Warpage Analysis Report - Legend & Terminology

STATISTICAL METRICS EXPLAINED

Basic Statistics:
• Mean: Average warpage value across all measurement points
• Standard Deviation (Std): Measure of data spread around the mean
• Range: Difference between maximum and minimum values (Max - Min)
• Min/Max: Minimum and maximum warpage values in the dataset

Process Capability Indices:
• Cp: Process potential capability = (USL - LSL) / (6σ)
  - Cp ≥ 1.33: Good process capability
  - Cp = 1.0: Minimum acceptable capability
  - Cp < 1.0: Poor process capability

• Cpk: Actual process capability considering centering
  - Cpk ≥ 1.33: Good centered process
  - Cpk = 1.0: Minimum acceptable centered process
  - Cpk < 1.0: Poor process centering or capability

Control Charts:
• X-bar Chart: Monitors process mean over time
  - Center Line: Average of all file means
  - UCL/LCL: Upper/Lower Control Limits (±3σ from center)

• R Chart: Monitors process variability (range) over time
  - Center Line: Average of all file ranges
  - UCL/LCL: Control limits for range variation

Process Stability:
• Measurement Variability (CV): Coefficient of Variation = (Std/Mean) × 100%
  - Lower CV indicates more consistent measurements

• Process Stability Score: Calculated as 100/(1 + CV/10)
  - Score ≥ 80: Good stability (Green)
  - Score ≥ 60: Fair stability (Orange)
  - Score < 60: Poor stability (Red)

Advanced Analysis:
• Hotspots: Areas where warpage exceeds 95th percentile threshold
• Local Variability: Spatial variation in warpage across the surface
• Gradient Magnitude: Rate of change in warpage values
• Contour Plots: Lines connecting points of equal warpage values
• CDF Plot: Cumulative distribution of (Max-Min) ranges across files
• Correlation Matrix: Shows relationships between different files

