**Purdue University**
**Purdue e-Pubs**

ECT Fact Sheets | Emerging Construction Technologies

4-25-2017

# HILLMAN COMPOSITE BEAM (HCB®)

Purdue ECT Team
*Construction Engineering & Management, Purdue University*, ectinfo@purdue.edu

DOI: 10.5703/1288284316365

Follow this and additional works at: http://docs.lib.purdue.edu/ectfs


Part of the Civil Engineering Commons, Construction Engineering and Management Commons, Engineering Education Commons, Engineering Science and Materials Commons, Environmental Engineering Commons, Geotechnical Engineering Commons, Hydraulic Engineering Commons, Other Civil and Environmental Engineering Commons, and the Transportation Engineering Commons

Recommended Citation
Team, Purdue ECT, "HILLMAN COMPOSITE BEAM (HCB®)" (2017). *ECT Fact Sheets*. Paper 228.
http://dx.doi.org/10.5703/1288284316365

This document has been made available through Purdue e-Pubs, a service of the Purdue University Libraries. Please contact epubs@purdue.edu for additional information.

EMERGING CONSTRUCTION TECHNOLOGIES

Civil – Composite Materials & Technologies

# HILLMAN COMPOSITE BEAM (HCB®)

## THE NEED

The Hillman-Composite Beam (HCB®), is an innovative structural member for use in highway and railroad bridges as well as marine facilities. The HCB is essentially a lightweight reinforced concrete beam strengthened and protected by a corrosion-resistant and resilient Fiberglass Reinforced Polymer (FRP) shell.

What distinguishes the HCB from beams of conventional materials is that the FRP materials offer vastly superior corrosion resistance with the sustainability of a projected 100-year or more service life. Additionally, since the weight of a typical HCB is significantly lighter than conventional beams, shipping and erection costs are lower. Since serviceability requirements (maximum deflection under live load) typically govern the design, the HCB provides additional strength capacity beyond that required by design codes. Laboratory testing has consistently demonstrated ultimate load capacities well beyond code requirements.

## THE TECHNOLOGY

The beam is comprised of three main components, a concrete arch (compression reinforcement), an FRP bottom flange encapsulating steel strands tying the ends of the arch together (tension reinforcement) and the FRP shell. Galvanized Rebar "shear connectors" are used to make the beam composite with the concrete deck in the same manner as pre-stressed concrete beams.

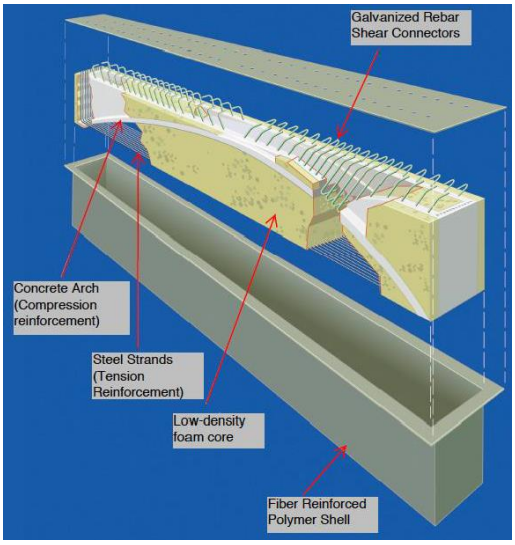


FIGURE 1 EXPLODED VIEW OF A TYPICAL HCB

http://dx.doi.org/10.5703/1288284316365
© Purdue University

CONSTRUCTION ENGINEERING & MANAGEMENT PURDUE UNIVERSITY

The main components as described above are shown with typical material properties listed below: Concrete Arch: 6,000 PSI / Steel Strands: ASTM A416 Grade 270 / Shear Connectors: ASTM A615 or A706 Gr 60, Galvanization A123 or A767 / Low-density Foam Core 2.0 Lbs/CF Polyisocyanurate

The HCB is protected by four US patents and over 26 international patents worldwide.

