An Engineering Odyssey: From All-Steel to True Unit Bodies 1914-1960

Technical advances in body engineering was not necessarily a hallmark of the early Chrysler Corporation. In fact, Chalmers and Maxwell more or less served as a parts bin for the for the first Chrysler, although it is true that body engineer Oliver Clark — working under ZSB — added a number of touches to make the early Chryslers attractive and contemporary-looking.

Fisher Body was one of the Company's early suppliers, providing the Chrysler bodies and body parts until Fisher became part of GM and Walter Chrysler cut off the relationship. The Fisher bodies were composite wood and steel, quick to tool and easy to change although requiring large numbers of skilled labors and experienced woodworkers to build. At Dodge Brothers, however, which Chrysler soon acquired, all-steel bodies were the standard.

The Dodge brothers had first hooked up with the E.G. Budd Manufacturing Company in 1914, and "all steel" had been a Dodge feature ever since. Budd had started to build all-steel touring-car bodies in late 1912. Among the company's early body customers was Oakland, and it also supplied pressedsteel panels that year for Ford, Willys-Overland and Buick. In late 1914, Dodge Brothers contracted with Budd to make 5,000 all-steel bodies for the company's new touring car. The 1915 Dodge became an immediate hit, and, by 1916, Budd was building 500 bodies a day for Dodge. Budd and the Dodge Brothers believed an all-steel body to be more uniform, lighter, stronger, more quickly made and painted and therefore less expensive than a composite body. This was a new and an unconventional view and very different from the tradition of that era's wood-based body industry.

The most significant advantage of the all-steel body was that Budd could paint it in just one day, a remarkable feat in 1915. Conventional — for the time — composite bodies required from three to eight *weeks* to paint. While other body makers had to hand varnish the bodies and warehouse them for weeks while they were drying, Budd sprayed the Dodge bodies with one heavy coat of enamel and then baked them at 450° F for one to two hours. With this technique, the gleaming black body emerged ready — in only one eight-hour shift — for final assembly. (Composite bodies could not be painted using high temperature baked enamel because the oven's heat would burn or split the wood framing.)

By using this painting improvement, all-steel bodies could hold a major “piece price” cost advantage over wood and steel composite bodies.

It wasn’t quite so simple, of course. The tooling (dies and presses) and fixtures to hold the pieces in place to build the all-steel bodies were much more expensive. Early welding efforts so distorted the panels that extensive reworking was required to pound them back in place. Later as welding techniques improved and the nature of the problems became better understood, elaborate jigs and fixtures were developed to hold the pieces during welding. But this was minor next to the problems of “drawing” or pressing the parts to shape. It would be years before the designers could be reasonably sure (they’re not absolutely sure even today) that the panels would come out of the press even close to the shape they expected. Gradually the improvements in steel manufacture, metallurgy and the surgeon-like skills of the “die-setters” were able to bring the process under control and eliminate trial and error die development.

Thus, for the all-steel body, even when all of these fixed costs were amortized, there were few cost savings unless the orders were substantial. The magic key was volume production. All of which helps explain why Dodge Brothers found itself in trouble during the late 1920s and turned to Chrysler for rescue.

After the all-steel body, Chrysler’s next evolutionary move toward what we now call “Unit Body” also came from Dodge, who had made a small step forward with what was known at the time as *chassis-less* construction. The Dodge Victory Six of 1928 introduced what Budd called monopeice construction. Four large units — side, rear, roof and cowl — combined on this Dodge with specially designed frame side-rails contoured to conform to bottom of the body, which was flanged to bolt securely to the frame. Another key element of this type of construction was the rounded rather than sharp door and window corners, which improved strength as the body panels now carried some of the loads, but ‘ more importantly — were much easier to form.

The next step along the path to unit body was the Airflow. ZSB set out to optimize everything about their 10th anniversary car. In addition to their efforts to reduce wind resistance, they decided to apply their talents to a new body architecture. Working with Budd, they developed an all steel “bridge-truss” body frame construction. This was a significant change. At the time, Chrysler’s normal practice was to create a body frame by bolting a separate wood and steel composite body to a heavy steel chassis frame. The Airflow used structural steel members, which ran up, over and around the openings. This framework was then covered with steel panels. Although not the sophisticated inner/outer panel design that was used in Dodge Victory Six all-steel bodies, it met ZSB's requirements for "all steel," and the load path was easy to understand for technical analysis.

As production started in 1934, the body was assembled from three main sections supplied by Budd. The rear assembly (deck panel, bumper pan and rear roof) was common to all Airflows. Side panels were selected depending on body style, and a front assembly differed somewhat between Chrysler and DeSoto. As production ramped up, Chrysler progressively added more and stronger jigs and fixtures to hold the body firmly in location during welding. Carl Breer in his memoirs notes, "We held various body stampings in place . . . [to] weld them by multiple electric spot welders operating in unison . . . this was new . . . much development was required resulting in extensive delays."

