K-PPS certified excellent product No.2022224
K-PPS Innovative product(FT3) No.2020-293
K-PPS certified product No.2020-07-0057
SOC-EX-2020-1-0057
KEC Technology Market-2017-0038
LH New Technology No.2018-Civil-13
Patent No.10-1614833 & 4 more complementary patents

High Functional Composites Form

H.F.C Eco-friendly floor formwork

SUNGHYUNTECH CO.,Ltd.

H.F.C Eco-friendly floor formwork | High Functional Composites Form

Technology overview

It was developed with the goal of drastically reducing costs and stabilizing the quality by substituting the high-functional composites floor formwork for the PSC girder construction. The H.F.C floor formwork is a plastic eco-friendly formwork that can reduce construction costs, improve workability as well as reduce logistics and storage costs with the optimized design of the girder type.

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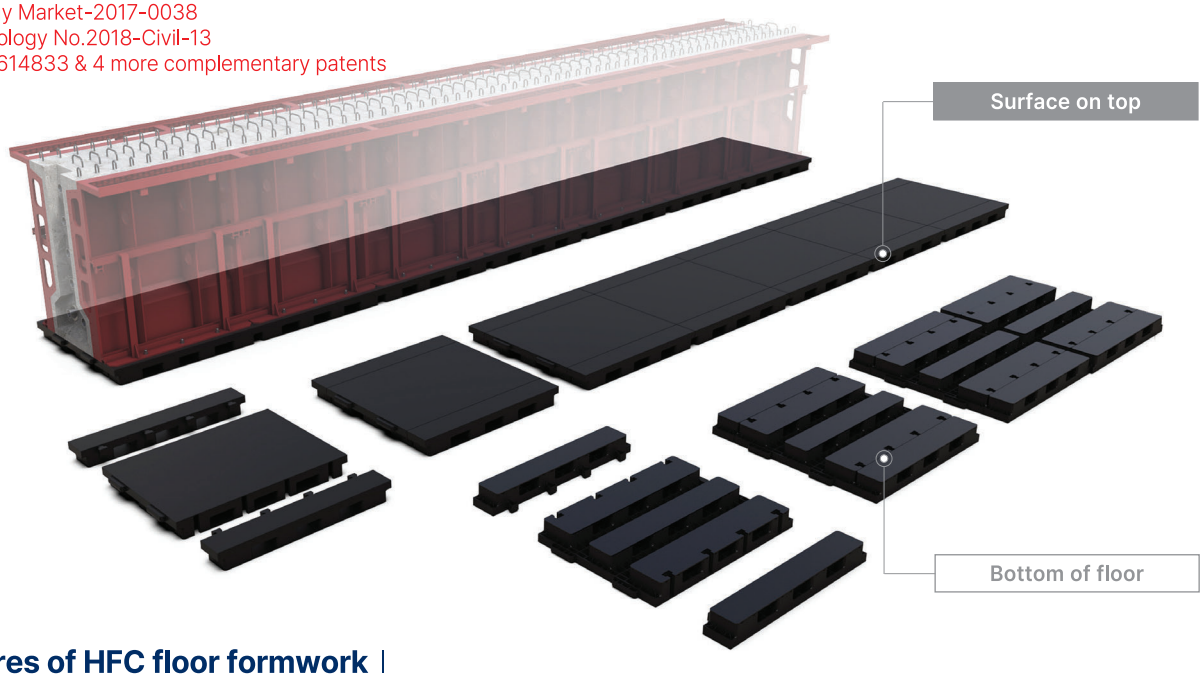
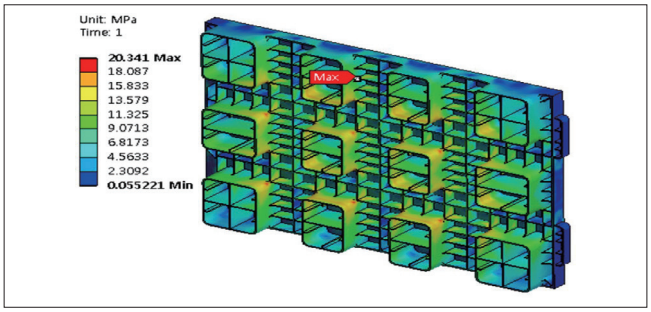


Key features of HFC floor formwork

Technical excellence



- Proven excellent mechanical properties, dimensional stability, heat resistance, and long-term durability based on engineering plastics material
- Performance confirmation by field experiments and technical evaluations by research institutes

Excellent cost saving

- Can be used semi-permanently repeatedly
- Reduced material costs by not using square lumbers (less than 3 times)
- Reduced logistics costs by the lighter floor form

Better & easier construction

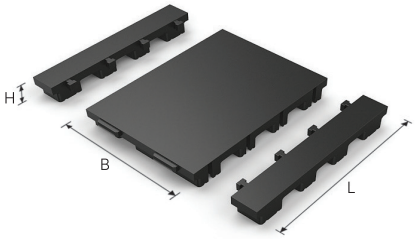
- Easier to install, dismantle, move, and store by standardization and integration
- 40% shorter construction period against conventional way

