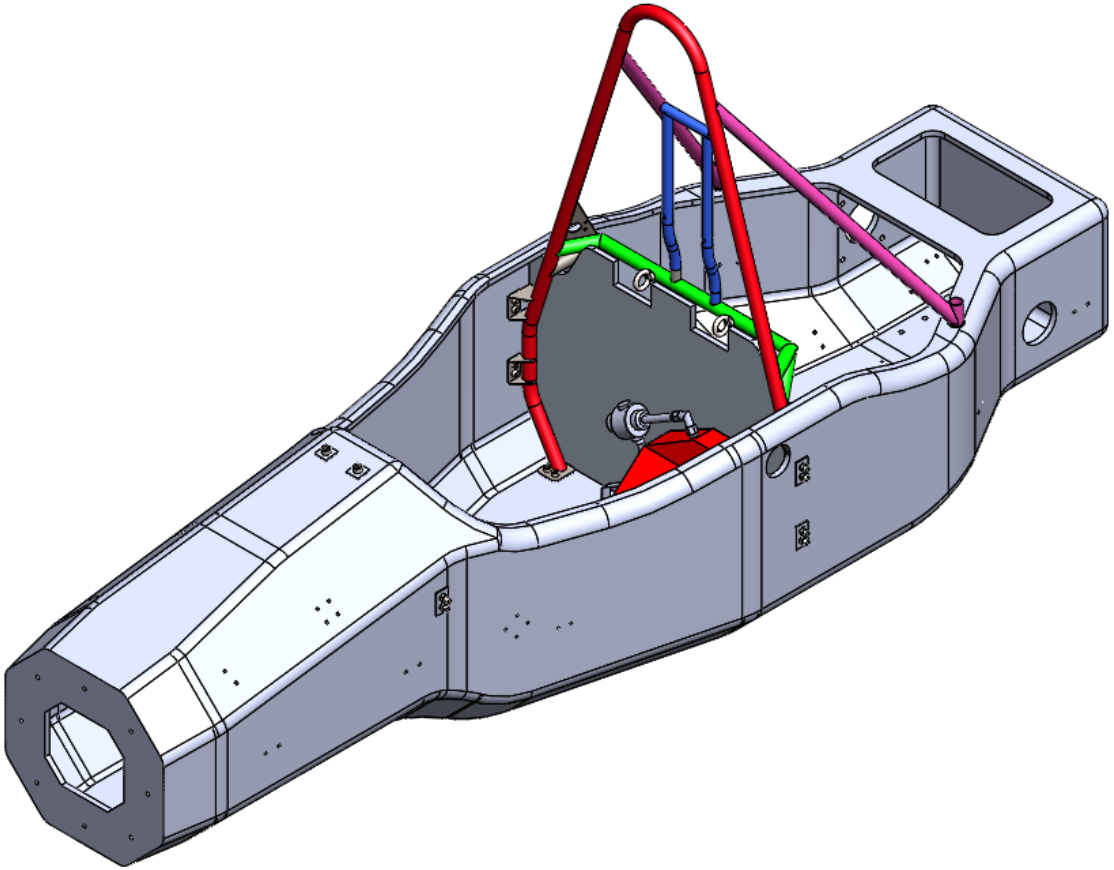
2020 SES Inspection

- Monocoque -

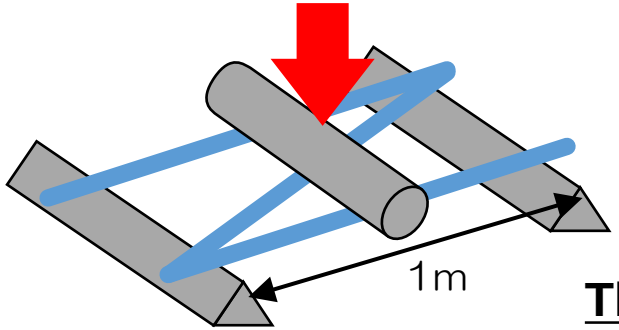


SES = Structural Equivalency Spreadsheet

Monocoque Laminated Test

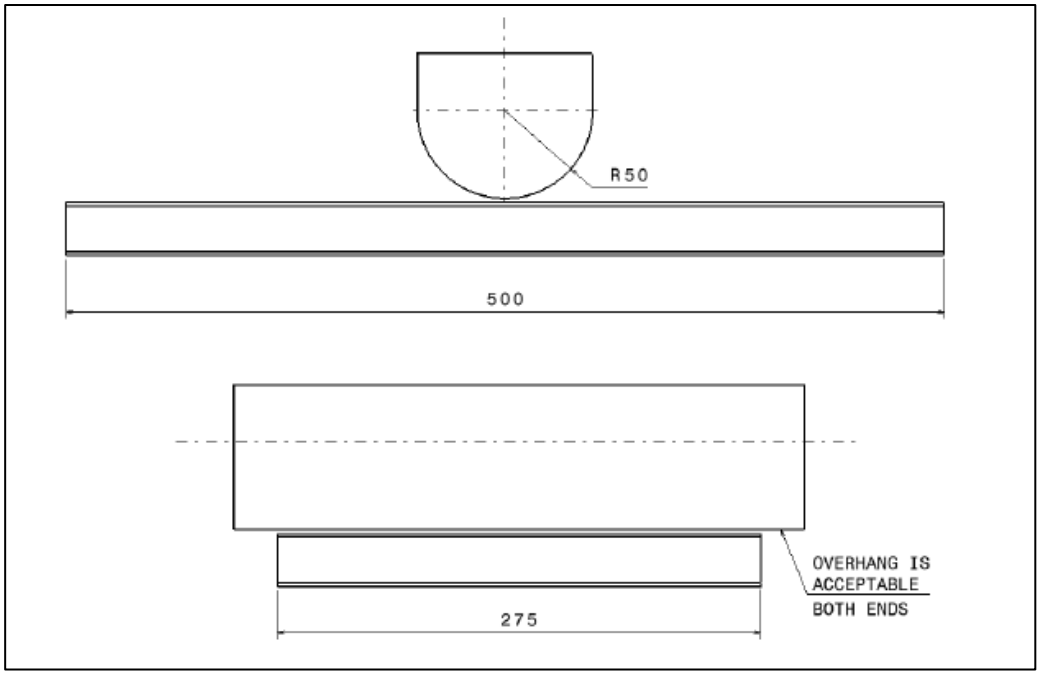
Purpose of SES (Pipe space frame)

Quick evaluation method to check your vehicle structure stiffness and strength compared to the baseline structure.



