Steel Structure Damage Analysis
This page is intentionally left blank.
Module 1 - Vehicle Structures
This page is intentionally left blank.
Video: Understanding Collision Forces
To understand the importance of restoring the integrity of the vehicle structure, it may be helpful to see the advances in safety features over vehicles of 50 years ago. Watch as this 1959 Chevrolet Bel Aire collides with a 2009 Chevrolet Malibu in a 40 mph offset test. In slow motion, take note of the Bel Aire structure. Notice how the door separates from the lock pillar. The windshield separates from the pinchweld, and the front structure on the driver side completely collapses. This view shows the impact from the backside.

From inside the vehicle, notice how the steering column pushes toward the driver. The driver's head impacts the roof structure, and the seat separates from the floor.

Here we see the impact from the driver's side of the Malibu. Note how the vehicle's center section remains intact, including the door, roof panel, and windshield. From inside the Malibu, we see that the driver remains properly positioned. The steering column remains in place, and the properly deploying airbag protects the driver from any contact with the steering wheel.

Advances in vehicle design over the past several decades have created a safer passenger cab, reducing the number of severe injuries and even deaths. Vehicle makers have added crush zones, higher strength steels, and advanced restraint systems to control collision energy and protect the passenger. These must be restored as originally designed to ensure they react similarly in a subsequent collision.

Video: Making Point-To-Point Measurements - Part 1
(Host) Damage analysis, sometimes the damage is obvious, while other times, we have to go a little bit farther to find that hidden structural damage. So what do we do? Point-to-point measurements, doing these provides us with a quick reference without having to put a vehicle on a measuring system. Remember these are only a quick reference. During a repair, we want thorough three-dimensional measuring to make sure we've identified all the damage from a collision.

This is our technician Dan, who'll be helping us today. Dan, the concept of quick checks or quick measurements seems pretty straightforward. But what is the best way to approach this?

(Dan) Well, we essentially have two options. We can use measurements out of an estimating guide, or off the vehicle maker's website. The quickest and simplest way to do this is comparative measurements.
For example, underhood let's use this tram gauge to measure from a bolt on the strut tower to a point on the radiator core support. Then we'll compare that measurement to the same bolts on the opposite side of the car. Cross measurements such as these help us determine if the vehicle upper structure has any sagging or sway. It looks as though we're in pretty good spec here. Now we should probably check the trunk opening area.

On the back of the car, the same type of measurements can be used to determine if there is a variation in the trunk opening. For a diagonal measurement, we'll use a point on the corner of the backglass to a mounting point on the tail lamp assembly. In this instance, we see that the trunk opening is no longer square and a little bit out of spec, which is understandable due to the hard side hit. These cross measurements work for any vehicle opening.

Another good measuring point is lower suspension points. We'll have to put the car up in the air for that, which will take just a few moments.

Now that we have access to the suspension, here we can make sure that the lower pivot points are in the right position.

(Host) So if we were taking a measurement from the lower pivot point right here, where's a point you would measure to?

**Video: Making Point-To-Point Measurements - Part 2**

(Host) Ok, so Dan, what points are we looking at?

(Dan) Well, measuring from the lower pivot point, there are a couple areas we can go to provided that we're fairly certain that these areas are undamaged. These areas include a spot on the engine cradle, such as where I'm at here, or a bolt or a reference hole that would be on the structure.

(Host) Quick-check measurements provide a good method to help identify potential damage. If damage is suspected, three-dimensional measuring is the only way to determine the extent of damage and verify repairs.
Module 2 - Structural Damage Analysis
Video: Front Structure Damage Analysis - Part 1

(Host) A thorough damage analysis requires examining all areas of the vehicle to ensure a complete and accurate estimate. Today we are looking at a Ford Taurus with damage to the front section. Due to the severity of damage, we are going to examine the entire vehicle structure for both primary and secondary damage. To help guide us through the damage assessment is Steve Marks. Steve, it looks like we have a fair amount of damage with this vehicle. With this type of hit, where do we begin?

(Steve) The best thing to do is to start out looking at the damage to determine what the severity of the damage is, and the general direction that the damage traveled. Then the next thing we’re going to do is take a look at the vehicle, walk around it, and get an overall impression of the transfer of collision energy throughout the vehicle.

(Host) At first glance, what do you see?

(Steve) I see evidence of a lot of collision energy that took place during this impact. Basically, we have an ultra-high-strength steel bumper bar which broke loose from the front frame rail, moving to the right, taking the right frame rail along with it, basically pushing this whole front end assembly over to the right. So as we look and analyze damage on this vehicle, we have to remember we have collision force going rearward and off to the side.

(Host) Should we continue assessing the damage by going under the hood?

