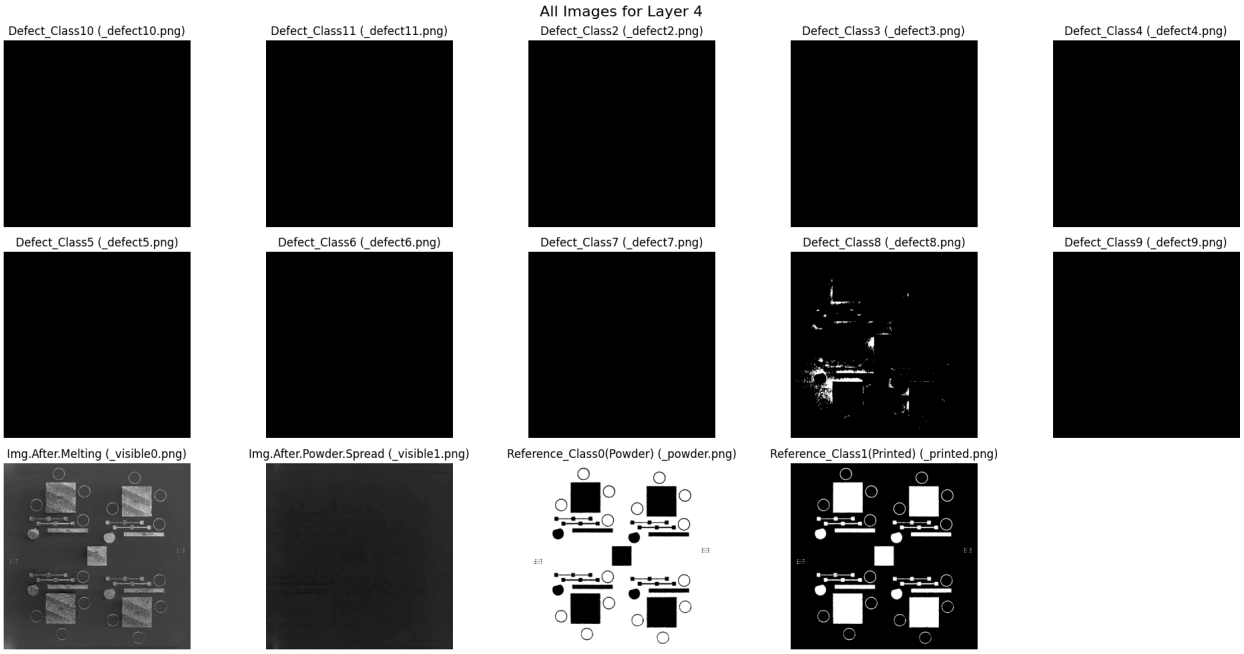
1. Visualizing sample Images



2. Pixel Intensity Analysis

1. Differentiating Between Defective and Non-Defective Areas

Pixel intensities vary between powder, printed, and defective regions.

Helps in setting thresholds to classify different defect types.

2. Identifying Defect Severity

Higher intensities (closer to white, 255) → Over-melting or recoater issues.