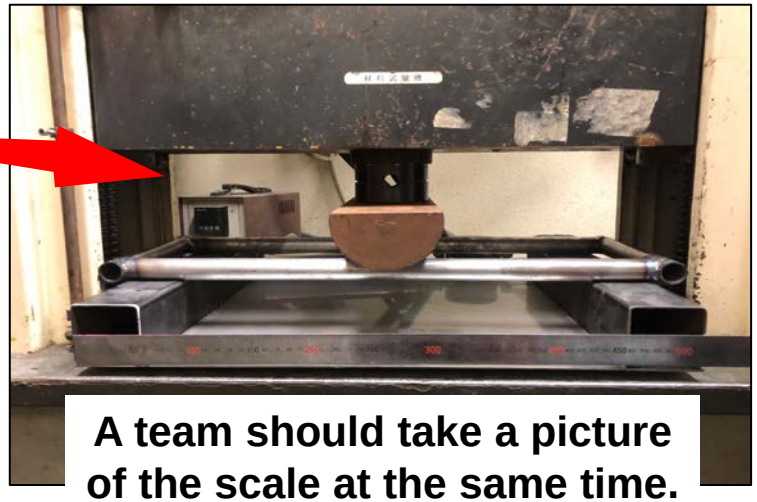
The number of tubes are considered in span of load transfer area.
The number of tubes are different in this area, please use the number of tubes **in the most weak section.**

The approach to a three-point bending test is the same.



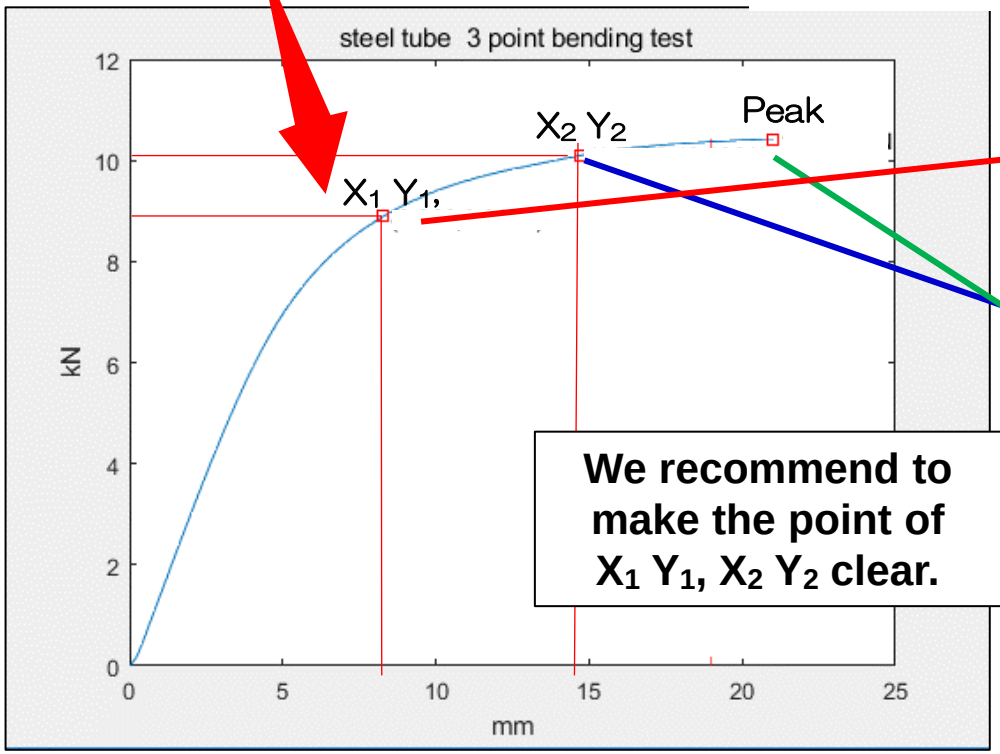
Steel Tube 3-Point Test

Required: Test setup images, measurements.
All test samples must be presented at Technical Inspection.

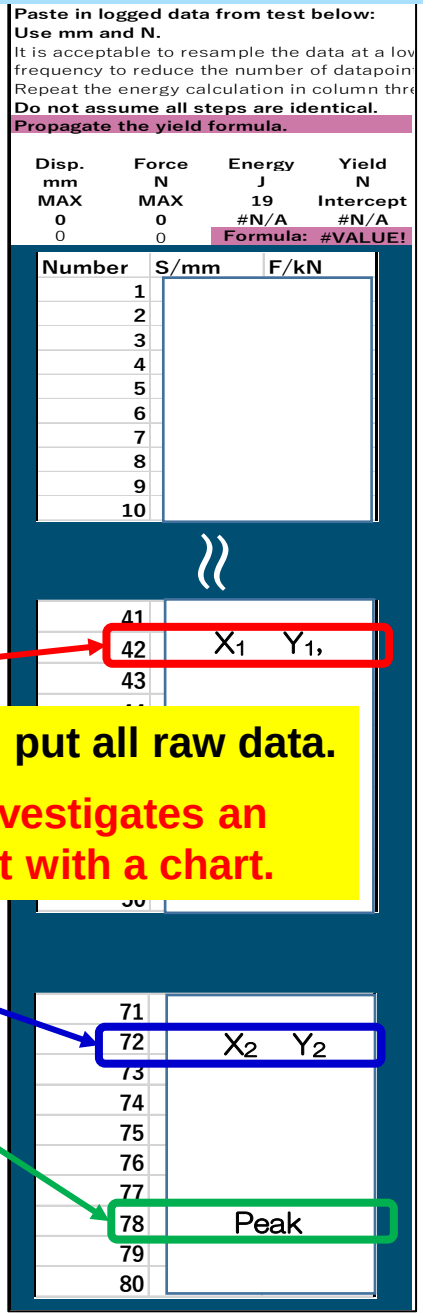


A team should take a picture of the scale at the same time.

Required: Load deflection curve.



We recommend to make the point of X_1 Y_1, X_2 Y_2 clear.



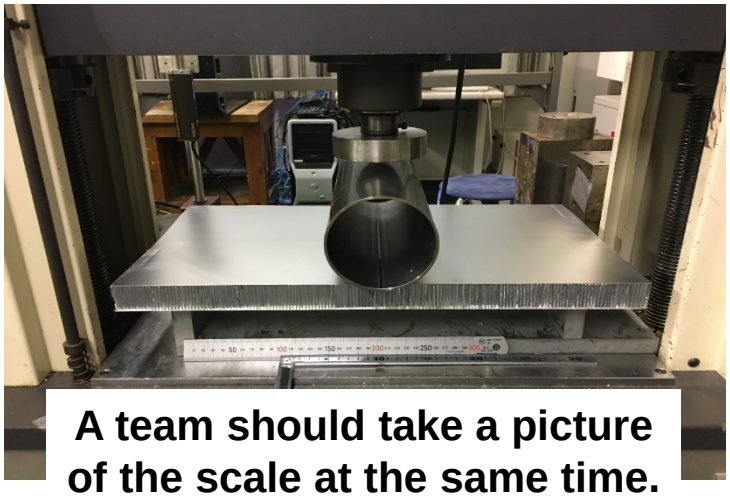
A team has to put all raw data.

A judge investigates an adjustment with a chart.