INTERPRETATION GUIDELINES

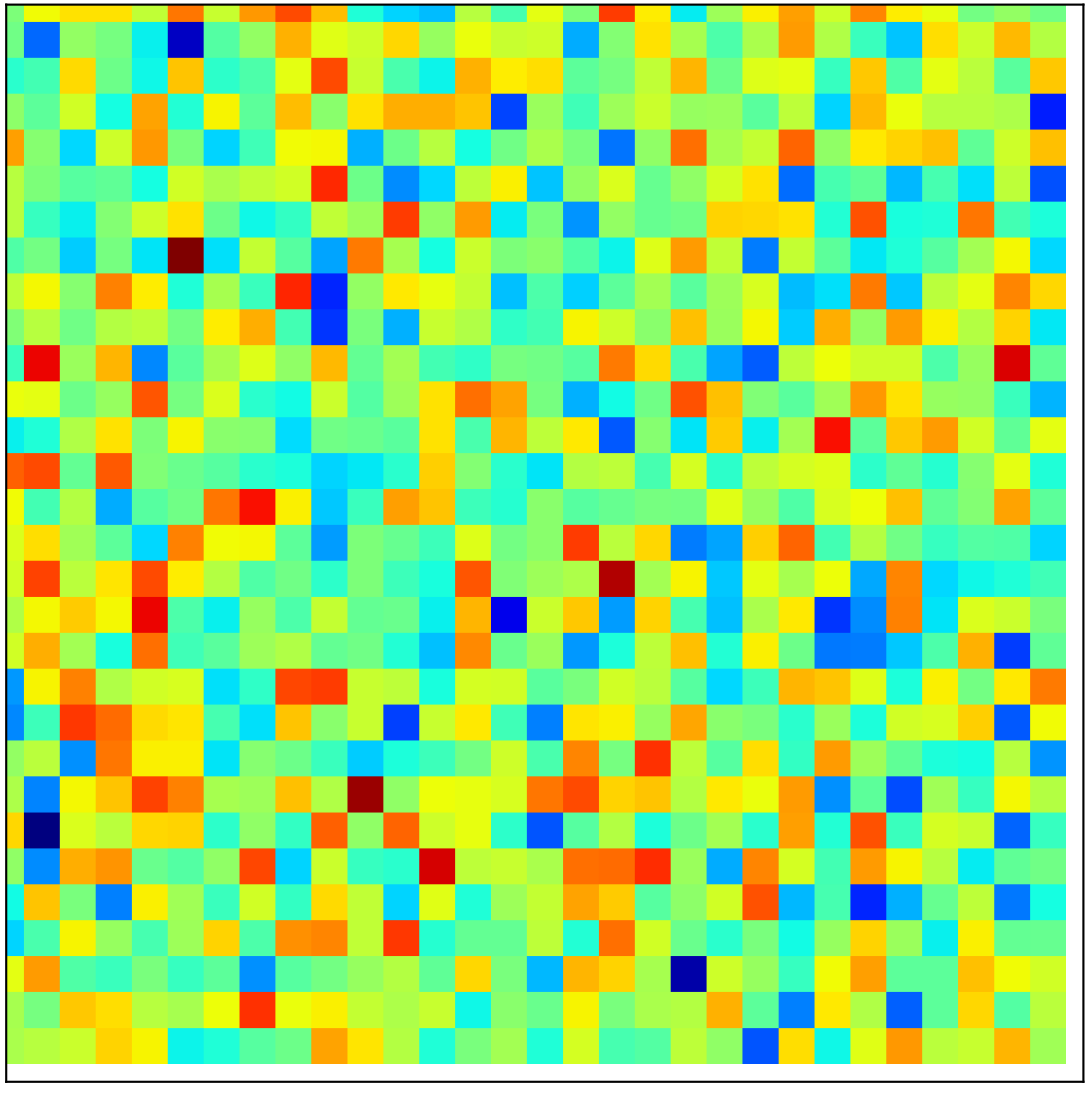
Good Process Indicators:
✓ Low coefficient of variation (CV < 10%)
✓ High stability scores (≥ 80)
✓ Cp and Cpk values ≥ 1.33
✓ Control chart points within limits
✓ Low gradient magnitude values
✓ Minimal hotspot areas

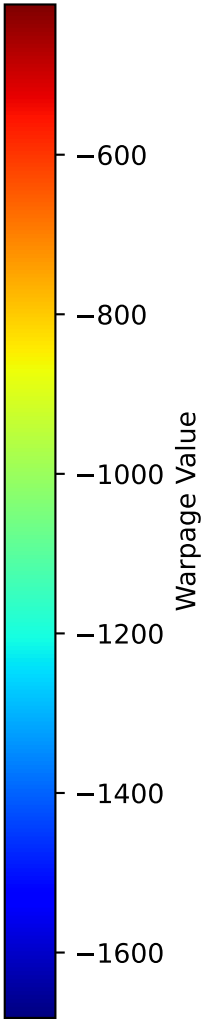
Process Improvement Areas:
⚠ High CV values (> 20%)
⚠ Low stability scores (< 60)
⚠ Cp or Cpk < 1.0
⚠ Control chart points outside limits
⚠ Large hotspot regions
⚠ High local variability

Generated by Warpage Analysis Tool v2.0
CAE Group, SiHun Lee

Shape: (30, 30)
Min: -1681.962396
Max: -411.688173
Mean: -999.350714
Std: 195.629800

