/16	1¾ × ¼	2.182	2.96	3.54	20.19
HD-5	4 × ⅜	1¾ × ¼	2.619	3.33	4.08	23.12
HD-6	4½ × ¼	1¾ × ¼	2.171	2.88	3.46	18.97
HD-7	4½ × ⅜	1¾ × ¼	3.256	3.88	4.79	25.67
HD-8	5 × ¼	1¾ × ¼	2.667	3.25	4.00	20.67
HD-9	5 × 5/16	1¾ × ¼	3.334	3.92	4.83	24.44
HD-10	5 × ⅜	1¾ × ¼	4.000	4.50	5.63	28.22
HD-11	6 × ¼	1¾ × ¼	4.156	4.40	5.93	26.37
HD-12	6 × 5/16	1¾ × ¼	4.856	5.17	6.50	28.69
HD-13	6 × ⅜	1¾ × ¼	5.827	6.04	7.71	33.32
HD-14	7 × ¼	1¾ × ¼	5.729	6.05	8.13	29.77
HD-15	7 × 5/16	1¾ × ¼	7.162	7.52	10.09	35.73
HD-16	7 × ⅜	1¾ × ¼	8.594	8.96	12.00	41.68

ArmaGrid™ EC

For economy, ArmaGrid EC bridge flooring, which is not interlocked, uses closely spaced Main Bars intersected with Secondary Bars which run perpendicular to the Main Bars. The closely spaced bars make it possible for ArmaGrid EC decks to support heavy loads and withstand impact. The deck surface is serrated for greater skid resistance.

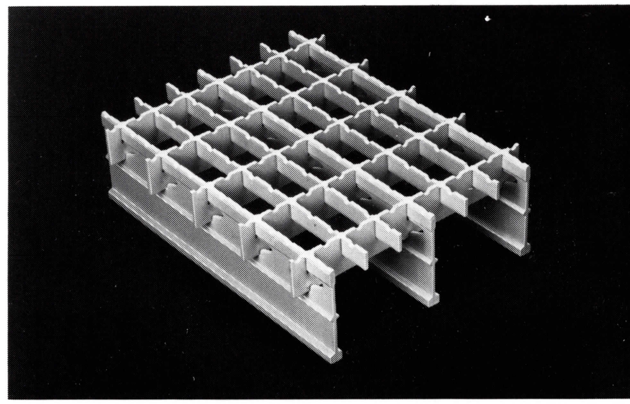


HS 20 Load Table/Armagrid EC

TYPE	MAIN BAR SIZE (in)	CROSS BAR SIZE (in)	MINIMUM SECTION MODULUS (in³/ft)	MAXIMUM SIMPLE CLEAR SPAN (ft) A36	APPROXIMATE WEIGHT (lb/sf)
EC-1	2½ × ¼	1 × 5/16	1.315	1.42	14.00
EC-2	2½ × ⅜	1 × 5/16	1.973	1.83	19.31
EC-3	3 × ¼	1 × 5/16	1.894	1.75	15.31
EC-4	3 × 5/16	1 × 5/16	2.370	2.00	18.67
EC-5	3 × ⅜	1 × 5/16	2.842	2.25	22.03
EC-6	3½ × ¼	1 × 5/16	2.578	2.08	18.20
EC-7	3½ × ⅜	1 × 5/16	3.867	2.83	25.97
EC-8	4 × ¼	1 × 5/16	3.368	2.42	20.40
EC-9	4 × 5/16	1 × 5/16	4.217	2.92	24.86
EC-10	4 × ⅜	1 × 5/16	5.053	3.42	29.33
EC-11	4½ × ¼	1 × 5/16	4.263	2.83	22.66
EC-12	4½ × ⅜	1 × 5/16	6.394	4.08	32.69
EC-13	5 × ¼	2 × ¼	5.263	3.33	26.79
EC-14	5 × 5/16	2 × ¼	6.589	4.08	32.12
EC-15	5 × ⅜	2 × ¼	7.894	4.83	37.54
EC-16	6 × ¼	2 × ¼	7.579	4.42	29.33
EC-17	6 × 5/16	2 × ¼	9.488	5.58	37.72
EC-18	6 × ⅜	2 × ¼	11.368	6.58	42.71
EC-19	7 × ¼	2 × ¼	10.315	5.75	35.62
EC-20	7 × 5/16	2 × ¼	12.915	6.92	44.62
EC-21	7 × ⅜	2 × ¼	15.473	7.58	52.22