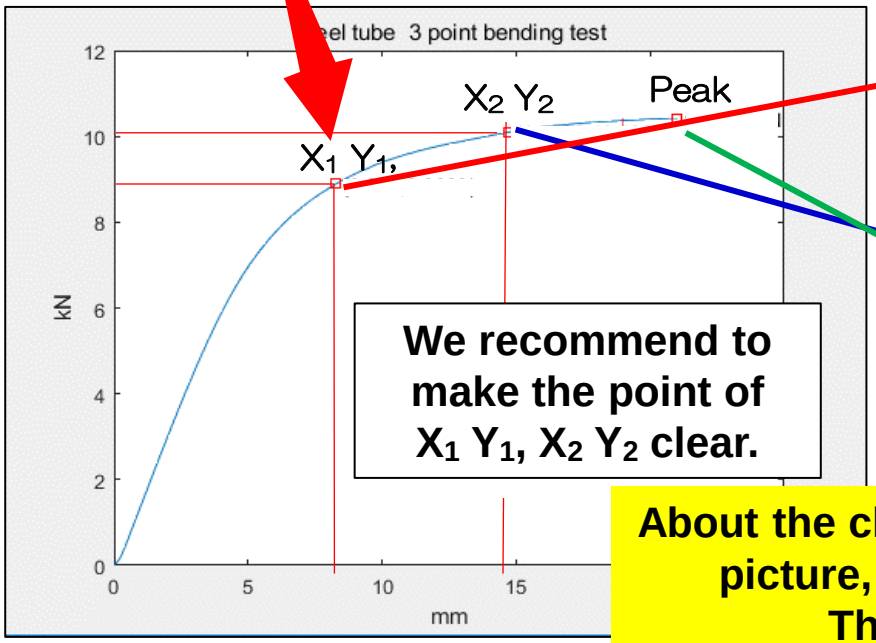
Composite 3-Point Tests

Required: Test setup images, measurements.
All test samples must be presented at Technical Inspection.

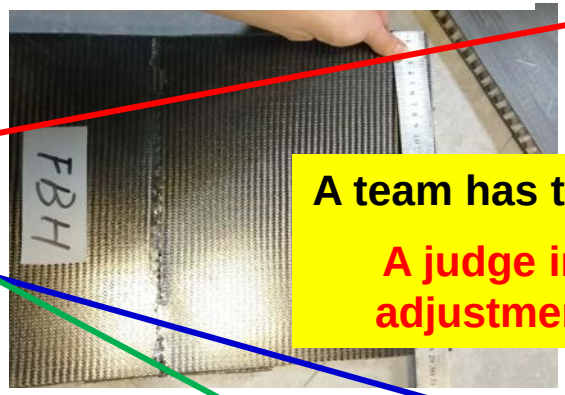
Required: Load deflection curve.



A team should take a picture of the scale at the same time.



We recommend to make the point of X_1 Y_1, X_2 Y_2 clear.



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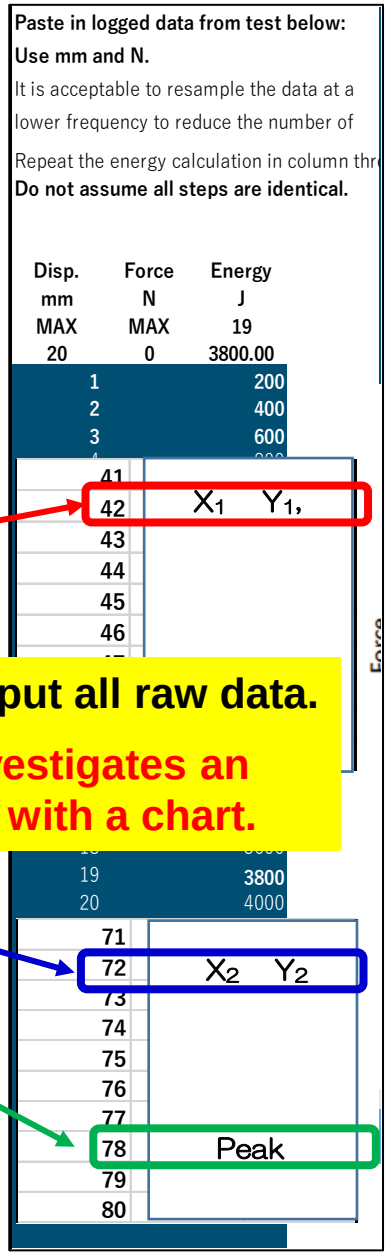


About the chart, raw data, attachment picture, we request to a team, Those are same as "Steel Tube 3-Point Test".

Perimeter Shear Test

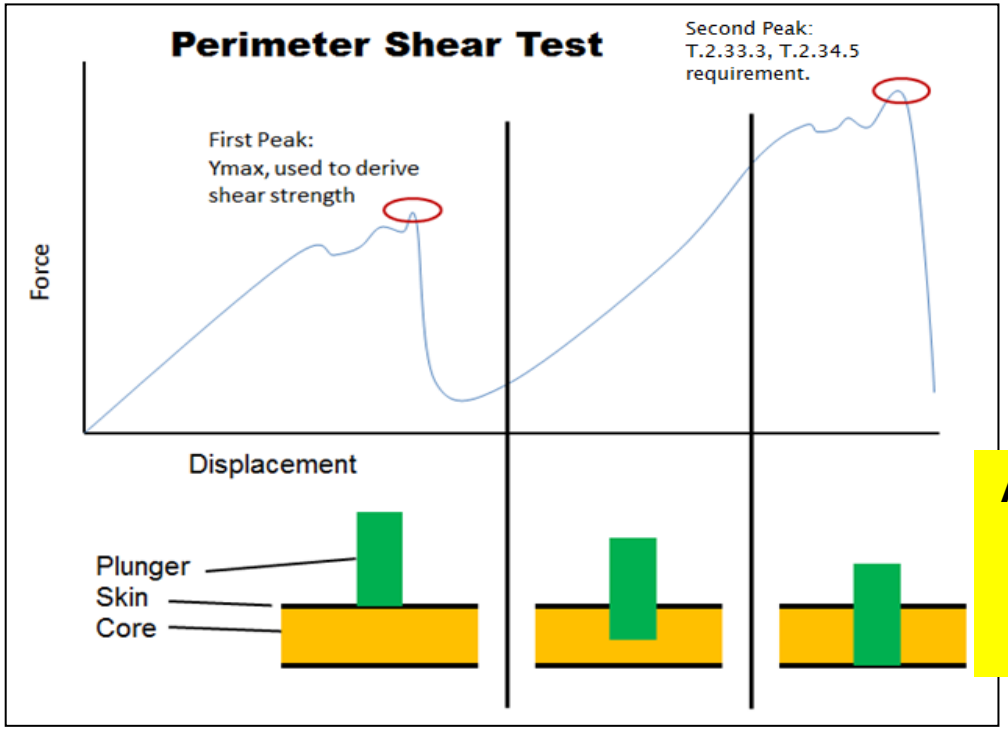
Required: Test setup images, measurements.

Note: If the first peak is higher, it may be used for T.2.33.3 or T.2.34.5.