Eco-friendliness

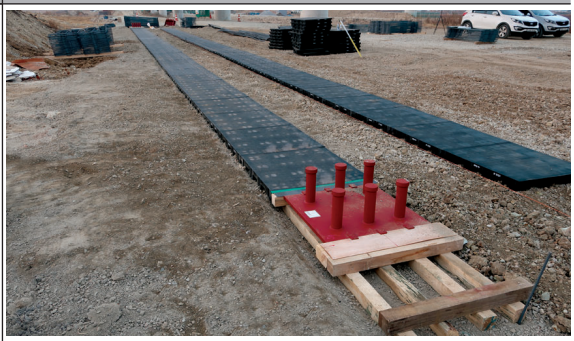
- Recyclable Plastic Formwork
- CO2 reduction by reducing construction time and activating eco-friendly materials
- Minimum environmental destruction(logging) due to non-use of square lumber

Product configuration

Satisfactory bottom width for all girder types

Size (L×B×H), mm	Bottom width(B), mm	Application	Remarks
1,000 × 700 × 125	660 / 680	Road bridge(30M), Railway bridge(25M)	
1,000 × 740 × 125	720	Road bridge(35M)	
1,000 × 935 × 125	900	All types of girder	
1,000 × 1,040 × 125	1,000		
1,000 × 1,130 × 125	1,100		
1,000 × 1,230 × 125	1,200		

Comparison with conventional methods

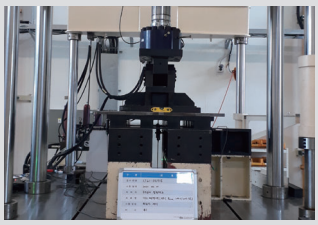
Item		Conventional method (Square lumber & steel plate)	H.F.C floor formwork
Installation on site			
Patent		-	• No.10-1614833
Loading test		-	• Accomplished at KCL in April, 2022
References		• Thousands of (for a long term, conventional way)	• Many road and railway bridge projects as below; • Railway bridge in the Pohang Youngilman new port link project (KR) • Road bridge in the Honamseon improvement project (KEC) • Local governments such as Jeonnam, Gangwondo
Technical overview		• Square lumbers and steel plates are used to construct the floor formwork of the cast-in-place girder, but it is difficult to reuse(less than 3 times) and there are problems with quality degradation such as damage to the structure due to deflection and deterioration of appearance.	• The H.F.C floor formwork, developed to solve the problems of conventional methods, is a plastic eco-friendly formwork that can reduce construction costs, improve workability as well as reduce logistics and storage costs with the optimized design of the girder type.
Work flow		• complicated and difficult Laying of stone powder → square lumber (longitudinal, transversal) → steel plate	• Simple and easy Laying of stone powder → Install floor formwork
Key features	Quality	• Sagging of steel plate joints and sagging (swelling) between square lumbers due to materials with non-uniform stiffness and errors due to non-standardized installation methods	• Based on structural stability (optimized design, special material with excellent stiffness), existing problems are solved, and structural reinforcement and sagging problems are eliminated by applying a shear key
	Constructability	• Low efficiency due to separate assembly of heavy steel plates and square lumbers	• Can be easily installed, moved, and dismantled as an integrated unit 40% shorter construction period compared to the conventional method
	Weight per meter	• About 60kg/M (Heavy to handel)	• About 20kg/M (66.7% lighter, Light enough to handle)
	Cost of logistics	• High cost due to heavy steel plate and non-uniform shape (lumber)	• Low by low weight and standardized size (80% cheaper than conventional way) • Excellent (Semi-permanent use available)
	Durability	• Lumber: less than 3 times • Steel plate: good	• Excellent (Semi-permanent use available) (high strength and functional composite material)
	Eco-friendliness	• Lumber waste and continuous logging needs	• Re-usable and reducing CO2
	Cost	• 74 USD/m x 1.45 = 108 USD/m (average cost in the market)	• 83 USD/m (Roughly 23% cheaper)

Performance Verification

Loading test

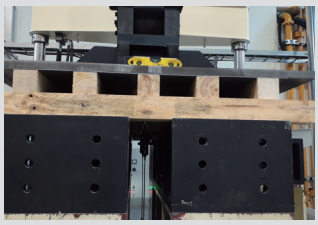
- Specimen : H.F.C Form _ 1000mm x 1120mm x 105mm (connection type)
  Steel plate : 1000mm x 1100mm x 3.2t
  Square lumber : 84mm x 84mm, 40mm x 50mm
- Test equipment : 2,500kN Actuator (1200mm x 1200mm x 30t steel plate)

H.F.C Form




1,000mm X 1,120mm X 105mm (link type)