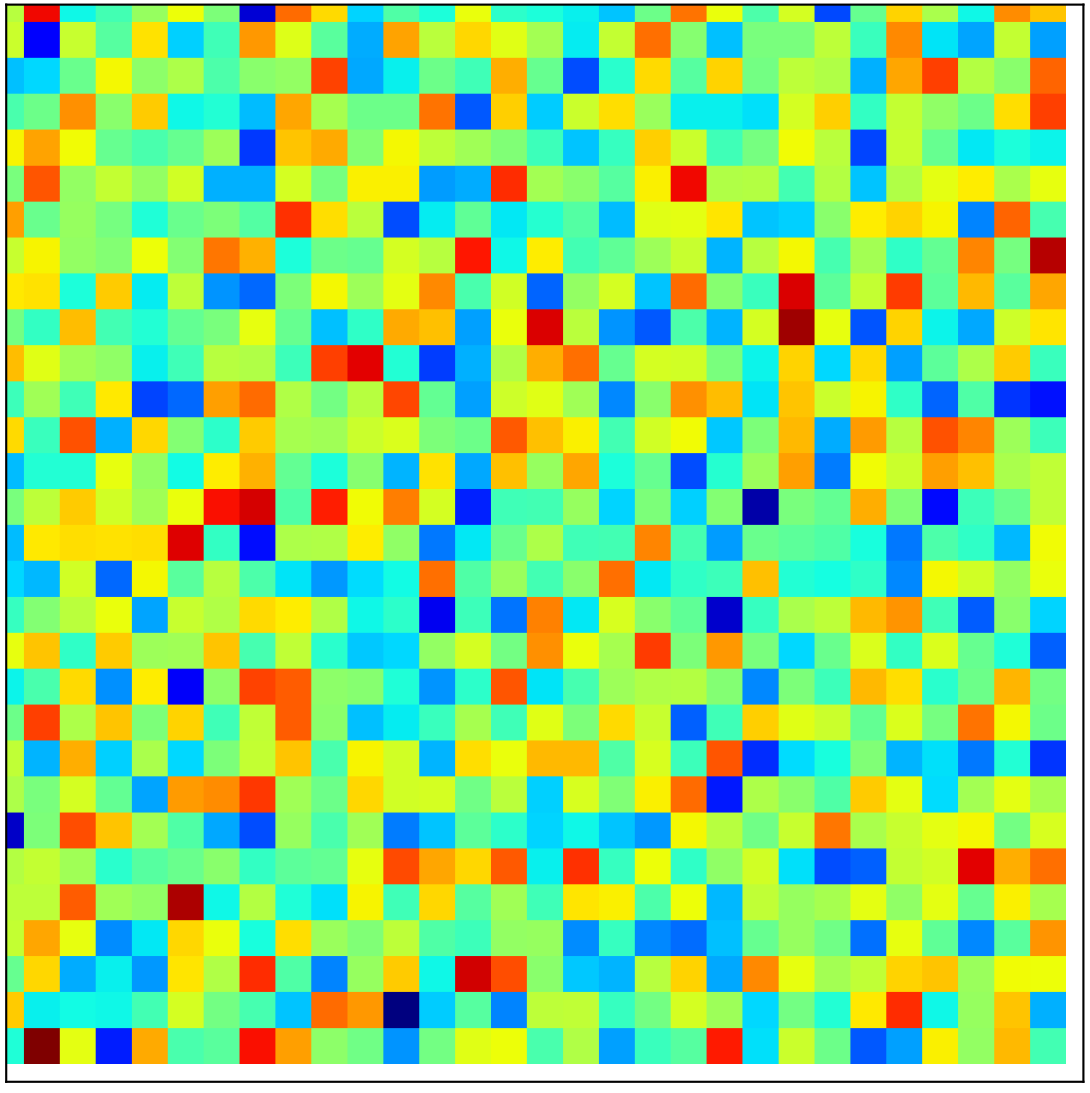
01 - test_1.txt

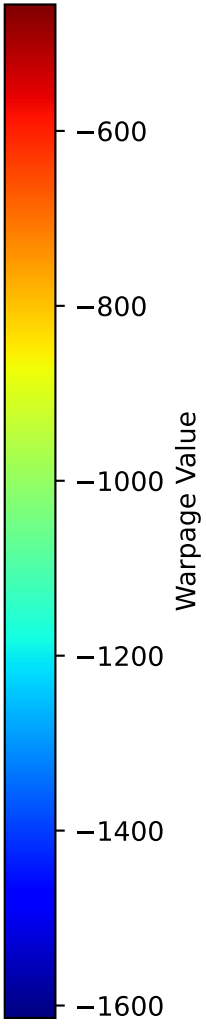