(Steve) This would be a good time to do that. When we look under the hood, we see that unlike the lower structure, which was moved very much to the right, this appears to be more square and in place, and maybe over to the right slightly, but not as much as the lower structure. We do see the composite radiator support has broken loose, and the other thing that we see, is this portion of the front upper rail assembly is moved downward. So we know that there is collision damage throughout the front structure, we're going to have to evaluate it more closely as we go along. But for right now, let's take a few minutes and walk around and take a look at the rest of the vehicle to see if any collision energy, which transferred into the rest of the car, has caused any secondary damage.

During the walk-around, what we look for is any irregularity in the panel gaps or panel fit. We're also looking for any dents or buckles on the upperbody that would indicate that the upper structure has twisted or moved. This vehicle doesn't appear to have any of that. So it appears as though the damage is basically confined to the front structure, but we have
to verify that with measuring. The other thing that's important to do on both sides is to try the doors for proper fit and operation. On this car, the doors seem to work very well, so judging from the overall appearance of the welded panels, and the operation of the doors, it appears as though the damage is confined to the front structure. Now on vehicles today with the ultra-high-strength steel and high-strength steel being used, especially in the vehicle center sections, we're not finding damage radiating into the rear of the body quite as much as we used to see with older structures in front end collisions.

(Host) So we have a good initial view of the damage on our vehicle, what is the next step?

(Steve) Our next step is to take the sheet metal off so we can get a better look at the upperbody structure. Then we're going to put it on a hoist so we can get a better look at the lower structure.

(Host) Now that we have a clearer view of the upper rail, do you think we have any damage?

(Steve) The good news is there is no physical damage to the upper rail assembly. We believe it might be a little out of position, but we can correct that with pulling. We checked the Ford collision repair information and found that upper rails on this car are made from mild steel, and according to the Ford Steel Repairability Matrix, if there is some damage, we can straighten mild steel.

(Host) Well, that takes care of the upper front structure on this side of the vehicle, let's go check out the other.

(Steve) Good idea.

As we expected from our initial inspection, when the upper rail moved to the right and downward, it created a large compression buckle in this upper rail assembly.

(Host) This damage appears to be substantial as there is collapse in the upper rail. Can this damage be repaired? What do you think?

**Video: Front Structure Damage Analysis - Part 2**

(Host) So Steve, what do you think? Can this part be repaired?
(Steve) Well, if the kink vs. bend rule were to be applied here, it would be considered a repairable part. Because there are no visible kinks, and we know that pulling this part is going to reduce this dent a lot, however, because we have such limited access to the backside and because the part has a lot of formed areas in it that must be restored exactly to the original shape, that's going to be challenging, and therefore, this may be a candidate for replacement.

(Host) So now that we've taken a look at the upper structure, let's get this vehicle on a lift, up in the air, so we can take a look at the lower structure.

(Steve) Good idea.

Along with getting the vehicle up in the air, we've taken off a few extra parts to make it easier to see the damage. Let's start by taking a look at the left rail.

On this vehicle, Ford gives three sectioning options. The first option is directly behind that second convolution. On this vehicle, that is probably the option we are going to choose.

(Host) So how do we know for sure this is the best option?

(Steve) The best thing to do is to measure the car. Measuring will allow us to make the most accurate repair plan. It tells us the severity of damage, and how far back the damage has traveled into the vehicle structure. In order to do that, we're going to use some electronic measuring equipment that will allow us to make three-dimensional measurements very quickly.

(Host) Steve, can you tell us a little bit about the measuring system we have here?

(Steve) Right, this is an electronic, three-dimensional laser measuring system. Each of these targets represents one point that we're measuring on the vehicle. LED lights represent height, length, and width, and when the lights are green, it means that the specification is correct. If it's off, it will show it to be yellow, if it's very much out of spec, it will show it to be red. What we see here is we're measuring the vehicle center section, we're measuring the engine cradle, and we're also measuring a couple points on the lower rails. This is going to help us determine the best location to do the sectioning on
those. The screen shows what we suspected. The center section of this vehicle has not been damaged. There is no collision damage rearward of the front structure.

Measuring has verified that we need to make some structural pulls to get the front of the structure back into specification. It's also verified that we can section this front rail just behind the front convolution. That's how we're going to repair the left rail.

(Host) Let's take a look at the other side.

(Steve) Great idea, let's do that.

On the right side, measuring has verified that the area directly behind the sectioning joint is very close to specification, so our structural pulling will restore that no problem. And finally, measuring has also verified that our engine cradle does have damage, and so therefore, it does need to be replaced.

(Host) Steve, thank you for walking us through the damage analysis process.

(Steve) No problem, my pleasure John.

(Host) When doing frontal analysis, you need to do a complete vehicle walkaround to help identify any secondary damage. Vehicle teardown will help identify any damage beneath the panels, while raising the vehicle will give you an underside perspective of the extent of damage and any other possible hidden damage. Lastly, basic vehicle measurements will further identify the damage, and identify possible repair methods if you have the necessary equipment.