Chrysler historian Gene Weiss has postulated that at least some of the "manufacturing problems" cited for the delay in Airflow availability were due to this bridge-truss body construction. The fully assembled body was longer than the previous model year offerings due to the welded front end. Therefore, it was much harder to handle and move through the plant. It is certainly true that this same kind of plant limitation was a factor in 1960 when the unit bodies were introduced with a "stub frame" bolted to the front to permit processing within the limited space at the Jefferson Assembly plant.

Retired Chrysler engineer and auto restorer Bruce Thomas has also pointed out that that the panel fits and joint matches were very poor on the Airflow; one car he has worked to restore had nearly 400 pounds of lead to cover the defects. Chassis assembly followed conventional process with the engine, driveline, suspension and other components mounted to the lightweight frame. Final assembly followed by mating the completed body with the built-up chassis frame by bolting and welding.

Although the Airflow was not a sales success, it did demonstrate to the Company what could be accomplished in cost savings from the important area of body panel interchangeability and common weld joints. Sedan doors were interchangeable (left front — right rear, and vice versa) with minor rework. The Custom Imperial used the Coup doors in the same way. By using a welded insert on longer models, all Airflows used the basic roof and floor pan stampings and the Chrysler used a seven inch ––vs. the DeSoto — longer dash to front axle assembly.

The next advance in body engineering came also from Budd but not from Chrysler.

Instead, it was the feat of another manufacturer that would later be acquired by Chrysler Corporation. The 1940(?) Nash Ambassador 600's newest feature was its true unit construction, a method that had long intrigued Nash's president, George Mason. Unit construction was not, as some press releases claimed, "introduced to the industry by Nash." That had been done earlier as we noted by Chrysler with the poorly received Airflow, and by Lincoln with its more successful Zephyr.

What the Nash 600 brought to the field was a more modern application of monocoque construction principles. With the advantages of real unit construction, it weighed 500 to 600 pounds less than its Nash predecessors — the Lafayette and Ambassador — or any competitors' cars in its class. It used formed box sections and stamped welded-together panels more extensively than any of its predecessor. More importantly perhaps, the Nash 600 succeeded in massproduction.

The 600's body structure had been studied and developed during 1937-1938 by Budd engineer Ted Ulrich who held several unit construction patents. (Ulrich carried on the work of the technical genius behind most Budd developments, Viennese engineer Joseph Ledwinka.) At the Nash Corporation Mason was already thinking about using such a body structure arrangement. To do so would give his car very real technical advantages and a bit of novelty for advertising interest — and when Ulrich presented a body that was 300 pounds lighter than Budd's body manufacturing competitor Briggs proposed, Mason gave Budd the go-ahead. Simultaneously in 1939, Mason hired Ulrich from Budd to head Nash Body Engineering and direct the 600's development.

For Chrysler Corporation itself true unit construction arrived on two versions for the 1960 model year. First the "stub-frame" C-body (full size Plymouth, Dodge, DeSoto and Chrysler) and later the "full-unit" A-body (compact Valiant.) Both before and after the Airflow, Chrysler Corporation had used the traditional chassis frame construction. Central engineering in the mid-1960s started investigating unit construction again looking for lighter weight and lower cost. Competitors Hudson and Nash had many years of experience with full unit construction and provided benchmarks.

The development of complete body emersion and "E-coat" (an electrostatic method of applying paint) to resist corrosion and the better engineering tools for stress and deflection analysis led Engineering to conclude that full unit was a better way to construct vehicles. A 250-pound weight advantage and a $200 cost saving were envisioned although several years would be required to amortize the additional tool and assembly fixtures. The decision was made to proceed on the new generation 1960 model year cars. As production design commenced on the new C-body, an old issue resurfaced — plant restrictions and space in the Jefferson Avenue assembly plant. The solution this time was a "stub-frame" bolted to the front of the main body although at some weight and cost penalty.

The Valiant's weight, cost and size goals dictated the most modern structure possible — "full unit." In this case, the Valiant body and frame were combined into a single welded shell. Reinforcements were used throughout the lower body structure to carry driving, braking and suspension loads. Heavy box sections distributed the major road forces to large areas of the body structure. The box sections also provide supports for the bumpers, springs and shock absorbers. All door pillars, sills, roof rails, windshield headers, and belt line rails were also fully boxed. The heavy gauge front fender side shield was welded to the dash panel, side sills, and radiator yoke to form a rigid front-end structure. More than 5,300 spot-welds and seam welds were used to join the steel stampings that made up the body. Two members were bolted in place, one the K-shaped engine support cross member, and the other the short member that supports the transmission. An intensive seven-stage immersion anti-corrosion and a rust-proofing process was used, and later large quantities of galvanized sheet were employed.