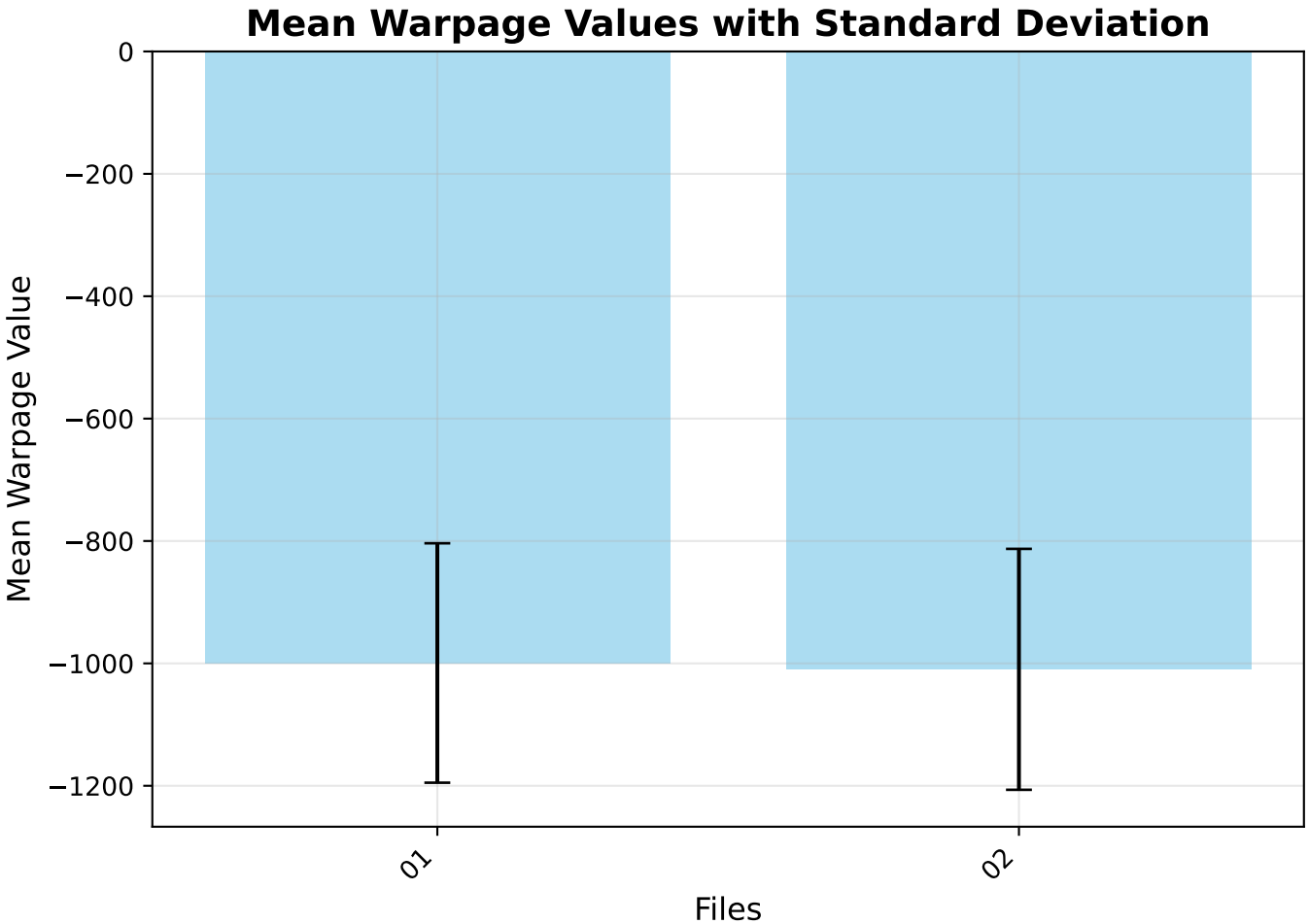
Shape: (30, 30)
Min: -1614.182329
Max: -455.418889
Mean: -1009.714241
Std: 196.862619

