

SHEET METAL VALIDATION SYSTEM

A PRE-MANUFACTURING QA FRAMEWORK
FOR CAD AUTOMATION

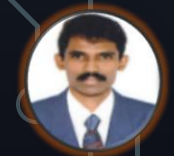


Ramu Gopal
CAD Automation | AI Systems Developer

PROBLEM STATEMENT

The Challenge in Sheet Metal Design

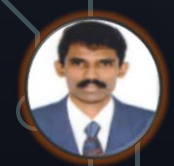
- 1 Errors often detected late in workflow
- 2 Manual validation is still common
- 3 High dependency on designer experience
- 4 Leads to rework, delays, and cost increase



COMMON ISSUES

Typical Engineering Errors

- 1 Incorrect Bend Deduction (BD)
- 2 Improper Bend Allowance (BA)
- 3 K-factor inconsistency
- 4 Feature-level design errors
- 5 Flat pattern mismatch



CURRENT APPROACH LIMITATION

Why Traditional Validation slow & Fails

1

Largely manual or semi-automated inspection, high-cost tool

2

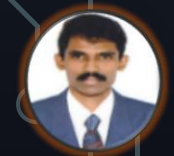
Reliance on manual calculations and experience-based

3

Lack of standardized, automated validation systems

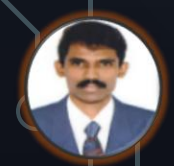
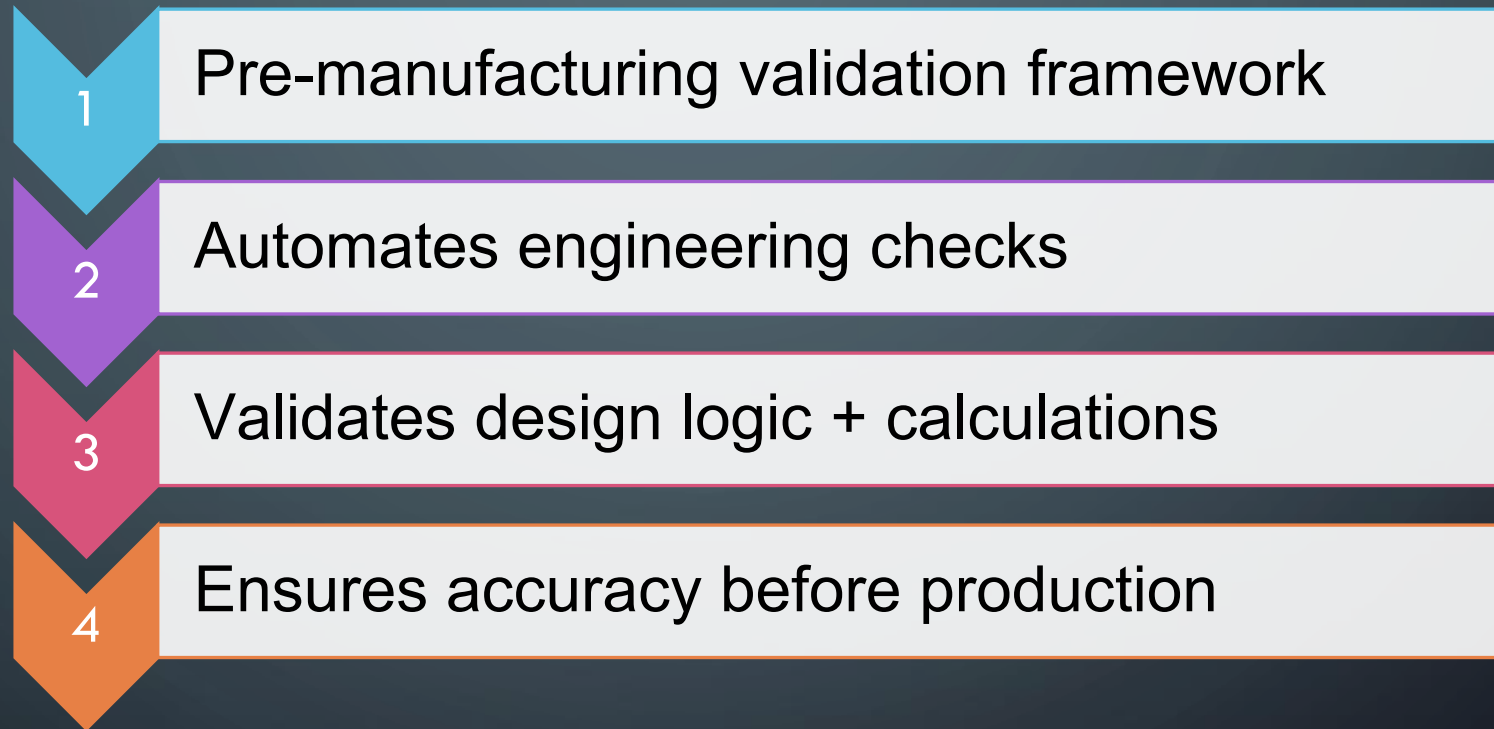


