Which board analysis is right for your board?

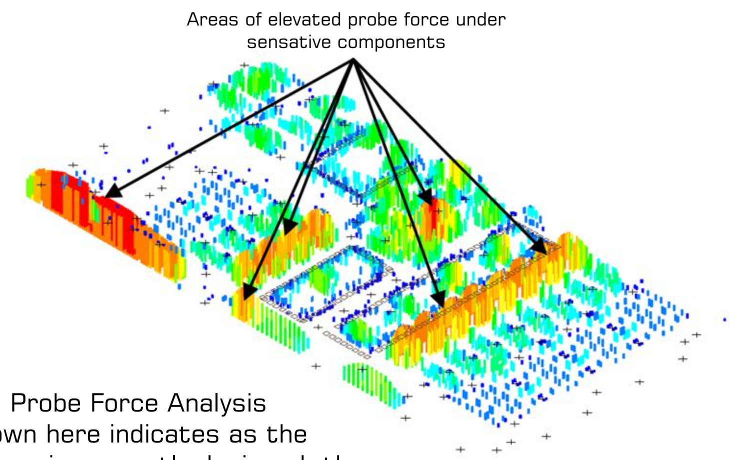
As circuit boards become more densely populated with components the need for test locations also increases. It is difficult for PCB designers to get one test point per net, much less having to design locations for board pushdowns and supports. Signals are rarely fanned out away from the BGAs, so engineers are left asking "Is my circuit board exposed to high levels of strain during test"? Are solder joints and components at risk of being fractured?

What services are available from CCI to prevent damage during test?

- **Probe Force**
- **Finite Element**
- **Strain Gage Testing**

Probe Force Analysis is a visual design tool not requiring the extensive modeling and computing time associated with Finite Element Analysis. Components and other board features are not modeled, resulting in probe forces being overstated. High probe force areas are quickly identified, allowing engineers to proactively place pushdown features and change probe spring forces to reduce possible board flex.

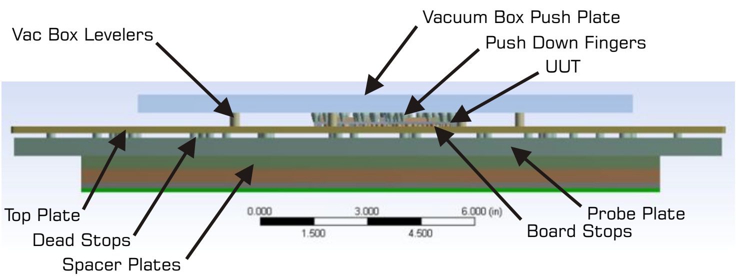
Example of Probe Force Analysis



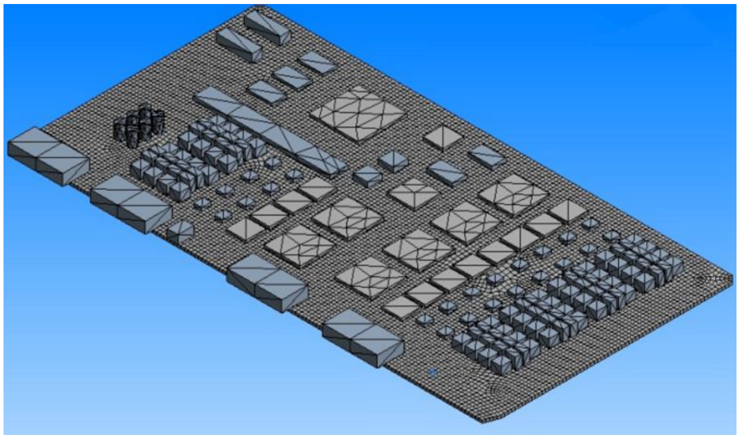
The Probe Force Analysis shown here indicates as the fixture is currently designed, the probe forces will be elevated under BGAs.

3D Finite Element Analysis is a method to mathematically analyze a model of the test fixture and PCB by dividing it into thousands of smaller pieces called elements. FEA provides **proactive results** when used during the fixture design process. Excessive strain that would be caused by probe forces can then be easily **pin pointed** and addressed.

3D FEA Fixture Model



3D FEA PCB Model



Why all of the modeling? The PCB and fixture are modeled in 3D, since stress and strain are not uniform on all surfaces as in a 2D model. The increased accuracy of 3D FEA allows for precise changes to the fixture during fabrication, resulting in a reduced amount of strain applied to the PCB.

The 3D model simulates the different contact types, frictionless and bonded. **Frictionless** - allows modeled parts to act as independent parts, simulating motion between the PCB surface and the fixture's pushdown features (push fingers, BGA stilts, push blocks).