Required: Load deflection curve.

Paste in logged data from test below:
It is acceptable to resample the data at a lower frequency to reduce the number of datapoints.
Use mm and N.

Disp. mm MAX	Force N MAX
0	0



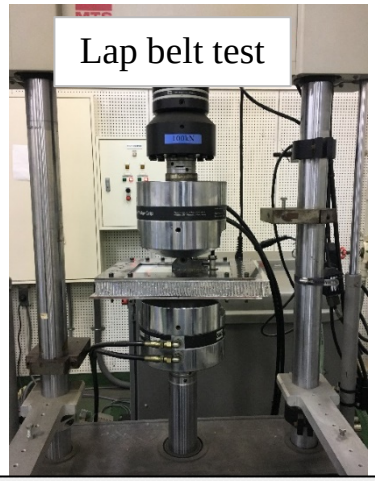
A team has to put all raw data.

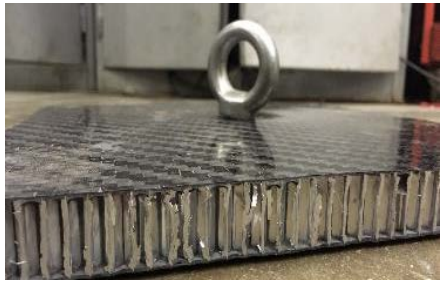
A judge investigates an adjustment with a chart.

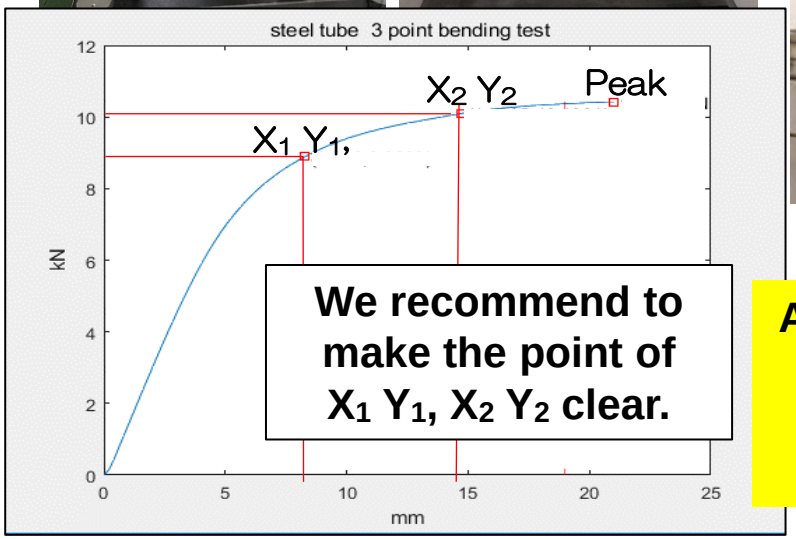
About the chart, raw data, attachment picture, we request to a team, Those are same as "Steel Tube 3-Point Test".

Harness Attachments

Load Deflection Curves
Test Setups and Measurement Pictures
Samples After Testing
Actual Design Images







We recommend to make the point of X_1 Y_1, X_2 Y_2 clear.

Paste in logged data from test below: It is acceptable to resample the data at a lower frequency to reduce the number of datapoints.					
mm	N	mm	N	mm	N

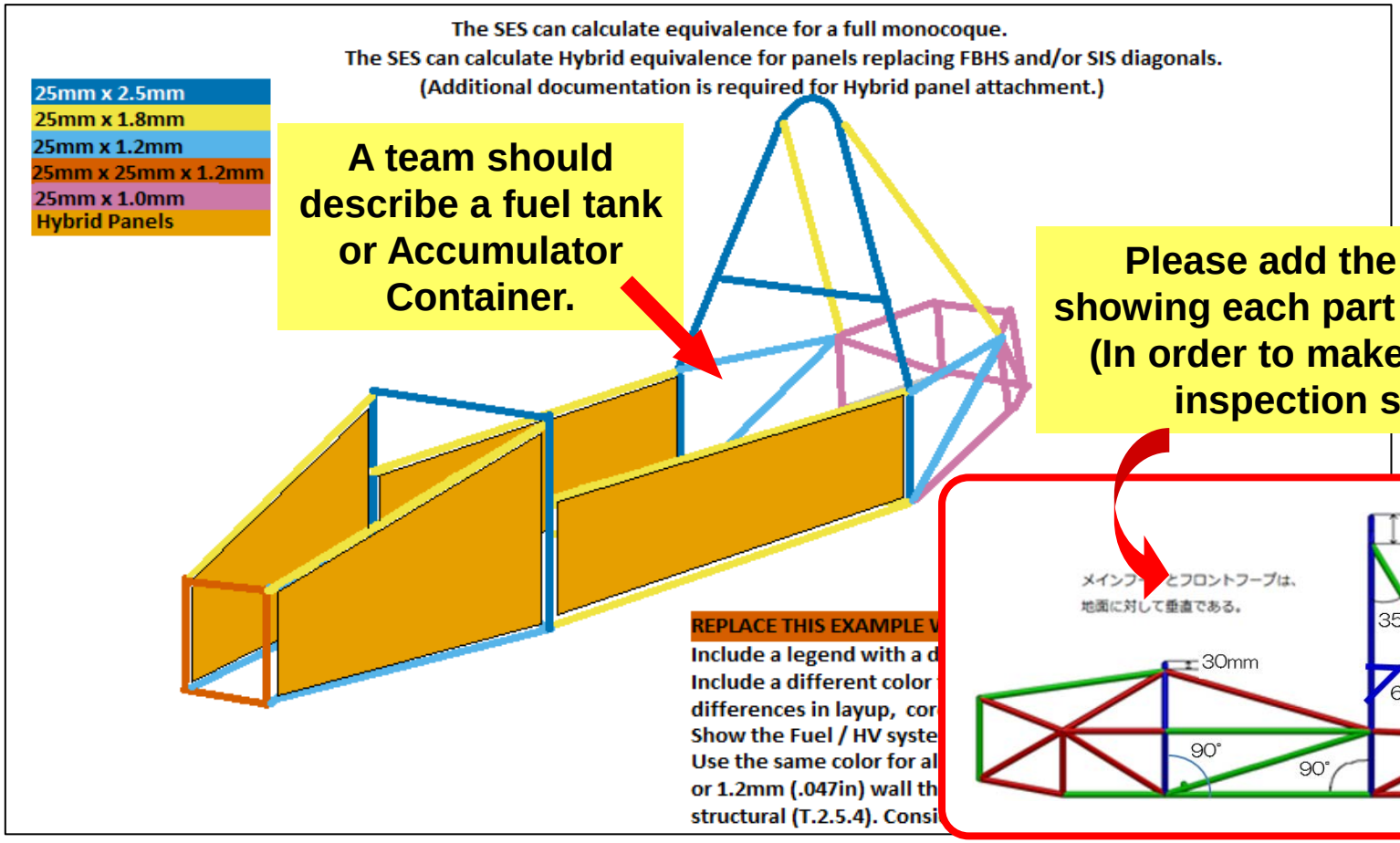
A team has to put all raw data.

