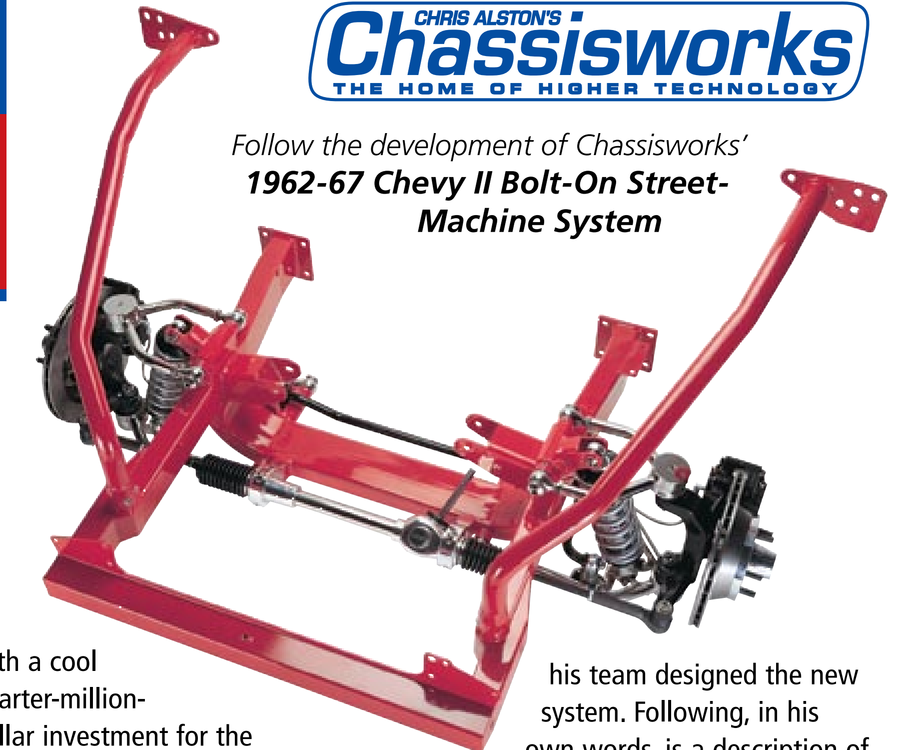
Product Tech

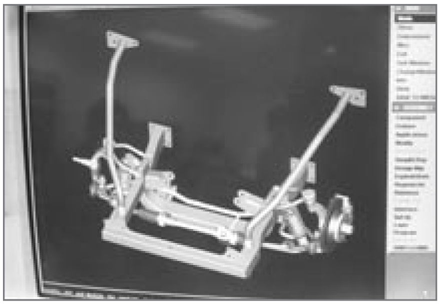
Designing a Trick New Front End

CHRIS ALSTON'S Chassisworks
THE HOME OF HIGHER TECHNOLOGY

Follow the development of Chassisworks' ***1962-67 Chevy II Bolt-On Street-Machine System***



As we mentioned previously, our '63 Nova was equipped with a modified Mustang II front end. However, as Chris Alston and his Chassisworks crew got deeper into the project, it became obvious to him that a new front-end suspension system should be installed to keep pace with the capabilities of the new 4-link and the massive tires in back-not to mention the blown, big-inch mouse motor up top-he volunteered to take care of that as well. Not only has Chassisworks come up with an exceptional new bolt-on front frame and A-arm suspension system for the Nova, with a dropped crossmember that provides extra engine clearance, but the operative words here are both "new" and "bolt-on." Everything was designed specifically for this application, for an installation process that would seem able to be completed with just a socket set; it is an undertaking that rivals the efforts of the Detroit auto makers, let alone most manufacturers in the aftermarket industry. Massive on-site computing power and computer-controlled production capability, coupled with a cool quarter-million-dollar investment for the extremely sophisticated software used to design and produce the parts, has led to a true 21stcentury result.