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Finite Element Analysis (continued) and Strain Gage Testing

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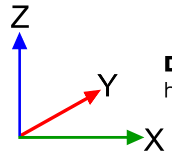
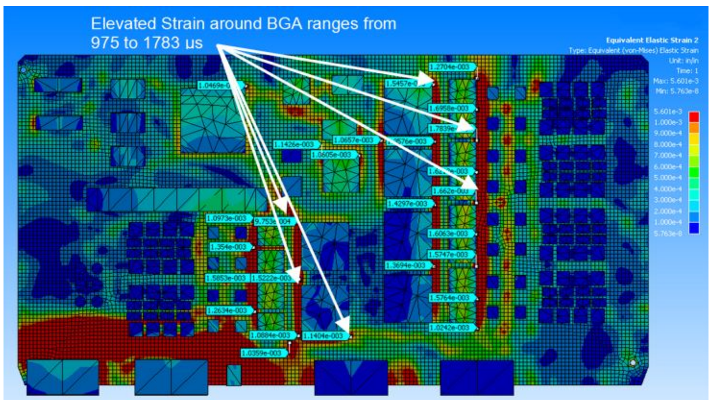
The **Bonded** modeled parts act as a singular unit like most of the primary fixture plates and all contact pairs that are not modeled as frictionless.



Degree of Freedom (DoF) each node of the model has 3 degrees of freedom.

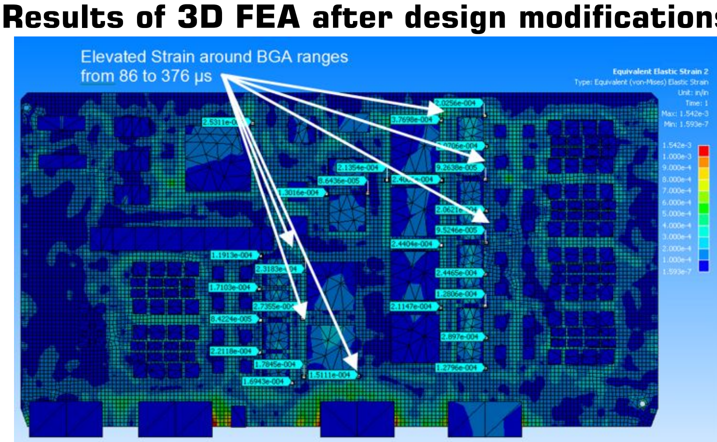
This is important when modeling the fixture; it allows features to slide (nonlinear) on the PCB surface, or loose surface contact as in the actual fixture.

Results of the 3D FEA



The initial 3D FEA results pin point strain levels over 1700μs, which easily exceeding the customer's 500μs limit. CCI **re-engineers** the fixture's PCB support system **during** the **design process** until the FEA returns **acceptable results.**

Results of 3D FEA after design modifications



Strains are reduced by increasing the number of pushdown features and adding pushdown blocks over the connectors.

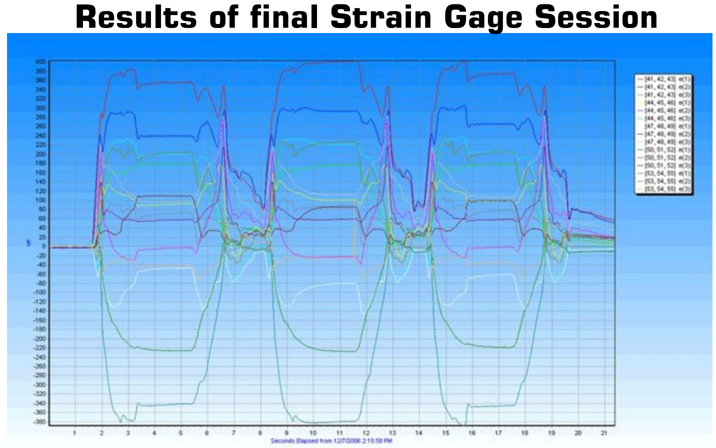
Strain Gage Testing is the actual measurement of strain at discrete points on the PCB while actuating the test fixture. Measurements are taken from sensors called "rosettes" which are mounted to the PCB. A scanner is connected to the rosettes that can take measurements from 2,000 to 10,000 cycles per second.

Components may have to be removed to permanently mount the rosettes to a mechanical sample of the PCB.

Correctly mounted rosettes

In this sample test the initial results of the strain gage test indicate levels above 1100μs, which are unacceptable by industry standards.

Results of final Strain Gage Session



After mechanical fixture modifications to the pushdown and support structure are made, a second strain gage session is performed. The strain gage results are now below 400μs which are well within the current **IPC/JEDEC 9704 standards.**

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