## The Benefits

- Longer Lasting Bridges: An HCB bridge will last longer as the FRP shell prevents corrosive and other deleterious materials from getting to the steel reinforcement providing a longer life and significantly reducing maintenance. Additionally, the beam's configuration extends the service life by operating at significantly lower stresses.
- Accelerated Bridge Construction (ABC): The lightweight HCB allows for prefabricated modules with reasonable pick weights to expedite construction. In recent deployments on Class 1 Railroad structures, two bridges with spans of 33 ft. and 42 ft. were completely replaced in less than 10 hours each using HCB bridge modules.
- Resilient Infrastructure: Global climate change is resulting in natural disasters that are causing billions of dollars in reconstructing severely damaged, aging infrastructure that is not well suited to resisting the forces of nature resulting from hurricanes, tornadoes, blizzards, earthquakes, flooding, etc. Numerous attributes of the HCB reflect performance capabilities that are not achievable with concrete, steel or timber structures. The lightweight nature of the HCB results in drastically reduced forces from accelerations resulting from seismic loads. The advanced composite shell provides tremendous strength while still allowing for significantly greater displacements with a linear elastic response. Impact testing has also been conducted to demonstrate the superior resiliency of the HCB in side impacts as demonstrated in the video (link)
- Composite materials have changed the game in several areas, including sporting equipment, boats, cars and commercial aircraft among others. The superior performance of these materials has proven their value and in many instances completely replaced the use of conventional materials. This same transformation is possible with our nation's bridges.
- The unique combination of conventional materials with advanced composites utilized in an HCB results in a bridge component offering similar game changing attributes. However, at the same time, they are simple and easy to design, fabricate and install. Despite being very different from conventional bridge technology, the HCB meets, and typically exceeds the code requirements for strength and serviceability while at the same time being compatible and interchangeable with conventional bridge components.

http://dx.doi.org/10.5703/1288284316365
© Purdue University

## STATUS

The HCB has been deployed throughout North America and is currently being sought out by transportation agencies worldwide: projects using the HCB over the last 10 years, several State DOTs, Class 1 Railroads, the US Army Corps of Engineers among others have successfully completed projects using HCB. In all cases, the owner received a low-maintenance, high performance beam with a minimum 100-year service life.

Awards
2006 Modern Marvels, Invent now competition – Top 25 inventions of 2006
2008 Popular science – Top 10 inventions of 2008
2009 American council of engineering Companies – National Grand Award
2010 ACE award – American Composite Manufacturing Association
2010 NOVA award – Construction Innovation Forum
2013 Charles Pankow Award for innovation

In addition to these accolades, Mr. Hillman, was awarded the Engineering News Record – 2010 Award of Excellence for the invention of the HCB. This is widely considered one of the highest honors in the civil engineering profession. In 2013 Mr. Hillman was also recognized by the Obama Administration as a White House - Transportation Champion of Change.

## BARRIERS

Barriers to deployment for the HCB are not unique, but characteristic of the built environment. There are always reservations about using proprietary technology due to 23 CFR 635.411. Also, designers, owners and contractors are always reluctant to take on any risk associated with a technology that they may not be familiar with. We have intentionally developed HCB that it is interchangeable with conventional bridge technologies from design to fabrication to installation. The only barrier is your imagination.

## POINTS OF CONTACT

***John Hillman, PE, SE, M.ASCE***, President & CEO, HCB, Inc.
Phone: (847) 722-4072, E-mail: hillmanjr@hcbridge.com
***Michael Zicko, PE***, COO, HCB, Inc.
Phone: (804) 400-4078, E-mail: mzicko@hcbridge.com

## REFERENCES

Hillman, J. (2017). “HCB (Hillman Composite Beams).” <http://www.hcbridge.com/> (Apr. 21, 2017).

http://dx.doi.org/10.5703/1288284316365
© Purdue University

## REVIEWERS

Peer reviewed as an emerging construction technology

## DISCLAIMER

Purdue University does not endorse this technology or represents that the information presented can be relied upon without further investigation.

## PUBLISHER

Emerging Construction Technologies, Division of Construction Engineering and Management, Purdue University, West Lafayette, Indiana

http://dx.doi.org/10.5703/1288284316365
© Purdue University