the torque of the engine." Thus, the first three engines flexed more than he liked and wore bearings out at an alarming rate. A rethink was in order.

"It only took me about six months of working on the engine in my free time to move from the initial measurements to the first cast 2.6-liter engine," Hartley recounts. "Redesigning the castings and upping the bores from 81 mm to 84 mm for a displacement of 2.8-liters took very little time. However, moving from the cast engine to the billet block took a fair amount of time and effort." That's because—in addition to redesigning the engine to be cut from solid blocks of 6061 T6—Hartley decided he wanted to deliver full 3D files to the machine shops so they could pull the tool paths straight from the math without any need for intervention. And that meant teaching himself to be proficient in SolidWorks design software (www.solidworks.com) so he could create 3D CAD files.

"As I looked at the whole picture, I decided to split the case and have the bearing caps laid out as one solid piece." To which he adds matter of factly: "Basically, you start out with about 200 b of aluminum and machine away about 80% of that to create something that looks like an engine block." The machining is done in New York by a man Hartley describes as "an engine guy at heart" who was anxious to get the contract so he could put his new four-axis Fadal CNC machine (www.fadal.com) to work. In no time, Hartley had the pieces in-hand, and set about building the first billet-block engine. "The neat thing," he says, "is that all of the speed parts for the Hayabusa are pretty much plug-and-play, and I'm working with one of the leading turbo makers for this engine—he gets 500 hp from race Hayabusas—for a package that will work with my V8." Yeah, like the stock 400 hp and 250 lb-ft of torque of the stock motor isn't enough.

Hartley has applied for a number of patents for the V8, including one that allows identical heads—one is reversed—to reduce the length of the engine. "It's cut about 40 mm from the total length of the engine, and would probably reduce the package even more on a larger engine," he says. The design uses the offset required for the second connecting rod to move the reversed head toward the cam drive, and saving 40 mm. "It could be more in a larger engine," he says, "and you save on design time and inventory." It's one of many ways Hartley thinks mainstream automotive engine designers could reduce the box volume of their designs. "Motorcycle engines are more expensive because the engineers are focused on trying to get everything to fit between a rider's knees," he says. "The car engineers are undoubtedly just as smart, but have much less concern about the engine's box volume because they have more room to play with. And while I'm certain they'd probably want to add a bit of stroke to increase the torque output of my engine, they also could design a V8 that fits in the same space as a four-cylinder—and reap the benefits it would bring in terms of size, weight, efficiency, and the ability to drop it into whatever vehicle you wanted." It would even, he suggests, cost considerably less than the $25,000 he charges for each hand-built Hartley V8. ■

@ For information on the all-wheel-drive race car designed to use the engine, see:

http://www.dpcars.net/dp1/

@ For a comparison of cross-plane and flat-plane crankshafts, see:

http://www.autozine.org/technical_school/engine/smooth4.htm and http://www.e31.net/engines_e.html

◀ *Hartley H1 V8 uses reversed heads to keep length and inventory low. The 75° engine produces 400 hp, 250 lb-ft of torque, and has a dry sump oil system and flat-plane crank.*

▼ ▶ *Box volume for the H1 V8 is 530 mm wide, 485 mm long, and 530 mm high, which means the engine easily can fit within a cube that is 21 inches on a side. Not only does it comfortably fit in place of the Ford Zetec originally found in John Hartley's Caterham 7 (with a much lower center of gravity), it also can be mated to the MTX75 transaxle Ford uses in the Focus.*