A judge investigates an adjustment with a chart.

About the chart, raw data, attachment picture, we request to a team, Those are same as "Steel Tube 3-Point Test".

Panel and Tube Clarification/Drawing

An isometric drawing is from the front as follows.



1. Three views drawing is unnecessary.
2. Illustrate a Fuel Tank in ICV and illustrate Accumulator Container in EV.
3. Please write pipe classification by color like a sample.
4. All pipes smaller than φ25mm or t1.2mm are the same colors.

Front Bulkhead Support

There should be EI of three or more Baseline pipes only with a perpendicular wall.

(1) It converts by the weakest panel.

=> If a size is inputted into a calculation sheet, comparative evaluation will be carried out to three Baselines. If there is EI of three or more Baseline pipes only with a perpendicular wall.

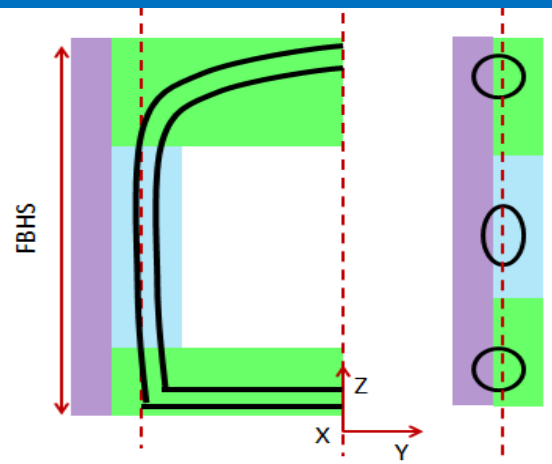
(2) When EI will be less than 100% by (1)

① Calculate the moment of inertia of area Izz of the circumference of a vehicles center vertical axis.

② Calculate moment of inertia of area Iloc+A*d2 of the circumference of a vehicles center vertical axis on the conditions which have three Baseline pipes in the position (distance d) of the width of MHBS one side.

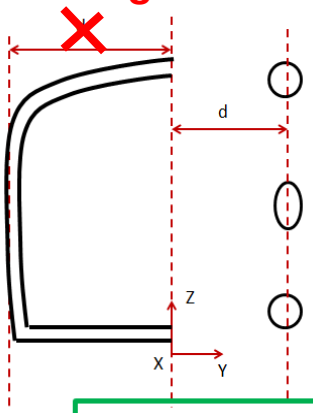
③ $E_{your} * I_{zz} \geqq E_{Baseline} * (I_{loc} + A * d^2)$ A certain thing is proved.

Setting the height of the whole FBHS minimum section to Panel Height in (1) is OKs.
The part must be deducted when there is a space portion.



The calculation method is indicated to guidance.

It is confusing.



Steel tube configuration used for equivalency comparison:

$A = 3 * \frac{\pi}{4} * (d_o^2 - d_i^2)$ $I_{loc} = 3 * \frac{\pi}{64} * (d_o^4 - d_i^4)$

$d = \frac{chassis\_width}{2}$

Composite configuration used for equivalency comparison:

-Use section cut properties calculated by CAD system.

- Izz of half car with the reference coordinate system at the centerline of vehicle.

$I_{zz} \geq I_{loc} + A * d^2$ Passes equivalency test

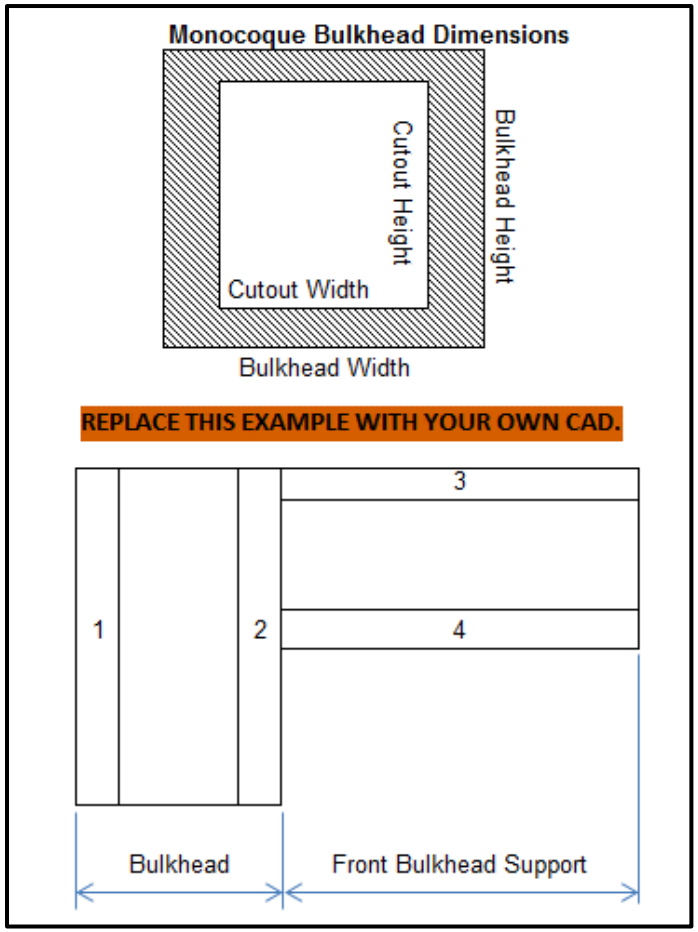
Compare on this condition.

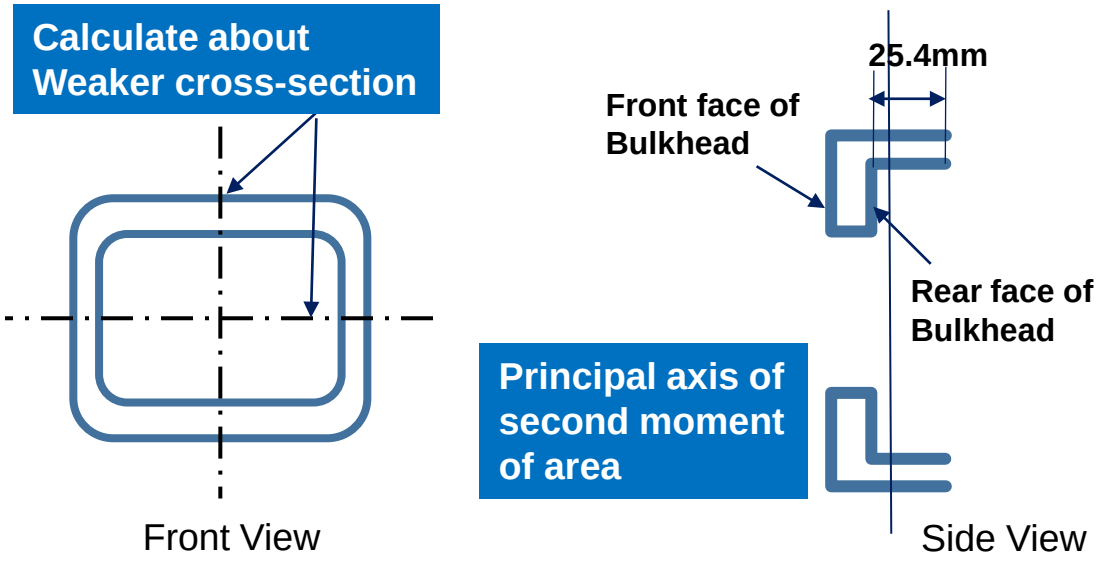
Front Bulkhead

EI of the weakest panel proves that they are two or more Baseline pipes.