▲ This computer rendering shows the new front frame and suspension. The dropped cross-member provides a large amount of clearance for just about any oil pan that would be used.

Before we began removing the old front end and installing the new one, we sat down with Chris and asked him to provide us with some background details of how he and his team designed the new system. Following, in his own words, is a description of the Nova's new front end and its related parts.

▲ This Is the machine that started this design process. What we have here is a portable digitizer, which Is an articulated, multi-segmented arm that knows exactly where In 3-dimensional space the tip of its interchangeable probe actually is. Accurate to within a couple of thousandths of an inch, this Information is relayed to a laptop computer which keeps track of the contours the probe Is following, along with any point that the operator chooses to note.

"When we originally decided to build the new frame," Chris began, "we didn't want to use the basic Pinto/Mustang 11-type setup. After all, if you're updating your state-of-the-art 1963 Nova, why go all the way back to a late-'60s design for a '71 Pinto when it's the year 2000?

"This isn't to say that the Mustang H design is inherently bad, but a guy needs to remember where it came from and why it's popular on street machines. It all goes back to the late '70s, and (Chassisworks) was involved with this, along with a lot of other people. It was apparent that the Mustang II had some really nice things about it for street-rod conver-

▲ The first step consists of running the probe's tip along this sphere that is mounted on h the device's body. This gives a point of reference for its duties.

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sion, and the immediate reason was that you could, at the time, buy a front crossmember from Ford that had the spring mounts, the shock mounts, the upper A-arm mounts, and the rack mounts all on a sheet-metal crossmember as a replacement body part.

"Ford sold a lot of these; that's how it really got popular, because then all you had to do was weld this crossmember on your car, weld the two lower trailing arm mounts on it, and you had a suspension geometry that was driveable with relatively inexpensive parts. But after a few more years, Ford stopped making them.

"People then started making their own crossmembers, then they started making tubular A-arms, and it went on from there. But the big reason it was popular was that all of the suspension components mounted on that one crossmember, which made the installation easier and helped keep the geometry correct.

"The trouble is that the Mustang II front suspension didn't have very good geometry to start with, at least not by today's standards. It was designed with slide rules and graph paper in the late 1960s, and first appeared in the 1971 cars. They made a little change to it in '73, and another in 1974. But its primary functions were to fit in the car and be cheap to build, and there were a lot of compromises between the ideal and the real-world versions.

"So after we decided that we would keep the concept of mounting all the suspension pieces on the crossmember, we went to work on getting better geometry. And the biggest drawback to the Mustang II geometry is the track width of the car; how wide the hubs are is completely dependent on the length of the rack. If that doesn't match in a specific way with the A-arms, it will not have good geometry; it's just an end-of-story deal.

"In a street car using a Mustang II rack, you can't make it more than maybe an inch or so different than the factory intended. So the problem is that if you don't want to have a 56- or 57-inch hub width in your car, you're done. Fortunately, this fits in a lot of cars, but it doesn't fit really well in more than about 35 percent of the cars made.

"So what we did is, we manufactured our own billet rack, along with new dropped spindles to go along with it. This was a massive undertaking. And since we're making our own rack, and a crossmember that all the suspension mounts onto, we wanted to set it up so that it will all fit into almost everything that anybody wants to drive. After checking everything out, we decided to make our billet steering box in 14 different widths, ranging from five inches wider than a Mustang rack to nine inches narrower. We also made our A-arms a little bit longer, to get a more gentle suspension curve, and that effectively lets us use a shorter rack in the same width, so we're a couple of inches narrower in our rack width.

"Now you can have really good geometry on a really nice suspension system that you can put in anything. We took this crossmember concept and adapted it to fit in our Chevy II/Nova bolt-in deal, which is the first new, completely redesigned front suspension. Every single part on this was designed specifically for this. We made everything; nothing was used from some OE deal, and we can make all of this in-house and keep it affordable."