Leads to inconsistency, delayed detection, and potential errors



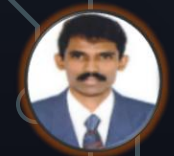
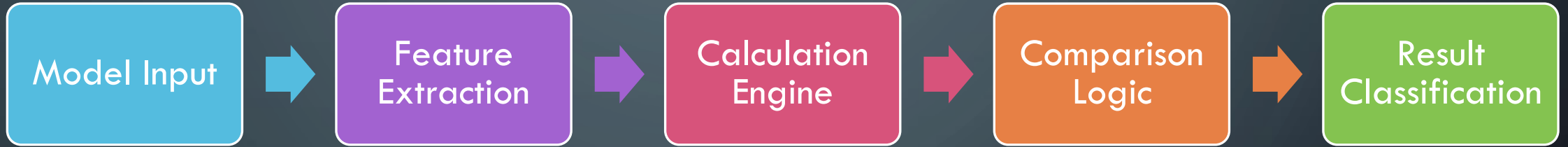
SOLUTION OVERVIEW

Introducing Sheet Metal Validation System



SYSTEM WORKFLOW

Validation Workflow



SYSTEM INITIALIZATION

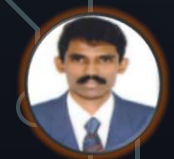
- Detects if no model is open
- Prevents incorrect execution
- Ensures safe workflow start
- Displays system status clearly

The screenshot displays the 'Sheet Metal Validator 1.0' application window. The title bar includes the text 'Sheet Metal Validator 1.0' and a close button. The main content area is titled 'Sheet Metal Validator' and is divided into several sections:

- Basic Details:** A panel containing fields for 'ID : No active document', 'Check By :', 'State : Checked-In', 'Rev : X1', 'Type : Sheet Metal', and 'Description : Metal Tray with Perforated'.
- Model:** A section with a dropdown menu currently showing '|||'.
- Model Summary:** A panel with fields for 'Material :', 'Default Bend Radius :', 'Thickness :', 'Active Configuration :', 'K-Factor:', and 'Drawing Available :'.
- Result Summary:** A panel with fields for 'Total Bends :', 'Passed Bends :', and 'Failed Bends :'.
- Feature Summary:** A table with columns: 'Feature', 'Type', 'B.Radius', 'Angle', 'Calculated BD', 'Model BD', and 'Deviation'. The table body is currently empty.

At the bottom of the interface, there are four buttons: 'Run Check', 'Report', 'Clear', and 'BD Calculator'. A status bar at the very bottom shows 'Status: No document open' on the left and 'Last Run: ...' on the right.

Intelligent System Initialization



MODEL RECOGNITION

- Detects active sheet metal model
- Initializes validation environment
- Prepares feature extraction
- Ready for validation

Sheet Metal Validator 1.0

Sheet Metal Validator

Basic Details

ID : Sheet Metal Tray.SLDPRT Check By : Ramu Gopal State : Checked-In Rev : X1

Type : Sheet Metal Description : Metal Tray with Perforated

Model

Model Summary

Material : Default Bend Radius :

Thickness : Active Configuration :

K-Factor : Drawing Available :

Result Summary

Total Bends :
Passed Bends :
Failed Bends :

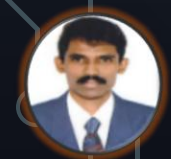
Feature Summary

Feature	Type	B.Radius	Angle	Calculated BD	Model BD	Deviation
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Run Check Report Clear **BD Calculator**

Status: Model loaded Last Run: ...