(1) Equivalent Flat Panel Calculation
Chassis where, when calculated as a flat panel, Front Bulkhead & structure between from rear face of FBH to 25.4mm show >=100% equivalency to 2 FBH tube.

(2) Chassis where the flat panel calculation shows <100% equivalence to 2 FBH tube. In this case additional proof of equivalence is required, by showing the actual chassis.





Main Hoop Brace Support

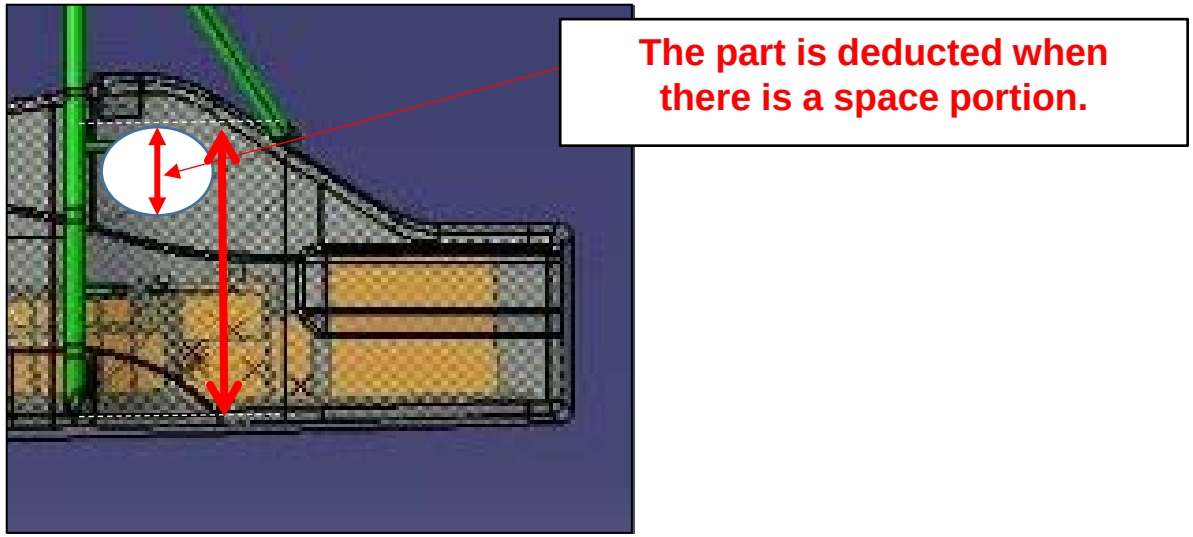
EI of the weakest panel proves that they are two or more Baseline pipes.

(1) It converts by the weakest panel.

=> If a size is inputted into a calculation sheet, comparative evaluation will be carried out to two Baselines. Panel Height is as the under figure.
When there is a space portion, it calculates in the minimum height except the height.

(2) When EI will be less than 100% by (1)

① Calculate the moment of inertia of area Izz of the circumference of a vehicles center vertical axis.
② Calculate moment of inertia of area Iloc+A*d2 of the circumference of a vehicles center vertical axis on the conditions which have three Baseline pipes in the position (distance d) of the width of MHBS one side.
③ $E_{your} * I_{zz} \geqq E_{Baseline} * (I_{loc} + A*d^2)$ A certain thing is proved

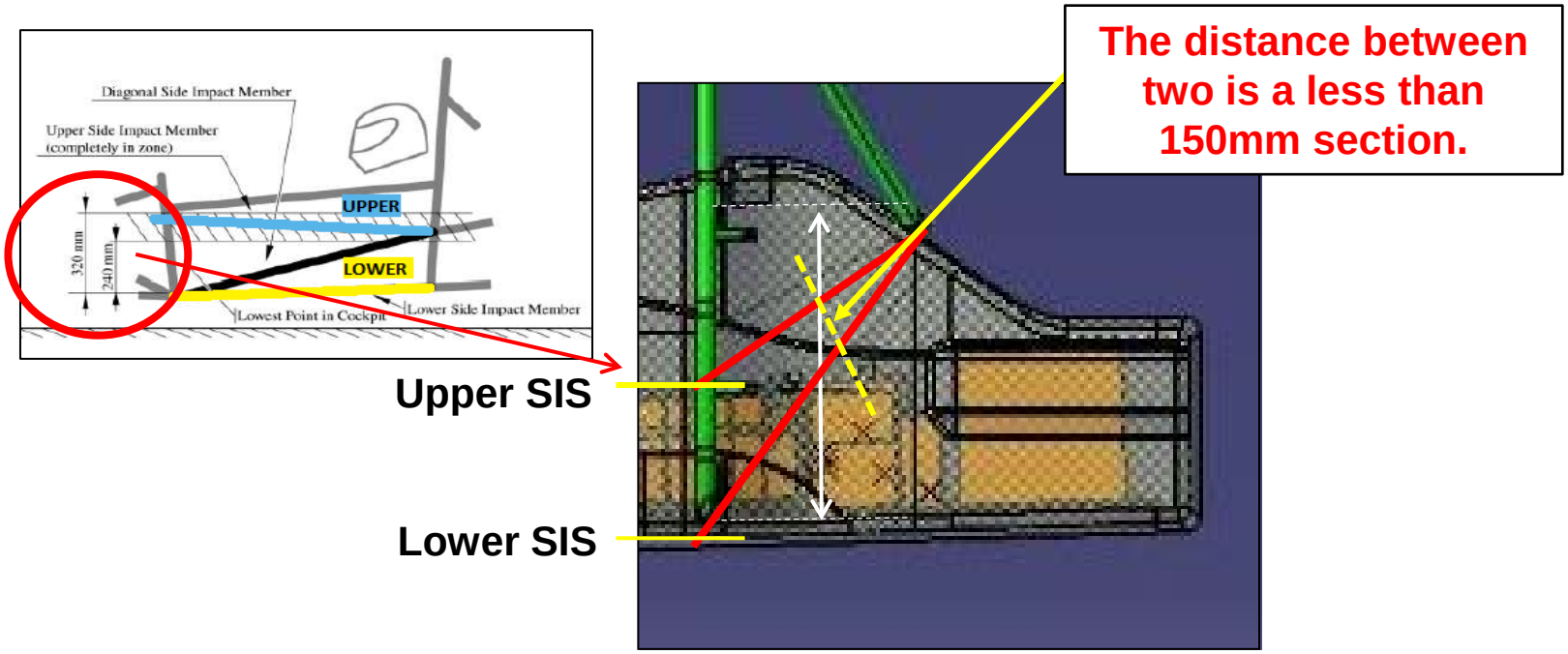


Main Hoop Brace Support

EI of the weakest panel proves that they are two or more Baseline pipes.