With this overview out of the way, we asked for a few specifics. "With the computing power and manufacturing abilities we have now," he said, "we are able to do things we couldn't have dreamed of even five years ago. We can design

▲ The operator then runs the probe over the surface of the object being scanned; every time a button on the arm Is pushed, the coordinates are recorded. Here, the locations of the bolt holes for mounting a Nova front end to the firewall are plotted.

▲ All the surfaces of a stock Nova's front end were recorded, along with the firewall of the car itself.

▲ Here, the all-important mounting bosses for the outer fender panels are located, along with the curve of the surface itself. This Information was critical in manufacturing the upper fender/hood hinge mount.

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something, completely check it out in cyberspace, make changes, analyze the results, try a few more things, all in an amazingly short time. We can make a couple hundred interratio changes on a certain suspension geometry in a few weeks that would have taken years before. They didn't do this in the old days because they couldn't afford the time, but what we were able to do is capitalize on the strength of that idea of a single cross member-mounted suspension and make it much better.

"The other part of it is that, with our true CAD-CAM capabilities, we can dream up a part, build it in the computer, output the data to our manufacturing centers, and have a part in our hands in 15 minutes!

"Another thing to keep in mind is that the best-designed front end in the world doesn't mean squat if you can't manufacture it accurately. The tolerances need to be tight, so if we make the crossmember, and all of our suspension pieces are machined from billet, not only does it look extremely cool, but it gives us much better dimensional control over the manufactured part.

▲ When it was time to relocate the digitizer so the front of the nose clip could be plotted, two of these magnetic-mount spheres were positioned where they could be reached by the probe from both locations. After running the probe over both spheres, the digitizer was moved; the probe was run over the spheres once again, which re-established its point of reference.

"There isn't a weld fixture in the world that is gonna hold the part as accurately as hooking a machined part onto a machined fixture. All the machined parts weld together, so the tolerance factor to start with is maybe a 20th of what it would be in a sawed-out, welded-together deal. What we end up with is not just a betterdesigned part, but the actual part the customer gets is way closer to the original design because we can manufacture it to much better tolerances.

"Also, we decided that we really, truly wanted this to be a bolt-on part. We didn't want to just say, 'Here's our frame that bolts on, thank you, goodbye,' and leave the customer to figure out what wheels fit on it, what brakes fit on it, what radiator fits in it, how to put the exhaust in it, how to hook up the clutch and throttle linkage, how to get the steering column back in it. We're trying to anticipate and deal with all the problems guys have in putting things like this together.

"For example, I believe that we're the only company to have a sophisticated enough facility to manufacture the formed upper fender-panel/hood-hinge mount. You really need that part, but it's very complex.

▲ Recording the stock hub locations was also of great Importance.

"Some of the other ones I've seen try to put a straight bend up against the fender. But the fender's got a curve on the bottom of it, so you can make it fit if you're willing to bend it and hack it and beat it, but it doesn't look right, and then how are you gonna deal with your hood hinges? Everybody doesn't have some fabricator guy down the street or some sheet-metal shop in his garage, so we want to be able to provide all of this stuff

"That's kind of how we ended up with our front-fender deal; you can buy this upper-hinge mount that bolts on the fender, and then the hood just goes back on it. We also make an aluminum inner-fender panel that attaches to the radiator core support and fits up tight against the firewall and attaches to the frame just like a factory fender panel.

"We also made a really trick billet-aluminum, urethane-bushed side motor mount that works with this deal. It's really affordable, it looks really cool, and it is in keeping with the theme of what we're trying to do here.

"We're trying to make something that's really nice, that a guy can be really proud of, and that looks like it was made in some super-custom place, but he can buy it and bolt it on with a few days' worth of work, with minimal aggravation and maximum results and satisfaction.

"What we're also trying to do is to elevate the standard of how all this stuff is made, and to give the customer a superior product, manufactured with new technology. That's our philosophy, and I believe that we have the resources, equipment, and talent to see it through."