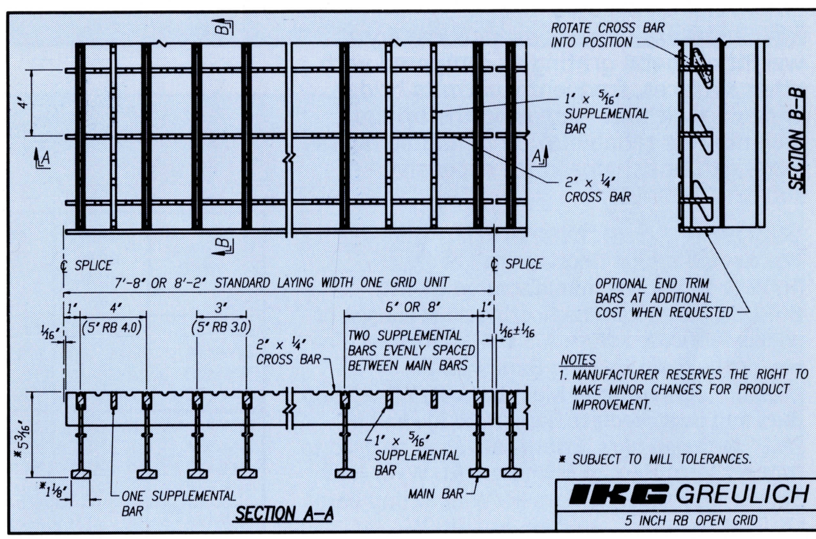
5 Inch RB

5-Inch RB achieves its rigidity and strength from the interlocking of the 5″ Special Rolled Main Beams with Secondary Bars and from Supplemental Bars which run parallel to the Main Beam. This design creates a strong deck with simple lines. While only a little heavier than 5-Inch 4-Way, this deck can carry HS-20 loads. This economical design meets the standards of most highway departments.



Finish

A.S.T.M. A-36 steel shall have a prime coat, shop applied.
A.S.T.M. — A-588 steel requires no painting. (Any approved finish may be specified and shop applied.)



HS 20 Load Tables

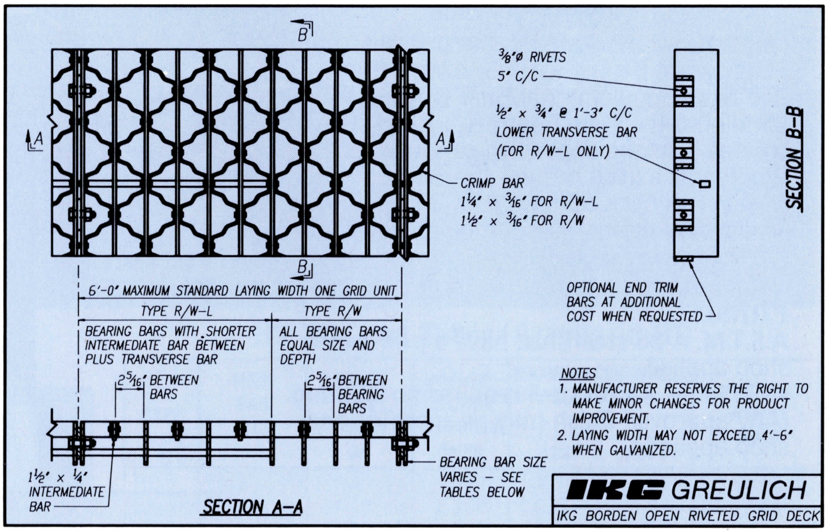
	MAIN BAR SPACING (in)	SECTION MODULUS (in^3/ft)		MAXIMUM CONTINUOUS CLEAR SPAN (ft)		APPROXIMATE WEIGHT (lb/sf)
		TOP STEEL	BOTTOM STEEL	A36	A588	
5.51 lb MAIN BAR	3	5.522	6.773	5.80	7.85	27.7
	4	5.124	5.993	5.75	7.75	23.4
	6	4.045	4.583	5.10	6.85	20.0
	8	3.034	3.438	4.20	5.70	16.5

Riveted Grid Decks

Borden R/W and R/W-L riveted grating is designed specifically for the demands of heavy-duty bridge and highway installations.