Square lumber, Steel plate



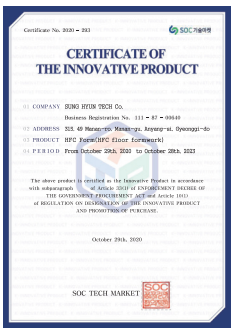

1,000mm X 1,120mm X 171mm

Displacement according to load

Load		H.F.C Form				Lumber and steel plate				Remarks
		1,000mm x 740mm		1,000mm x 1,120mm		1,000mm x 740mm		1,000mm x 1,120mm		
kN/㎡	tonf/㎡	Displacement	Difference	Displacement	Difference	Displacement	Difference	Displacement	Difference	
9.8	≒ 1.0	3.24		1.80		3.46		2.38		Zero calibration
44.1	≒ 4.5	3.62	0.38	2.06	0.26	4.62	1.17	3.55	1.17	Checking load
49.0	≒ 5.0	3.65	0.41	2.08	0.28	4.76	1.30	3.65	1.27	
Breaking load (kN/㎡)		2,764		Over 3,001		458		511		

Attestation

PPS
Certified excellent product
No.2022224



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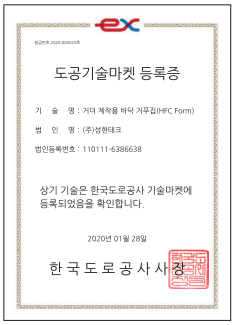
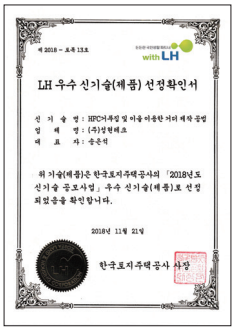


KEC
Technology
Market-2017-0038



LH
New Technology
No.2018-Civil-13

KOR Patent
No.10-1614833

KOR Patent
No.10-2114018

Vietnam patent
NO.VN 28575

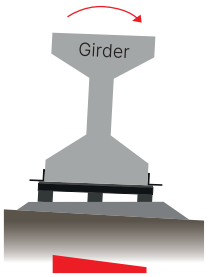
Indonesia patent
NO.IDP000064660

China patent
NO.ZL201680026581.3

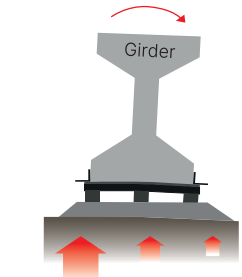
Structural stability of H.F.C floor formwork

- Prevention differential settlement due to un-flatness and poor bearing capacity at site (Prevention of lateral sweep)
- 3 times more contact area, a quarter deflection and 6 times stiffness against conventional method

Problematic field condition



Unflat ground



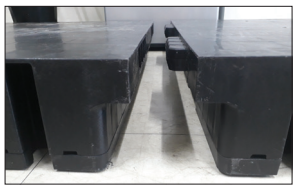
Poor bearing capacity

<lateral sweep>

<overturning accident>

Structural improvements

<Enlarged contact area>



<Shear key action ▶ Integration>

Project references

Construction

Project owner	Main contractor	Project name
KR	Jinheung corporation	Pohang Youngilman new port link project
KEC	Boseong E&C	Honamseon improvement project
Jeollanam-do		Songgwang stream improvement project
Heongseong-gun		Anheung-Saeje road project
LH	Seohan	Gwachen route 47 bypass project
Chilgok-gun		Pyungbok bridge project
LH	Daewoo E&C	Gwachen public housing district
KEC	Posco E&C	Ganjin-Gwangju expressway project (sec 2)
KEC	Daewoo E&C	Ganjin-Gwangju expressway project (sec 1)
KEC	KCC E&C	Sejong-Anseong expressway project (sec 5)
KEC	Namkwang E&C	Sejong-Anseong expressway project (sec 1)
KEC	Hanwha E&C	Sejong-Anseong expressway project (sec 2)

Design

Project owner	Main contractor
KEC	Inju-Yumchi expressway project (sec 2)
Gimhae-si	Chojeong-Hwamyun linking road project
KEC	Daesan-Dangjin expressway project (sec 3)
LH	Road adjacent to Anyang stream project
KEC	Ganjin-Gwangju expressway project (sec 1~7)
KEC	Outside Ulsan expressway project
KEC	Sejong-Cheongju expressway project (sec 4)
KEC	Dangjin Asan expressway project (sec 1)

*KEC: Korea Expressway Corporation, KR: Korea National Railway
*PPS : Public Procurement Service

Construction order

Step_1 Site preparation

Step_2 Deliver floor formworks to site

Step_3 Install floor formworks

Step_4 Rebar assembly and Install steel formworks

Step_5 Pour concrete & curing

Step_6 Erection of PSC girders

Step_7 Dismantle floor formworks

Step_8 Back to storage yard

Comparison with conventional methods

Square lumber & steel plate	H.F.C floor formwork
	
Separation at the steel plate joints by using of old lumbers	Securing the construction quality at joints by applying H.F.C floor formwork
	
Bad bottom condition due to the use of old lumbers	Securing stable constructability with shear key connection of floor formwork
	
Bad bottom condition due to the use of old lumbers	Securing the quality of clean and flat bottom
	
Stain due to bending of steel plate and rust	Securing constructability with eco-friendly formwork made of high-functional composite materials
	
Defects due to differential settlement under the soft ground construction(lateral sweep)	Securing sufficient ground contact area (3 times more than square lumber) and rigidity

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