Chris Alston's Chassisworks — The Home of Higher Technology

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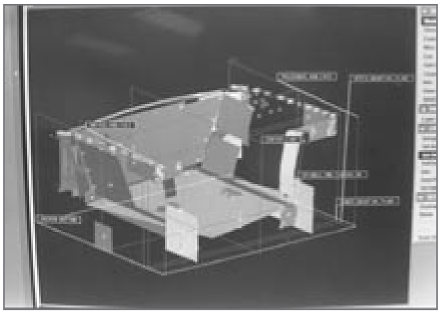
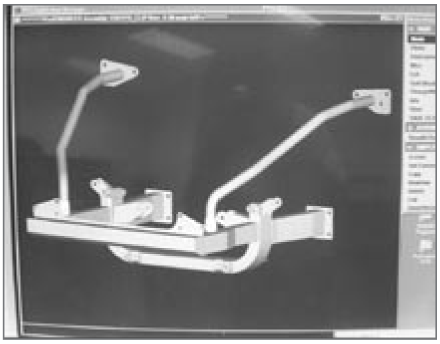
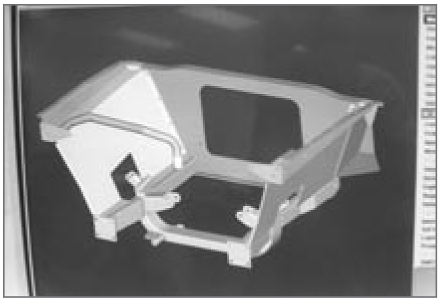
▲ After a few passes and the plotting of numerous points, the screen of the laptop attached to the digitizer began to show a recognizable shape.



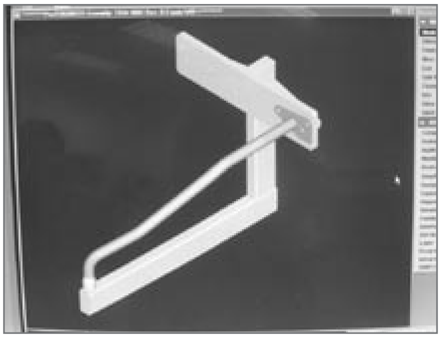
▲ With all the data from the laptop downloaded into the main Chassisworks engineering computers, the real work began. This is a view forward from the passenger compartment of various plotting points and structures.



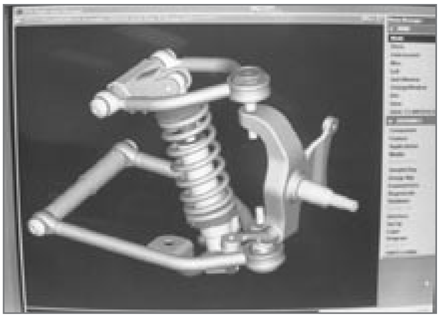
▲ This computer rendering shows the basic bolt-on frame components, minus the suspension pieces.



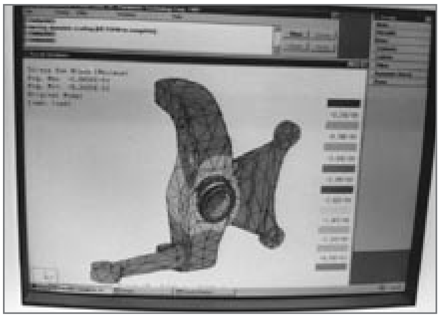
▲ Looking forward once again shows the frame joined by the stock radiator core support and the optional inner-fender aluminum panels.



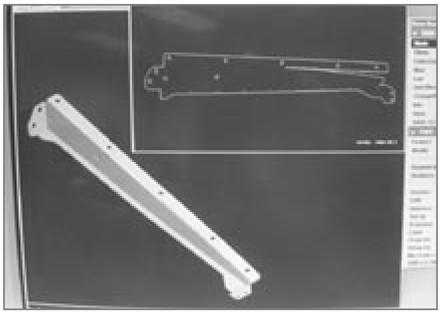
▲ The Chassisworks computers can not only be used to design the parts, but also to design the fixtures that will be used to assemble them. This is the fixture that will be built to align the firewall mounting plate and the new Gemini connectors to the forward strut tube for the factory welding.