The most substantial and oldest design of grating made, riveted grating is especially appropriate for difficult stress situations where a grating with high strength and flexibility is required. In IKG Borden riveted grating, each rivet is cold-pressed individually by high pressure riveting tools, clamping the bearing bars between the cross bars in a high-strength joint. The truss style, riveted crimp bars provide excellent lateral stability and are ideal where vehicular loads must be handled such as plant floors, mezzanines, highways, bridges, airports and plant loading areas.

New installation methods, plus the light weight of metal grating as compared with other surfaces, frequently permits bridge widening without increasing the bridge weight — or rehabilitation to handle heavier loads without the need for expensive substructure work.

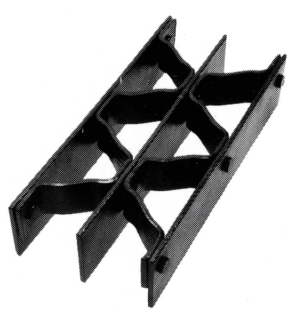


Suggested Specifications

The riveted bridge flooring shall be __________ (R/W or R/W-L) as manufactured by IKG BORDEN, or equal. The flooring shall consist of panels fabricated from A.S.T.M. A-36 steel. The size of the main Bearing Bars shall be __________. Spacing of Main Bars (R/W) or Main Bars and Intermediate Bars (R/W-L) shall be 2 5/16" between bars. Crimp bars shall be used to connect Main Bars to Main Bars (R/W) or Main Bars to intermediate Bars (R/W-L). Crimp bars shall be __________ 1¼" × 3/16" (R/W-L) or 1½" × 3/16" (R/W) and shall be riveted at all intersections with a 3/8" dia. rivet at 5" centers. A ½" × ¾" Lower Transverse Bar shall be supplied at 1'-3" centers for R/W-L only.

Finish

A.S.T.M. A-36 steel shall have a prime coat, shop applied.