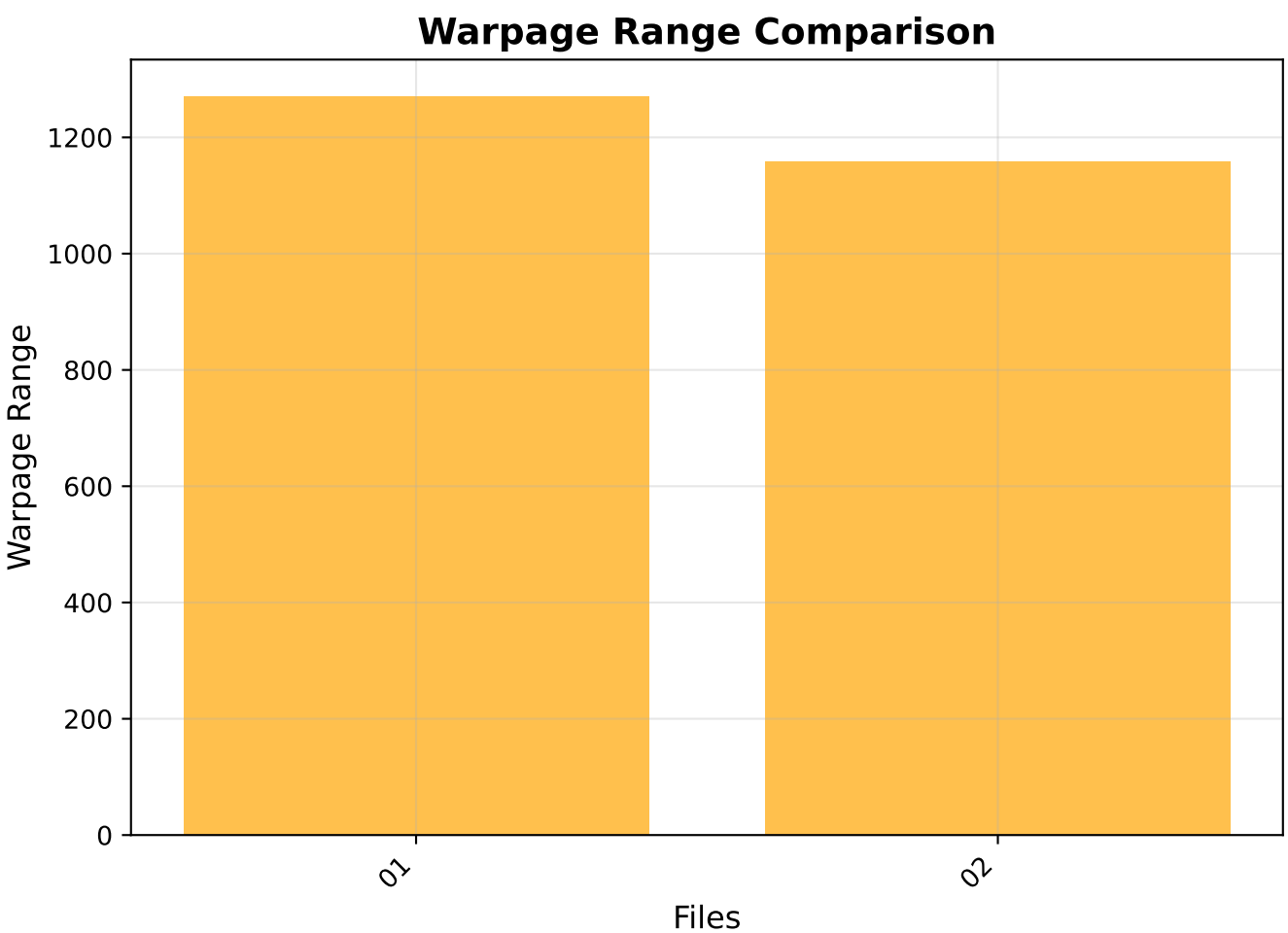
02 - test_2.txt



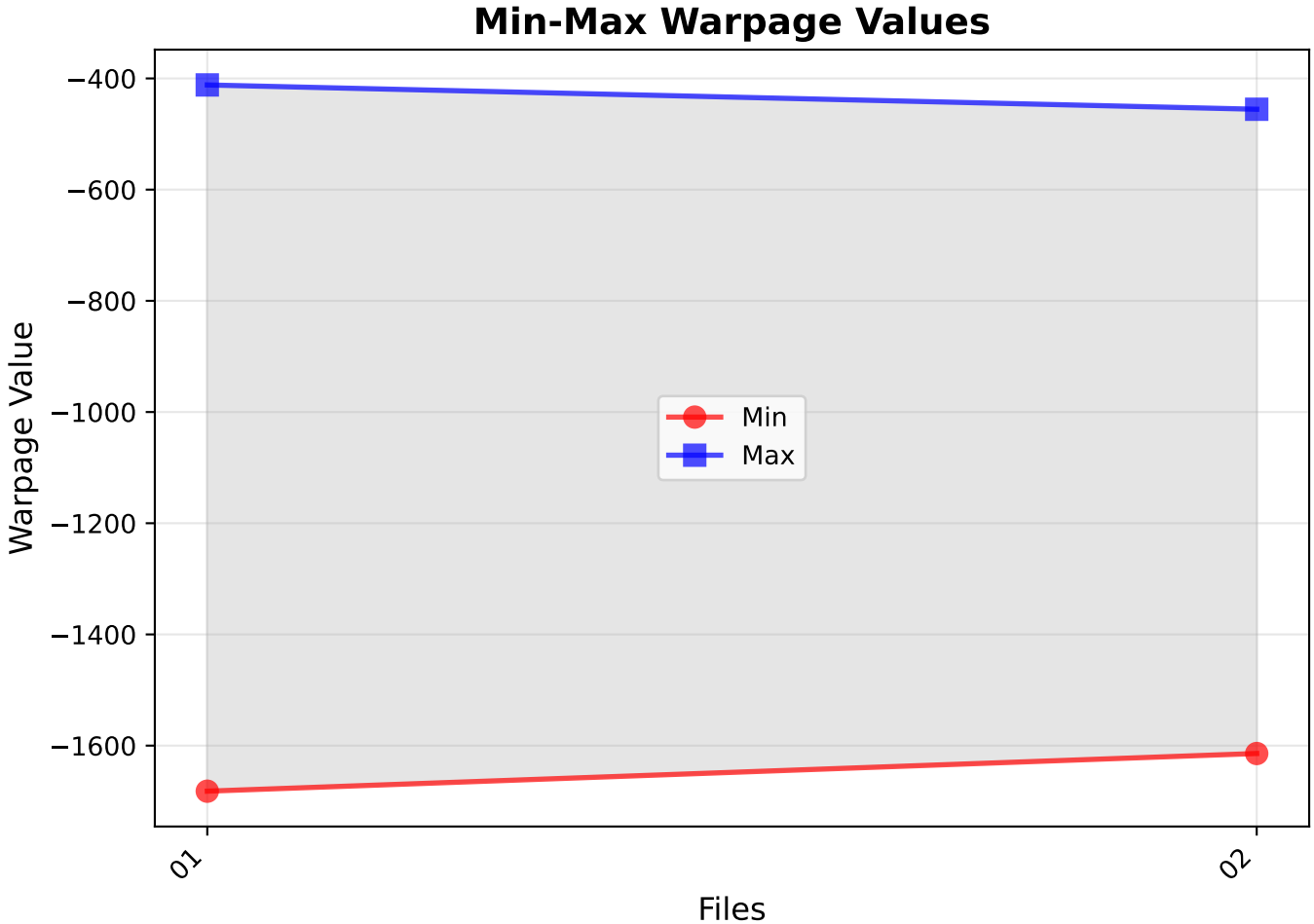