▲ Newly designed A-arms and dropped spindles are also part of this new Chassisworks kit.



▲ The high-dollar, high-tech engineering software is also used for analyzing the stress points and limits of the various components.



▲ Another advantage to the engineering software Is Its ability to Interface with the computer-controlled machinery throughout the Chassisworks facility. In this Instance, after the design of the upper-fender/hood-hinge mount was finalized, following the factory contour of the hood, the software “flattened it out” Into a shape that could be formed out of steel plate by the laser cutter.

▲ Next, the 9-axis, computer-controlled fabrication press performs the complex bending operations required to completely form the laser-cut piece into the finished upper-fender/hood-hinge mount.

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▲ The 2x4-Inch box tube used for the crossmember Is bent with the assistance of a mandrel with eight segments to keep the bend smooth and kink-free.

▲ The next stop for the crossmember is this Mazak milling center, where the holes for the A-arm mounts and the slots for the rack-mount bosses are machined Into It.

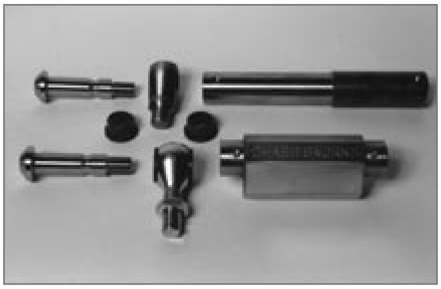
▲ Here is an almost-complete crossmember, with the shock, rack, and A-arm mounts In place, lacking only the motor-mount brackets (which would not be attached if motor plates were to be used, Instead of the motor mounts). The pads to the rear are for mounting the anti-sway bar.

▲ This Is the first look at the new billet Chassisworks steering rack. Available In 14 different lengths, It can be used In cars with front-hub widths of from 51 to 65 inches, which will fit everything from a skinny little Anglia to a full-size Chevy pickup.

▲ The new rack also features these wrap-around clamps, which not only allow the output shaft to be rotated for the steering shaft to clear various engine accessories, but also provide greater ground clearance.

▲ The tabs on the steel rack-mounting bosses, left, fit into slots on the crossmember, while the tab on the aluminum rack mount fits into the cut-out of the boss, ensuring precise alignment accuracy when bolting the rack to the crossmember.

▲ The new A-arms will be available In either mild-steel (shown) or stainless-steel versions; the mounting hardware Is machined in-house out of stainless for either type.



▲ The lower A-arm mount (top) features a welded-In adapter, while the upper A-arm mount Is adjustable for setting the caster and camber. The bushings are not made of urethane, so they won't squeak; the ones that are used provide nice, firm suspension control and never need grease.

▲ These are the trick new billet-aluminum side motor mounts that are now available. Strong enough to handle high-horsepower engines, the urethane bushings ride around steel sleeves and eliminate the rattles and shakes Inherent with solid motor mounts.

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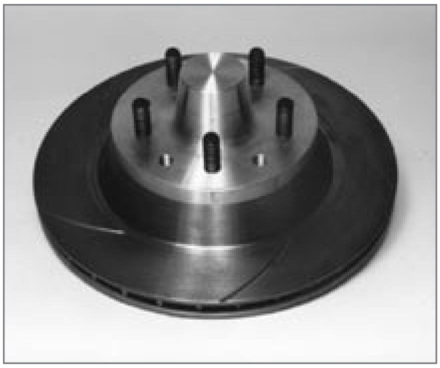
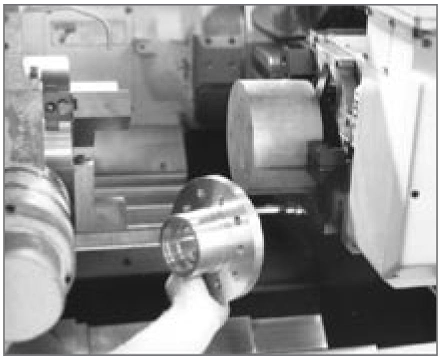
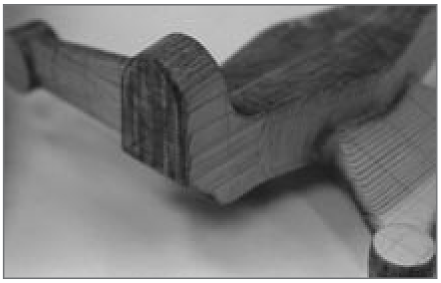


