Discontinuous Edges and Surfaces
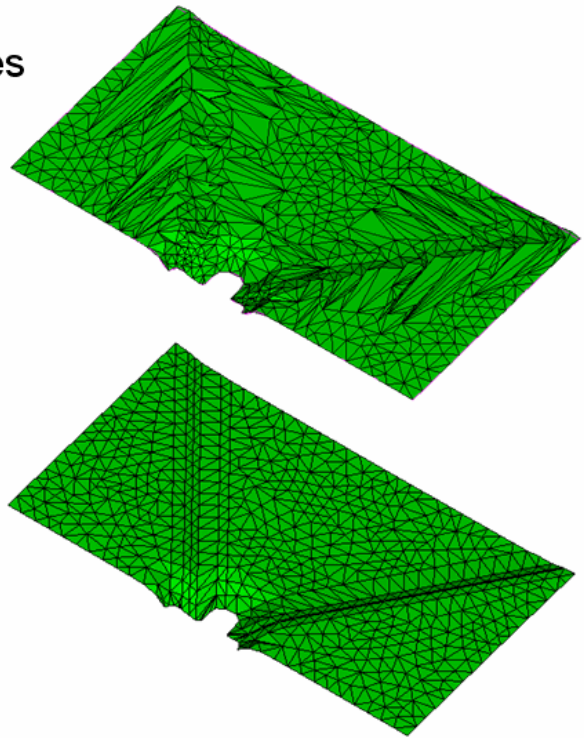
- Badly parameterized surfaces
    - Rejected in translation
    - Split and topology destroyed
    - Potential meshing problems
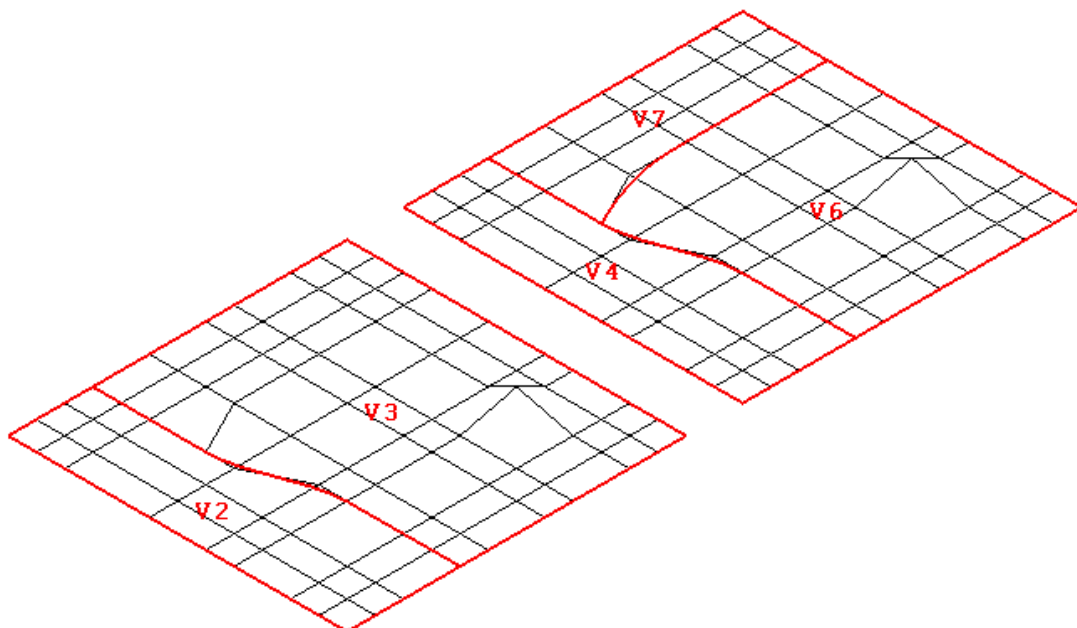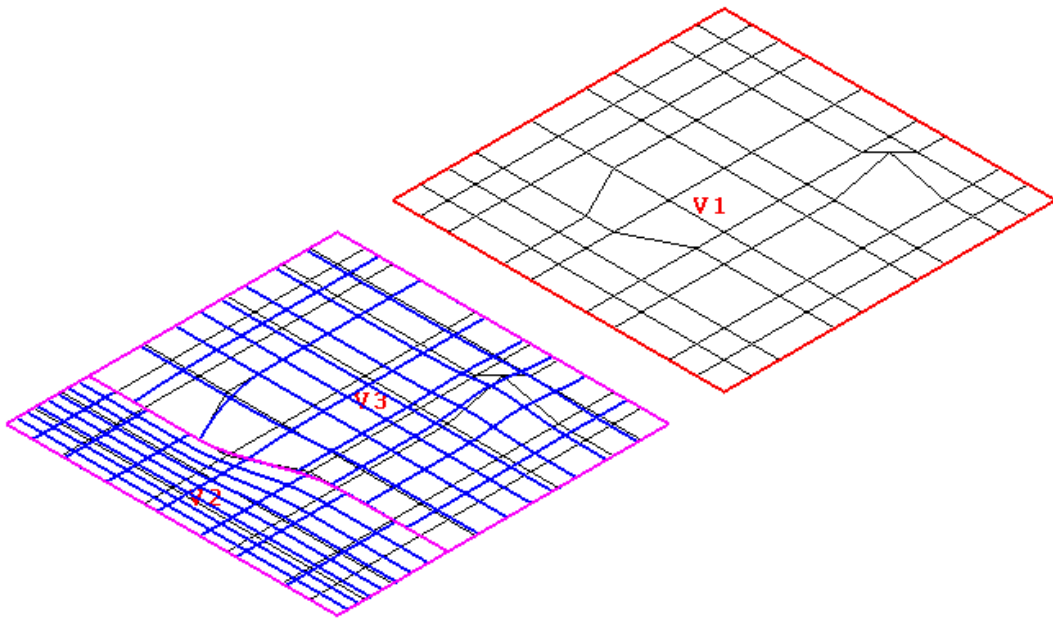- Correction options
    - Split surface
    - Adjust parameterization
    - Conversion to analytic
    - Replace with approximation
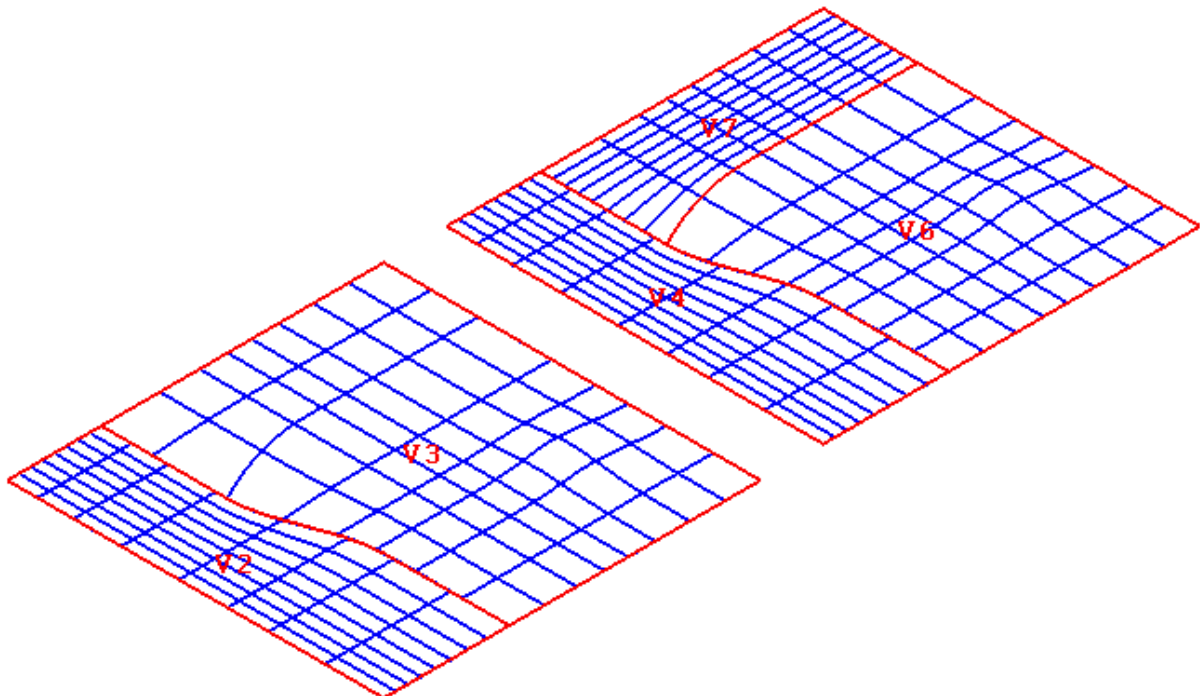
Detecting Kinks in NURBS Surfaces:

Here are a couple of items that, I hope, will explain, a little, the problem of discontinuity in surfaces. The problem can be related back to edges also on a simpler scale.

The top image is a slide that shows the problems caused by discontinuity or bad parameterisation of a NURB. Other CAD systems can have problems when they attempt to split the faces were topology can go missing and in other cases this can cause problems for those wishing to do analysis as free meshing algorithms can be badly affected. The slide also lays down a few methods that can be used in CADfix to get rid of this problem.

With the use of the Complexity Tools or Wizard Prepare option for discontinuity CADfix would normally either re-adjust the parameterisation were possible (thus leaving the face whole) or in the case of the example given split the face.

After the discontinuity fix has been applied with a rate factor of 3.0 the face will be split into two. If a rate factor of 1.4 is applied the face will be split into three. Unfortunately there is no specific way of displaying or seeing the discontinuity problem in CADfix because it is in the parameterisation of the NURBS itself.

A kink in a NURB can only happen where there is a potential slope discontinuity, and for this to happen, there must be a knot multiplicity of the NURBS degree or more. At such a multiplicity, there may be a genuine slope discontinuity, in which the surface must be split.

On the other hand, the slopes at the multiplicity may be collinear, in which case the user will be happy to have the multiplicity removed if the shape of the surface is not affected by more than the given tolerance. A test is made to check whether the control points at a potential kink are within a user specified tolerance of the knots. If this is the case then it is judged that removal of the control point(s) and the multiplicity can be achieved without affecting the position of the curve.

You may also be interested in pseudo-kinks, where the ratio of the tangent lengths across the multiplicity exceeds some given FACTOR. When this happens, you may also want the surface to be split. The tangent length either side of a kink is the parameter span length divided by the real span length. Dividing these numbers by each other across their multiplicity gives the "discontinuity rate". Typically the rate factor for IDEAS Master Series NURBS needs to be 1.4. If the NURBS surface has equally spaced and matching ratios along opposite sides (i.e. parallel distributions of knots) it may be possible to re-parametize the knots thus maintaining the single surface. Otherwise it will be necessary to split the surface.