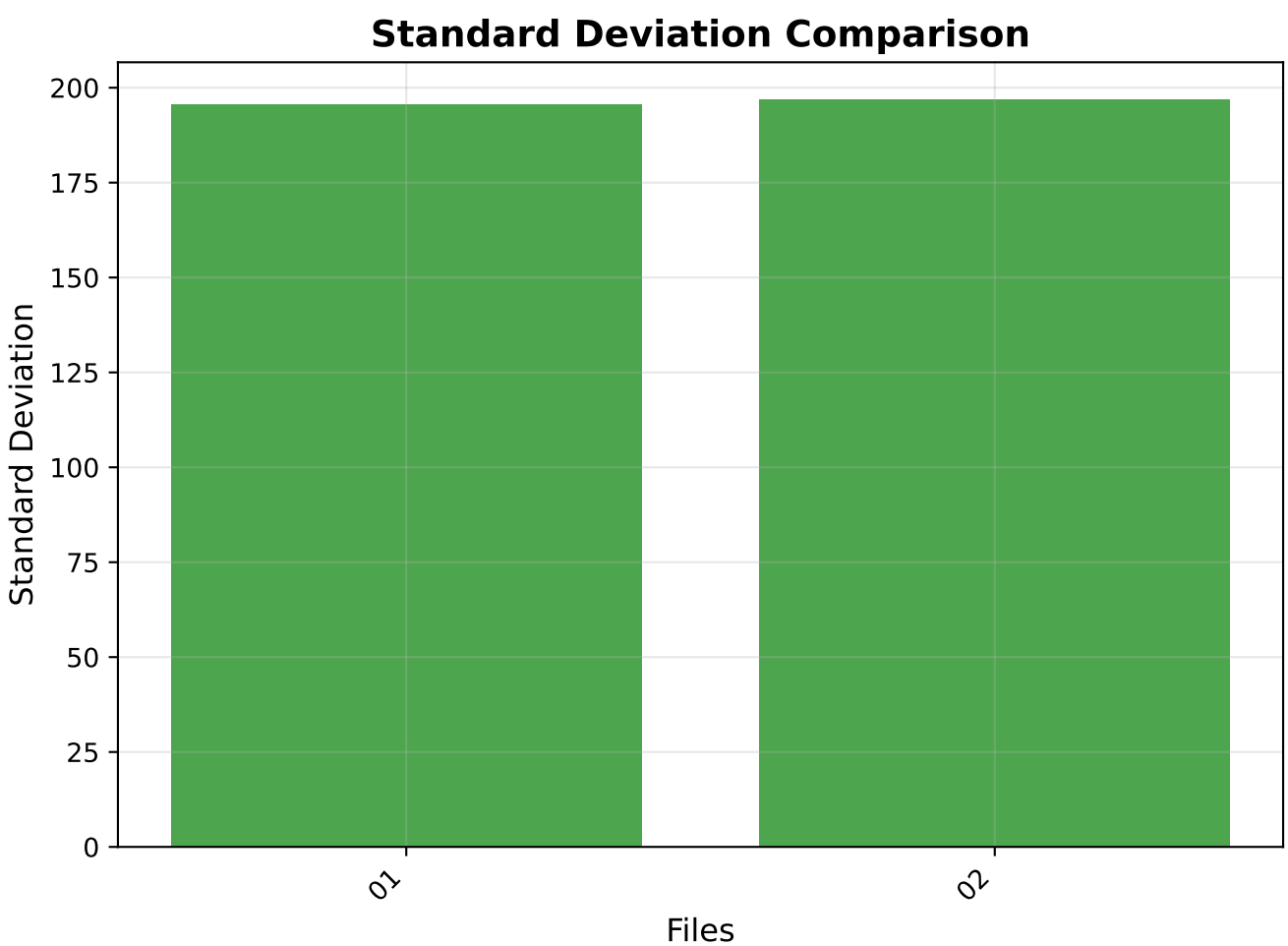
Statistical Comparison - Mean and Range





Statistical Comparison - Min-Max and Standard Deviation





Warpage Range Distribution