HS 20 Load Table

TYPE	MAIN BAR SIZE (in)	CRIMP BAR SIZE (in)	SECTION MODULUS (in³/ft.)		MAX. CONTINUOUS CLEAR SPAN (ft)	APPROXIMATE WEIGHT (lb/sf)
			TOP STEEL	BOTTOM STEEL	A36	
R/W-12	2½ × 3/16	1½ × 3/16	0.925	0.938	1.60	15.11
R/W-12A	2½ × ¼	1½ × 3/16	1.204	1.220	1.84	17.23
R/W-12B	2½ × 5/16	1½ × 3/16	1.469	1.488	2.07	19.25
R/W-12C	2½ × 3/8	1½ × 3/16	1.722	1.744	2.29	21.18
R/W-14	3 × 3/16	1½ × 3/16	1.341	1.350	1.95	16.64
R/W-14A	3 × ¼	1½ × 3/16	1.745	1.756	2.29	19.23
R/W-14B	3 × 5/16	1½ × 3/16	2.129	2.143	2.62	21.68
R/W-14C	3 × 3/8	1½ × 3/16	2.495	2.512	2.94	24.03
R/W-16A	3½ × ¼	1½ × 3/16	2.390	2.390	2.83	21.22
R/W-16B	3½ × 5/16	1½ × 3/16	2.917	2.917	3.28	24.12
R/W-16C	3½ × 3/8	1½ × 3/16	3.419	3.419	3.71	26.88
R/W-18A	4 × ¼	1½ × 3/16	3.122	3.122	3.44	23.21
R/W-18B	4 × 5/16	1½ × 3/16	3.810	3.810	4.02	26.55
R/W-18C	4 × 3/8	1½ × 3/16	4.465	4.465	4.58	29.73
R/W-20A	4½ × ¼	1½ × 3/16	3.951	3.951	4.13	25.20
R/W-20B	4½ × 5/16	1½ × 3/16	4.821	4.821	4.86	28.98
R/W-20C	4½ × 3/8	1½ × 3/16	5.651	5.651	5.57	32.58
R/W-22A	5 × ¼	1½ × 3/16	4.878	4.878	4.89	27.19
R/W-22B	5 × 5/16	1½ × 3/16	5.952	5.952	5.80	31.41
R/W-22C	5 × 3/8	1½ × 3/16	6.977	6.977	6.66	35.42
R/W-L-16A	3½ × ¼	1¼ × 3/16	1.961	1.400	2.24	17.16
R/W-L-16B	3½ × 3/16	1¼ × 3/16	2.233	1.691	2.54	18.68
R/W-L-16C	3½ × 3/8	1¼ × 3/16	2.489	1.972	2.83	20.18
R/W-L-18A	4 × ¼	1¼ × 3/16	2.572	1.830	2.67	18.15
R/W-L-18B	4 × 5/16	1¼ × 3/16	2.925	2.211	3.06	19.91
R/W-L-18C	4 × 3/8	1¼ × 3/16	3.261	2.579	3.44	21.63
R/W-L-20A	4½ × ¼	1¼ × 3/16	3.249	2.321	3.17	19.15
R/W-L-20B	4½ × 5/16	1¼ × 3/16	3.699	2.803	3.66	21.14
R/W-L-20C	4½ × 3/8	1¼ × 3/16	4.128	3.269	4.14	23.09
R/W-L-22A	5 × ¼	1¼ × 3/16	3.974	2.869	3.71	20.14
R/W-L-22B	5 × 5/16	1¼ × 3/16	4.551	3.465	4.32	22.37
R/W-L-22C	5 × 3/8	1¼ × 3/16	5.088	4.039	4.91	24.55

Design Example–Open Grid

Due to superior rideability, skid resistance, and fatigue life. Let us design for the best open grid. The 5″4 Way, 5.51# beam, made of A36 steel must be suitable for a stringer spacing of 5.0 ft. c/c. The stringer has a flange width of 12″.

Given:
- — HS20 live load
- — Weight 16 lb/sf
- — Continuous span

The net section properties in (in³/ft) are:
Positive: $S_{top} = 4.117$ $S_{bot} = 4.107$
Negative: $S_{top} = 3.719$ $S_{bot} = 4.112$

Clear Span $= 5 - \left(\frac{12}{2}\right)\left(\frac{1}{12}\right) = 4.5$ ft

(AASHTO 3.24.1.2)

Live Load Distribution:
(16 x 1.3) 1.25 + (2 x 7.5) = 41 in
(AASHTO 3.27.3.1)

Live Load + Impact per ft:
16 x 1.3 (12/41) = 6.088 K/ft

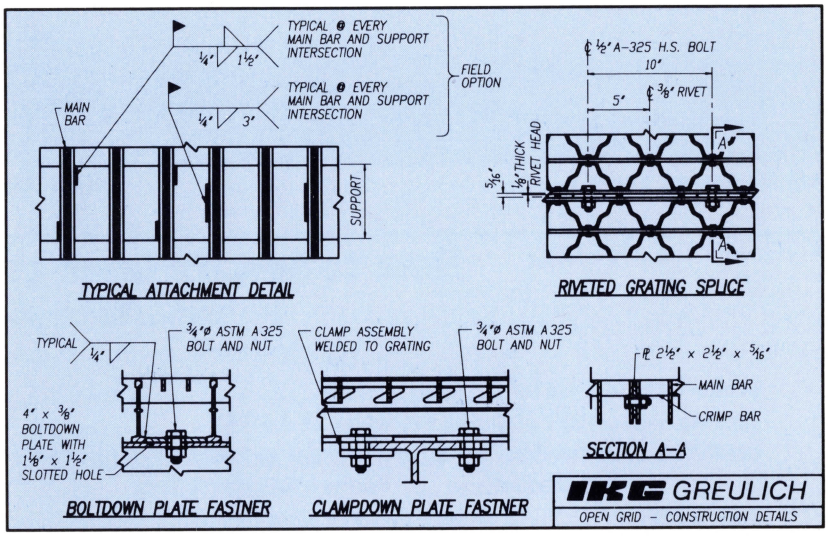
Dead Load Moment:
$(.016 \times (4.5)^2/8).8 = .032$ K-ft/ft

