BETA
SIMULATION SOLUTIONS

Semiconductor Manufacturing International Corporation

Chip-Package Interaction stress modeling time reduction using ANSA

An efficient automated process for modeling bump cells, and for creating a global simulation model.

Photo by Alexandre Debiève on Unsplash

Chip-Package Interaction stress is the mechanical instability caused by thermo-mechanical stress buildup. This instability results from the coefficient of thermal expansion mismatch between the silicon and the substrate during the flip chip assembly process.

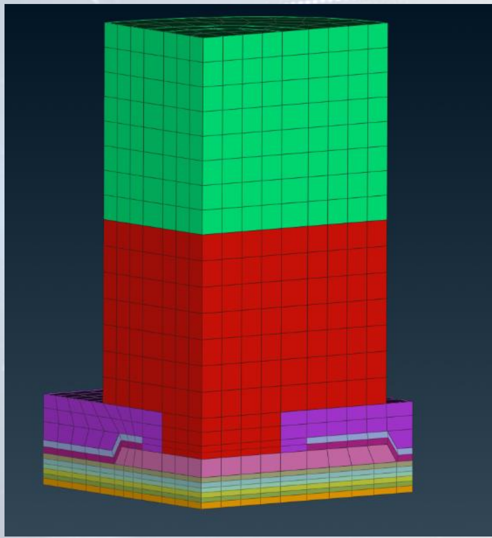
Being of critical importance for the performance of flip-chip packaging, engineering simulation is employed to alleviate reliability risks.

Modelling CPI stress, however, is a highly complex process. It involves a vast amount of bump cells, each requiring specific modelling treatment to accomplish the required quality levels for the simulation. This makes the buildup of the global model a complex and time-consuming process.

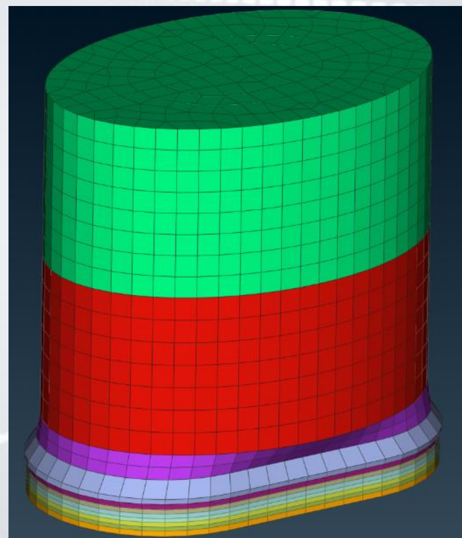
BETA CAE Systems China, in close co-operation with Semiconductor Manufacturing International Corporation (SMIC), developed a python script that enhances the capabilities of ANSA to address and handle these issues effectively and efficiently.

“This cooperation achieved a complete and almost automated process for preparing Chip Package simulation models with complex geometrical characteristics.
By empoloying the ANSA pre-processor we were able to drop modeling time from 2 days to less than 30 minutes.”

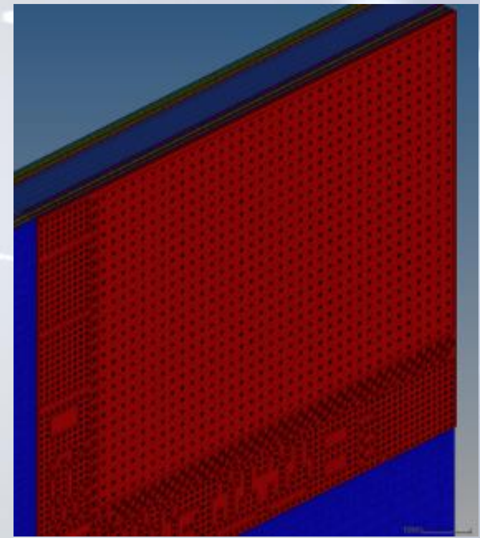
Liu Bo
R&D Senior Engineer
SMIC



Bump Cell Cross-section



Bump Cell



Chip Package

Challenge

The objective was to reach the maximum possible automation level and minimize the manual work when building the global model for CPI stress modelling. Such manual work involves multiple tedious tasks including geometry cleanup, shell meshing, extruding layers, pasting nodes, grouping materials, and more.

In this effort, rough patches were:

- The complex geometry.
- Solid mesh consisted of Hexahedral elements.
- The geometric clean up.
- The model size.

Approach

Starting from a single bump cell, a hexahedral mesh is generated, employing ANSA's pre-processor advanced meshing tools, preserving its intricate geometry features. This becomes the input file of a script.

With the aid of available ANSA APIs, the script was written to perform the following tasks. First, the previously prepared bump cell was copied to each position according to a coordinate list. Each bump cell mesh was projected to the substrate multi-layer and BEOL (Back End of Line) layers. Same time, the mesh is reconstructed accordingly to meet the mesh parameters and quality criteria given by the user. Continuing, all remaining layers were created using extrusion algorithms according to a given dictionary. This dictionary contains the information for each layer to be generated (name, thickness, position).

Results

Modelling and assembly can now be performed automatically. The script runs also in No-GUI mode, enabling the user to run it on a HPC server.

This allows the engineering team to test various designs using only a fraction of the time that was previously needed and same time eliminate the manual work needed.

Semiconductor Manufacturing International Corporation (SMIC) has achieved an overall time reduction of more than 97% by using ANSA, instead the alternative software tools.

For more about BETA CAE Systems, visit www.beta-cae.com