Model Recognition & Pre-Processing



CALCULATION ENGINE

- Supports BD / BA / K-factor inputs
- Applies engineering formulas
- Computes expected bend values
- Combines theory with practical validation

Sheet Metal Validator 1.0

Sheet Metal Validator

Basic Details

ID : Sheet Metal Tray.SLDPRT Check By : Ramu Gopal State : Checked-In Rev : X1
Type : Sheet Metal Description : Metal Tray with Perforated

Model |||

Model Summary

Material : Plain Carbon Steel Default Bend Radius : 0.09 in
Thickness : 0.063 in Active Configuration : Default
K-Factor : 0.5 Drawing Available : NO

Result Summary

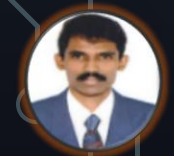
Total Bends : 4
Passed Bends : 3
Failed Bends : 1

Feature Summary

Feature	Type	B.Radius	Angle	Calculated BD	Model BD	Deviation
<input type="radio"/> Sheet-Metal1	Default	0.	0.	0.	0.	OK (0.)
<input type="radio"/> Base-Flange1	Default	0.09	0.	0.	0.	OK (0.)
<input type="radio"/> Edge-Flange1	Deduction (BD)	0.09	0.	0.	0.	OK (0.)
<input type="radio"/> EdgeBend1	Deduction (BD)	0.09	90.	0.115	0.115	OK (0.)
<input type="radio"/> Edge-Flange2	Deduction (BD)	0.09	0.	0.	0.	OK (0.)
<input type="radio"/> EdgeBend2	Deduction (BD)	0.09	60.	0.049	0.049	OK (0.)
<input type="radio"/> EdgeBend3	Deduction (BD)	0.09	60.	0.049	0.049	OK (0.)
<input type="radio"/> Edge-Flange3	Deduction (BD)	0.09	0.	0.	0.	OK (0.)
<input type="radio"/> EdgeBend4	Deduction (BD)	0.09	90.	0.115	0.3	NOT OK (0.185)
<input type="radio"/> Flat-Pattern1	Default	0.	0.	0.	0.	OK (0.)

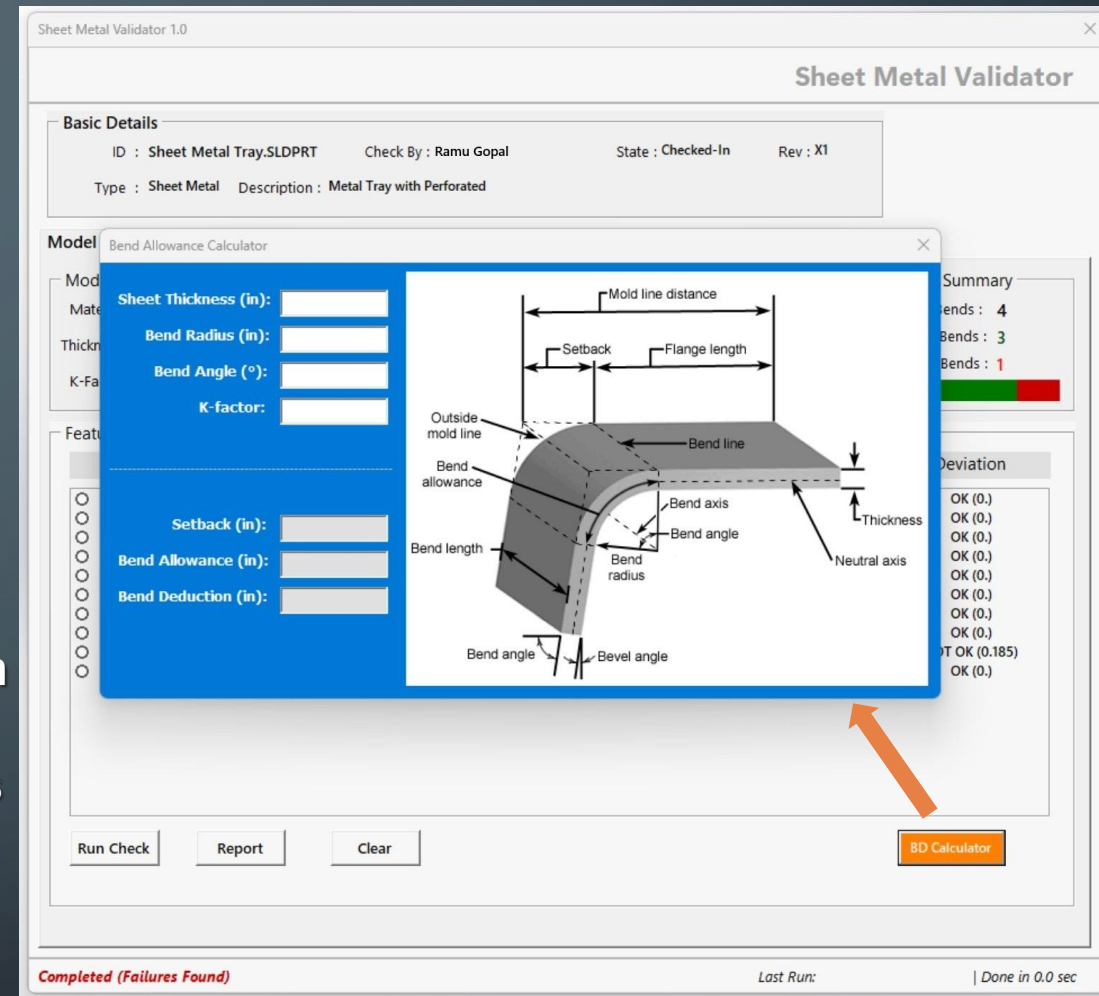
Completed (Failures Found) Last Run: Done in 0.0 sec