▲ To provide greater stopping torque for the relatively heavy street machines, Chassisworks now manufactures these 11-3/4" vented rotors and aluminum hubs to match up with the new suspension system.



▲ The aluminum hubs start out as chunks of billet, right, and are completely finished In one pass In this CNC machining center.



▲ The magic of high-powered computers Is seen in the manufacture of the new dropped spindles, too. After the design of the spindle body was finalized, the digital information was sent to a service bureau where this LOM (laminated object model) was built up by way of computer control, using layer after layer of paper and glue, rather than the old way of carving It out of wood. The model was then sanded smooth and used to make the form used in the casting.

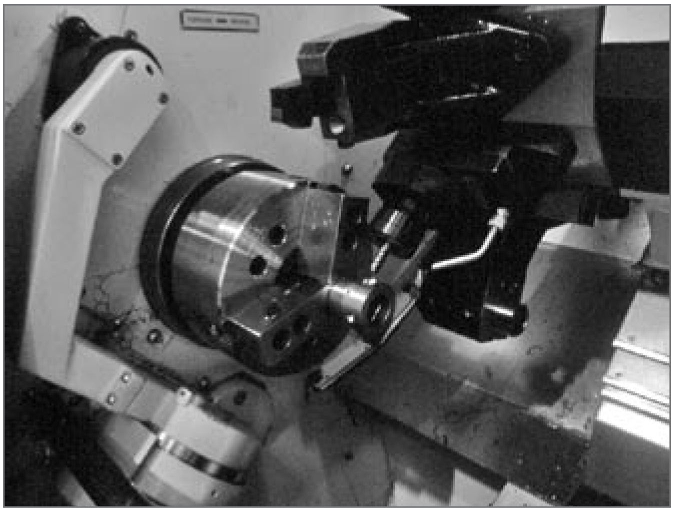
▲ On the left is the LOM form; on the right is one of the raw, ductile-iron castings; in the background is the pattern used in the casting process.

▲ The spindle shaft Is built out of a semisecret material with higher mechanical properties than the Detroit OEM spindles. Chassisworks has used this material for years in the highly stressed components of Its suspension pieces.

▲ These are the two halves of the new Chassisworks Gemini connector. The two 5/16" bolts that hold It together provide so much strength that during destruction testing, the welded-In tubes ripped apart before the connector could break.

▲ In actual use, the male connector will be factory-welded to the frame, while the female will be welded to the forward strut tube, waiting to be bolted together.

▲ This laser tube-measuring center has a scanning laser in the fork. Passing the fork over the bends In the tube, each of which lie In a different plane, measures them with an accuracy of within a few thousandths of an Inch and compares them to the print specs. If there Is a discrepancy, It will Instruct the tubing bender to adjust Its program so the part will then match the print.



▲ The manufacture of a female half of the new Gemini connector Is just about complete.

▲ This laser cutting machine is amazing to watch. The sparks fly as the initial hole is burned in the steel plate, after which a gentle glow is all that is seen as the laser cuts the steel with an incredible precision.

▲ The fender/hinge mount is then checked against the test-mule Nova used for acquiring all of the dimensions for this project, along with one of the new aluminum Inner fender panels.

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