Video: C-Pillar Damage Analysis - Part 1

It's generally pretty easy to see damage to exterior panels when performing an inspection. However, determining if there is damage to the inner structure will require further inspection. Here we have a C-pillar with noticeable damage to the outer skin. What other visual clues can we use to determine if damage extends into the inner panels?

Video: C-Pillar Damage Analysis - Part 2

If possible, and time and location permits, it is helpful to remove parts to get better visual access to the backside of a panel. Here we have removed the splash guard which allows us a better view of the damage on the backside of this quarter panel. With these
parts removed, has it changed your conclusion about the extent of damage to the inner panel?

**Video: C-Pillar Damage Analysis - Part 3**
Noting the extent and depth of damage on the outer panel, along with the damage to the wheelhouse, it is likely there is damage to the inner structure. For the purpose of this video, we have removed part of the uniside to verify our conclusion. With the outer panel removed, we can see the damage to the wheelhouse, and the damage to the rear rocker panel reinforcement in the striker mounting area, and the upper portion of the reinforcement. The extent of damage will require replacement of the wheelhouse assembly and the reinforcement. In this case, even though the damage is minor, it is not repairable due to the use of high-strength steel in the vehicle's construction.

**Video: Side Impact Damage Analysis**
(Host) Side impacts, understanding how the vehicle was hit, and where the collision energy was directed is key to understanding how the vehicle should be repaired. Today we're looking at a 2006 Chevrolet Malibu with damage to the A-pillar area. To help us analyze the damage is Robbie Robinson, Body Shop Manager at Bergstrom Automotive in Appleton, Wisconsin. Robbie, from the perspective of an auto physical damage appraiser or estimator, looking at this vehicle, where do we begin?

(Robbie) The first step that we always do is we ask our guests what actually happened during the accident. As we can see here, it has front fender and door damage.

(Host) Do we need to remove any parts to get a better picture of the damage?

(Robbie) As you can see, there is damage behind the fender and the left front door. So we'd want to remove them so we have a better view of the A-pillar damage.

(Host) With the door and fender removed, we definitely get a better picture of the damaged area. Do you think this vehicle is going to need to be straightened?

(Robbie) The first thing what we'd do is we'd end up doing a rough pull to see if we can try to repair it, but by physically looking at it, it will need to be replaced.

(Host) What indicators are you using to go with that straightening?
(Robbie) You can see where the door hinges are. They are twisted and the original spot welds are pulled apart.

(Host) Can you tell by looking at this vehicle if there is any suspension damage?

(Robbie) You can't physically tell if there is any suspension damage without putting it on the alignment machine.

(Host) How about any secondary damage on the rest of the vehicle?

(Robbie) As you look down the side here, you can see some secondary damage by looking at the door gap right here along with damage to the left quarter panel.

(Host) Do you approach side impact damage differently than front or rear impact damage?

(Robbie) No we don't. We work right from the direct impact damage and work our way out when we're writing the estimate.

(Host) So the damage areas have been identified, and we've determined what needs to be repaired or replaced. Now with side impacts, such as this or on other vehicles, what do you find are the most common items that are missed on an estimate that result in a supplement?

(Robbie) The most common thing is any inner structural that we can't physically see without cutting the A-pillar apart.

(Host) What tips do you have for someone new to the job so they can have a complete and accurate estimate?

(Robbie) The biggest thing is just making sure you tear down the vehicle completely, removing all trim and things for the repairs. Also, review the estimate with the technician to make sure you have everything before submitting it to the insurance company.
(Host) So what would be some potential indicators of a possible total loss?

(Robbie) The biggest thing is the year, the make, and the model, and the mileage.

(Host) Robbie, thank you for spending time with us today. You've provided some valuable insight into side impact damage analysis.

When doing side impact damage analysis, it's important to look beyond the area of direct damage. This may require removing parts to get a better look underneath at the damage. Also, you want to make sure you walk around the vehicle for any possible secondary damage. Don't forget what's on the opposite side of the impact zone. Items such as cross car beams, electronics, and trim pieces. Essentially anything that could be damaged from the collision.

**Video: Laminated Glass Damage Analysis - Part 1**

(Host) Glass damage. It can happen from a collision, or from road debris during our day-to-day driving. The question is, is it repairable?

(Technician 1) Here we have what appears to be a stone chip in this windshield, but it's more than a chip it's a crack. There are cracks radiating from the center and those cracks will only spread. This is not a repairable crack.

(Technician 2) This certainly looks repairable to me. It's not a crack, it's what's called a star break, and since it's not in the driver's direct field of vision or too large, a qualified glass repair technician with a glass repair kit could fix that.

(Host) Well, it looks like we have a difference of opinion. What do you think would be the best repair option?

**Video: Laminated Glass Damage Analysis - Part 2**

This type of chip is repairable. The damage doesn't extend into the laminate, and it isn't too large. So a glass repair kit should be able to make a repair that's nearly invisible, and one that won't spread.
This page is intentionally left blank.