Integrated Bend Calculation Engine

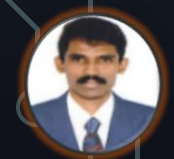


ENGINEERING FOUNDATION & INBUILT CALCULATION ENGINE

- Built on real sheet metal bend theory
- Integrates geometric, material behavior
- Includes inbuilt bend calculator, for verification
- Computes Bend Allowance and Bend Deduction
- Validates engineering logic, not just data values



Combines engineering theory with inbuilt calculation and automated validation



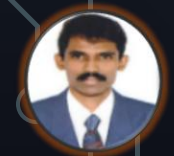
FEATURE VALIDATION

Feature Summary

	Feature	Type	B.Radius	Angle	Calculated BD	Model BD	Deviation
<input type="radio"/>	Sheet-Metal1	Default	0.	0.	0.	0.	OK (0.)
<input type="radio"/>	Base-Flange1	Default	0.09	0.	0.	0.	OK (0.)
<input type="radio"/>	Edge-Flange1	Deduction (BD)	0.09	0.	0.	0.	OK (0.)
<input type="radio"/>	EdgeBend1	Deduction (BD)	0.09	90.	0.115	0.115	OK (0.)
<input type="radio"/>	Edge-Flange2	Deduction (BD)	0.09	0.	0.	0.	OK (0.)
<input type="radio"/>	EdgeBend2	Deduction (BD)	0.09	60.	0.049	0.049	OK (0.)
<input type="radio"/>	EdgeBend3	Deduction (BD)	0.09	60.	0.049	0.049	OK (0.)
<input type="radio"/>	Edge-Flange3	Deduction (BD)	0.09	0.	0.	0.	OK (0.)
<input type="radio"/>	EdgeBend4	Deduction (BD)	0.09	90.	0.115	0.3	NOT OK (0.185)
<input type="radio"/>	Flat-Pattern1	Default	0.	0.	0.	0.	OK (0.)

Feature-Level Validation Engine

- Extracts sheet metal features
- Calculates expected BD values
- Compares with model values
- Detects deviations automatically



RESULT DASHBOARD & OUTPUT CLASSIFICATION






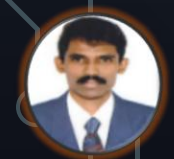
Calculated BD	Model BD	Deviation
0.	0.	OK (0.)
0.	0.	OK (0.)
0.	0.	OK (0.)
0.115	0.115	OK (0.)
0.	0.	OK (0.)
0.049	0.049	OK (0.)
0.049	0.049	OK (0.)
0.	0.	OK (0.)
0.115	0.3	NOT OK (0.185)
0.	0.	OK (0.)

Validation Summary Dashboard

- Total bends analyzed
- Passed vs Failed bends
- Visual status indicator (Green/Red)
- Enables quick decision-making

Structured Validation Output

- PASS  → Within tolerance
- WARNING  → Needs review
- FAIL  → Incorrect values



KEY BENEFITS

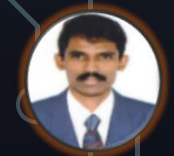
Why This System Matters

- Reduces manual checking effort
- Improves design accuracy
- Minimizes rework and errors
- Increases manufacturing confidence
- Standardizes validation process

SYSTEM IMPACT

From Tool to Engineering System

- Combines extraction + calculation + validation
- Moves validation upstream
- Reduces dependency on manual review
- Enhances engineering productivity





Thank You