

# Differences between MAX Combination Load Case and the Maximum Value Reported by the Restraint Summary (or Code Compliance) Report.

Intergraph CAS

Nadia Strikovski

There is often a misunderstanding of the way CAESAR II calculates or combines the loads/stresses for the MAX combination load case and the values reported on the “max” line of the Restraint Summary report.

## Restraints

The “Maximum combination” load case selects the maximum load on each of the modeled restraints from all the selected load cases. If there is more than one restraint defined at a node (e.g., on the same node there could be 2 restraint types: rigid Y w/friction, and rigid Z w/friction), then each restraint type is calculated and evaluated individually. CAESAR II considers each restraint component/type separately and picks the highest load among them, as well as from all the specified component load cases. Thus, the “Restraints” report for “max combination” case would have largest magnitude loads (saving the sign) for different restraint types from all specified load components at a node. For example, at some node the max load  $FX=-11\text{kN}$  that came from L3 for Y-restraint (friction component) and  $FX=3.5\text{kN}$  that came from L1 for Z-restraint (friction component).

If you then use the “Restraint Summary” report for that same “max combination” load case, the loads from different restraint types for each degree of freedom simply sum together at the same node, whether they occur on the same restraint type or not, and whether they belong to the same load case or not. The “Maximum combination” load case does not keep track of where its loads came from. Thus, the “combined” load from the above example would be  $FX=(-11\text{kN}+3.5\text{kN})=-7.5\text{kN}$ .

On the other hand, the “MAX” line on the “Restraint Summary” report simply displays the “max” value from all the lines shown in this particular report; again, it does not discriminate against the load case types or types of loads. So for the above example, the value would be 11kN.

Therefore we suggest the use of the “Restraints” report instead of the “Restraint Summary” report for combination methods such as max/min if you have more than one type of restraint at a single node.

If you want to make sure that loads of opposite sign don’t cancel each other on the “Restraint Summary” report, you should run the load case using the “SignMax” summation convention, and possibly add a second load case using the “SignMin” convention to cover the range.

## Stresses

This is the way the software and this feature is designed to work: the “max” combination just lists the maximum value from included load cases for all calculated fields; it does not consider which load case or stress type the reported value came from. So, for the “code stresses” it picks the maximum code stress for the node from all selected load cases, and for “allowables” it picks the max allowable; and it is very possible that these values will not be correlated. This is especially prominent when using “MAX combination” on different types of stresses (such as SUS and EXP) or for the offshore piping codes where three stresses are calculated and only the worst case stress and allowable are reported per node.

The “percent” is not a stored value; it is calculated on the fly.

The user documentation states that “MAX would typically be used to report the greatest restraint loads among a selected set of load cases”. While this combination method can be applied to any load case/ field, it does not really make much sense for stresses. Different load cases (stress types) have different calculation formulas for stresses, different failure criteria; and the report does not list the load case where the max value came from. It’s similar to checking displacements for EXP case – each load case and any results require a human “validity” check.