(3) When panel conversion cannot be performed

The same calculation as (2) is done.
When MHBS in tube frame structure is assumed, the width of two pipes calculates the section used for calculation in the section used as less than 150mm.



In SES, you have to prove by one of methods.

Side Impact Structure

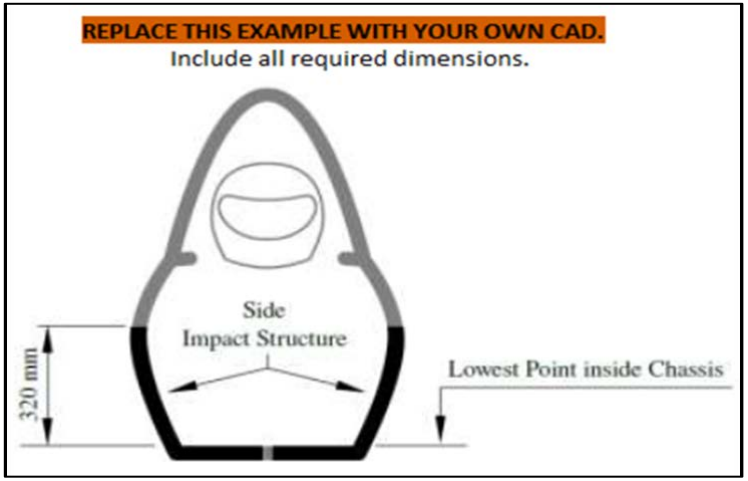
EI of the weakest panel proves that they are two or more Baseline pipes.

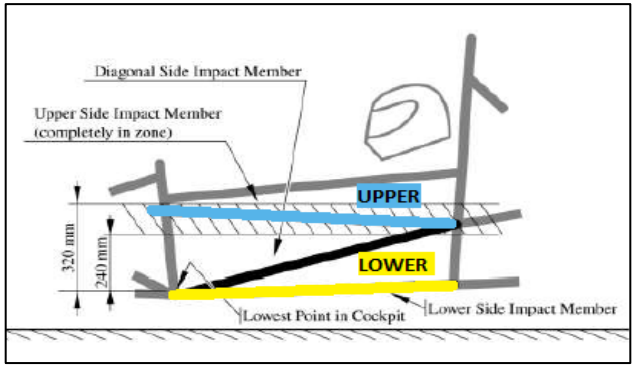
It converts by the weakest panel.

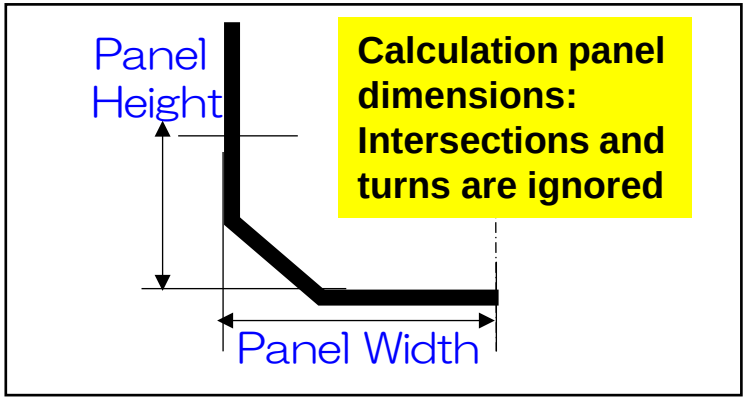
A choice only has converting by the weakest panel.

The minimum EI of a perpendicular wall
≧EI applicable to two Baseline pipes
The minimum EI (floor boards)
≧ EI applicable to one Baseline pipes

The height of the Side Impact Structure in a monocoque structure must not include more than 320mm from the Lowest Point inside Chassis.







F.7.6.3, F.4.4 - The vertical SIS wall is calculated as a flat panel.
F.7.6.3 - The vertical SIS must be equivalent to two SIS tubes.
F.6.4.4b - The vertical SIS must reach 240mm+25mm from the lowest top surface of the floor.
F.6.4.4b - 320mm panel height is the maxiumum available for equivalence.
Structure above 320mm is encouraged.
The horizontal SIS floor is calculated as a flat panel, and must be equivalent to one SIS tube.

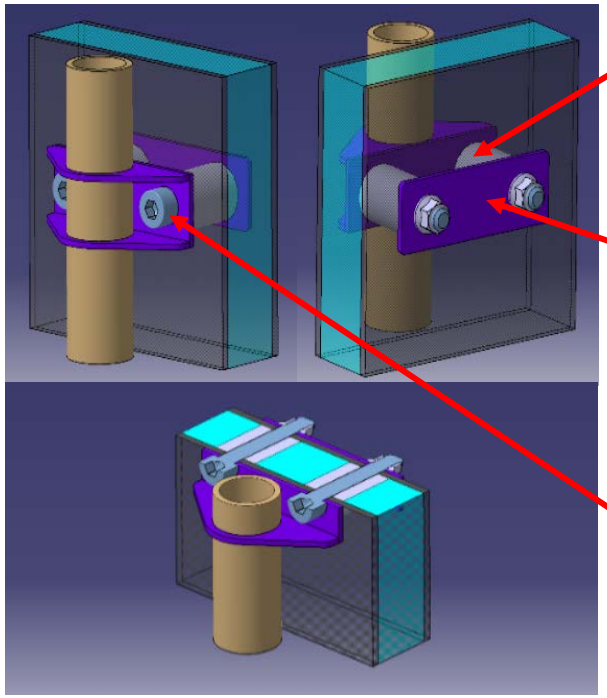
Monocoque Attachments

Graphical Evidence for Bracket / Insert / Backing Plate / Edge Distance are required

More than 2 attachments in each side are required each attachment must have Min. TWO M8 bolts. Front Hoop can be laminated

(Expose a part so that inspector can inspection the pipe thickness)

That it the bracket itself bends or breaks in 30kN or less is not accepted.



Insert

No crushing of the core is permitted

Backing Plate

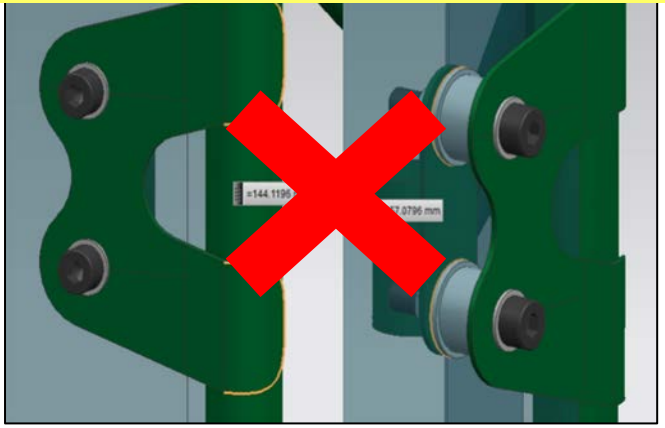
It's necessary t he back plate made from steel beyond t2 is indispensable. Input outside perimeter length correctly.