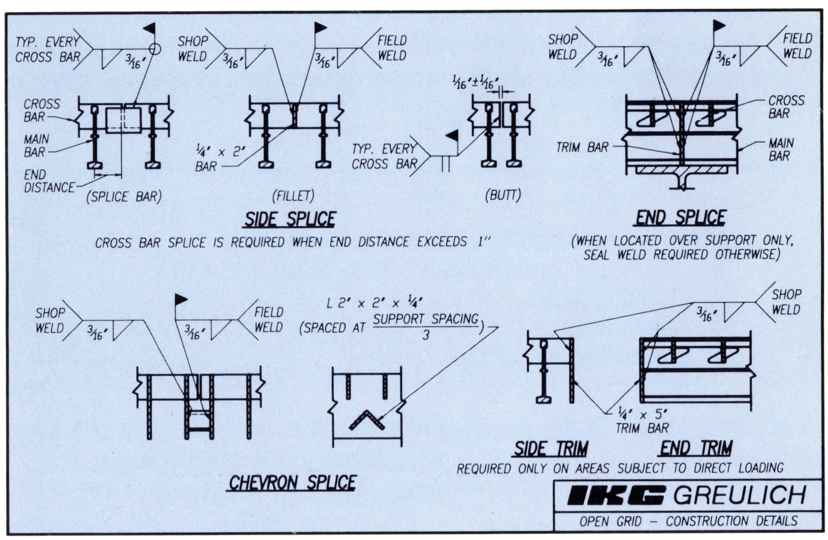
Live Load + Impact Moment:
(6.088 x 4.5/4).8 = 5.479 K-ft/ft

Total Moment = 5.511 K-ft/ft

Maximum Stress =
(5.511 x 12)/3.719 = 17.78 Ksi
(< 20 Ksi)

The total maximum stress is under the allowable stress limitation for A36 Steel. The design is therefore satisfactory.






Williamsburg Bridge; NY, NY


Brooklyn Bridge; NY, NY

How to Specify Greulich Bridge Decks!

(Sample Specifications)

Bridge Flooring shall be ______________________________ as manufactured by IKG GREULICH. The flooring shall consist of panels fabricated of A.S.T.M. ____________ steel in maximum widths of 7'8" (narrower units furnished when required at slab end, transverse joints, or along edges of slabs adjacent to curbs), with Main Rolled Beams ________ deep, spaced on ________ centers. Secondary Bars ________________ with holes for ________ reinforcing bars spaced on ________ centers between Main Beams. Reinforcing Bars to be shop installed. The Secondary Bars shall be intersected by Supplemental Bars ________________ which shall be spaced ________ on center with Main Beams. Diagonal Bars shall connect alternately at a Main Bar and a Supplemental Bar. A 20 gauge form pan shall be provided between the Main Beams and tack welded in the shop. The Main Beams, Secondary, Supplemental and Diagonal Bars shall be interconnected by welding in accordance with manufacturer's standards. The flooring shall weigh approximately ________ lbs./sq. ft.

For more information on Bridge Deck call:
Phone: (412) 828-2223 FAX: (412) 828-4103
IKG Greulich
Route 910
Cheswick, PA 15024

BGFMA
Bridge Grid Flooring Manufacturers Association

American Institute of Steel Construction Inc. AISC Founded 1921

For more information on IKG Borden Products call or write the sales office below for our brochure on:

- IKG Borden Grating
- IKG Deckspan Safety Grating
- IKG Borden Stair Tread Nosings
- IKG Borden Fiberglass Systems
- IKG Fiberglass Structures
- IKG Greulich Bridge Flooring Systems
- IKG Borden Mebac—Slip Resistant Surface
- IKG Borden Safe-T-Grid
- IKG Borden Grid Steel Floor Armor

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