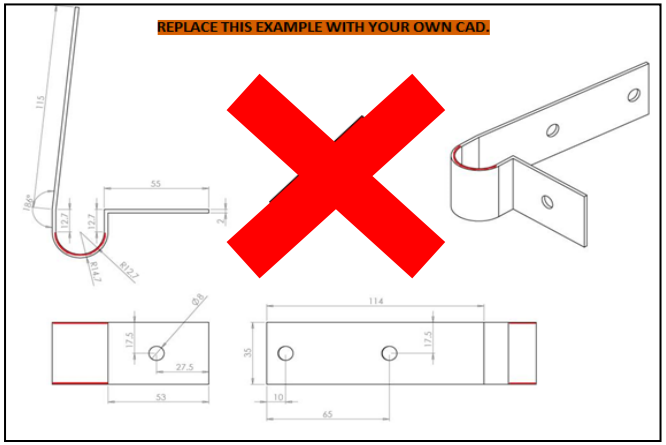
Bracket

Input outside perimeter length & weld length correctly

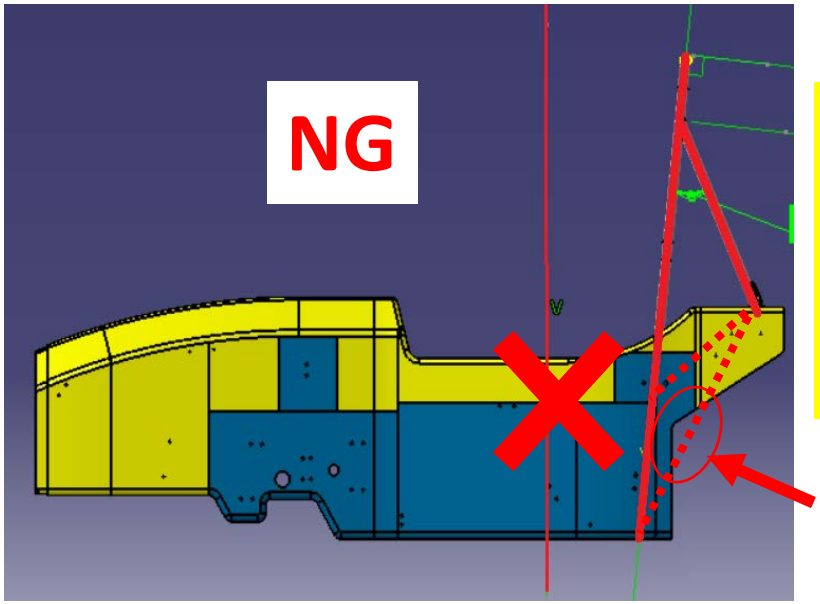
Edge Distance

Distance from bolt centerline to nearest "free edge"



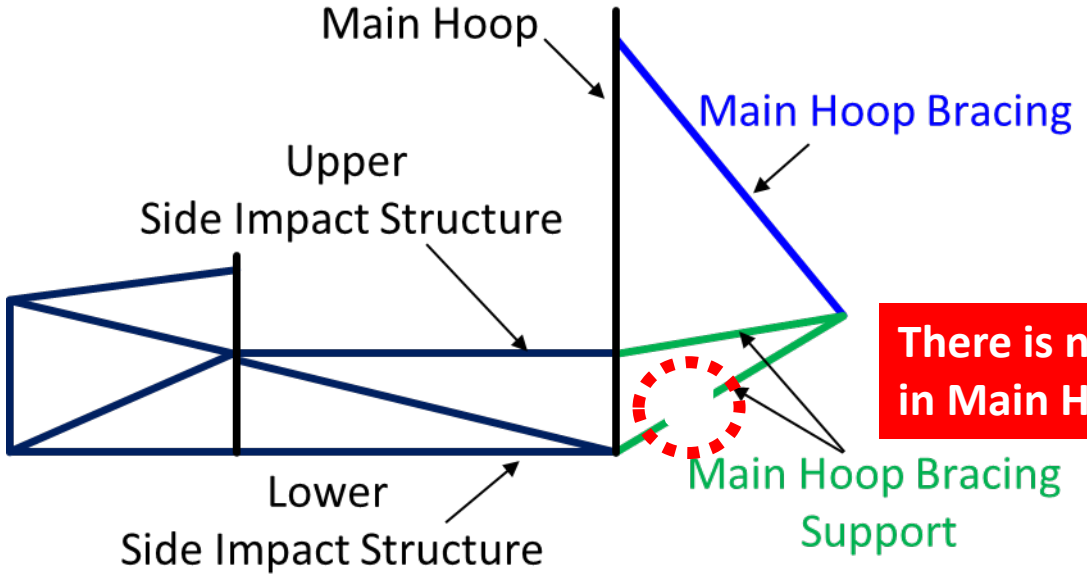


Monocoque Improper Case



Like CAD drawings,
If there is space in the connection between Lower Main Hoop Bracing Support and Lower Side Impact Structure,
We do not admit that the lower frame configuration has been established.

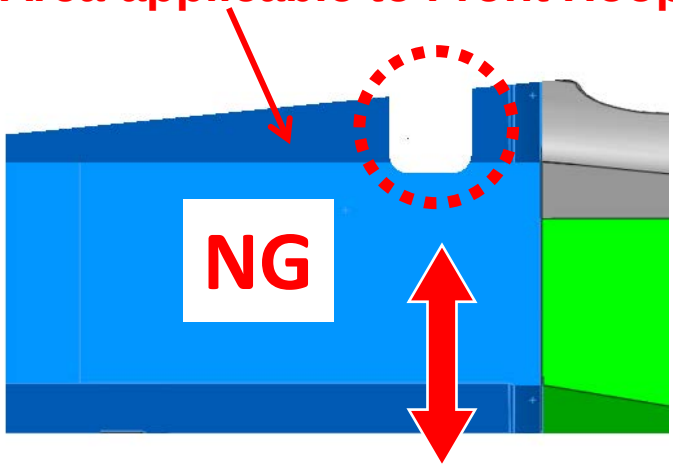
Composite material is insufficient.



There is no continuity in a Lower part in Main Hoop Bracing Support.

Monocoque Improper Case

Area applicable to Front Hoop Bracing



If the part corresponding to Front Hoop Bracing of the Monocoque structure is cut to fix the damper as in the above CAD diagram, Front Hoop Bracing is cut in the pipe frame diagram below.
Therefore, this layout is not allowed.

Front Hoop Bracing is missing