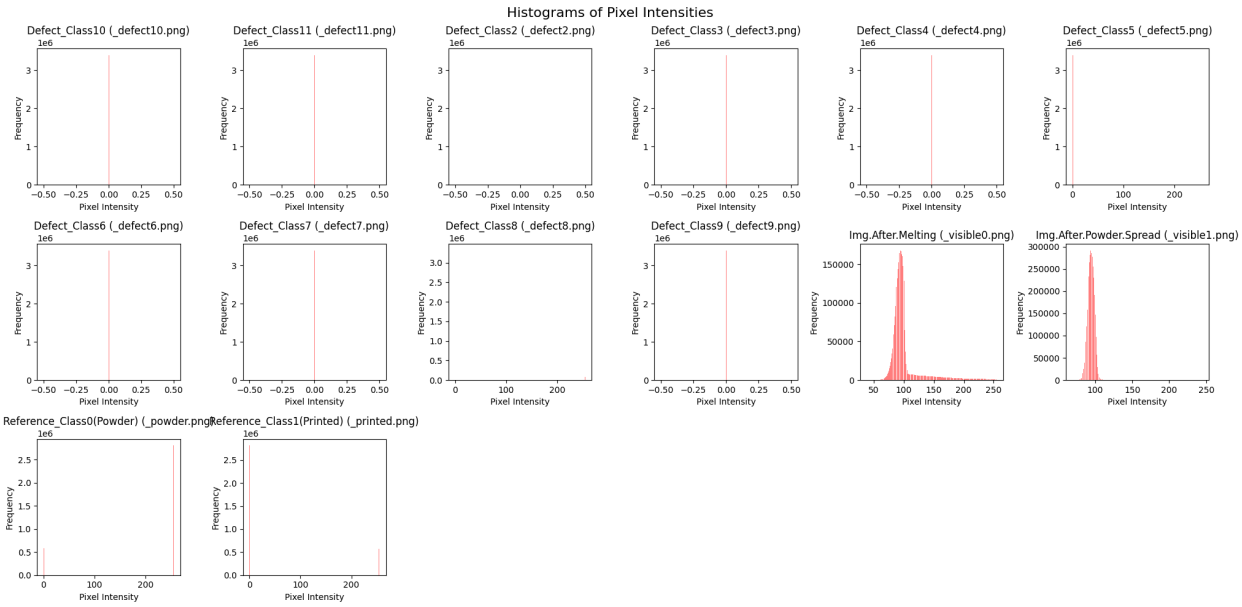
Lower intensities (closer to black, 0) → Under-melting, debris, or incomplete spread

The intensity variance gives clues about defect severity.

3. Detecting Changes Across Layers (Before & After Melting)

Helps in analyzing powder distribution consistency before melting.

Detects how defects evolve after melting.

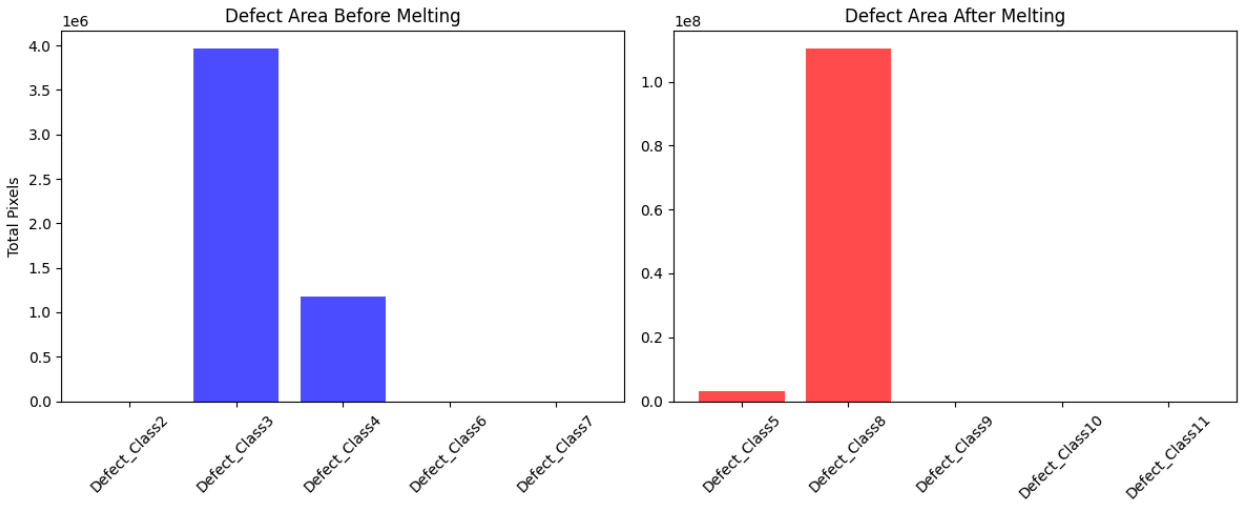


3. Defect Area Distribution Analysis

This analysis helps in understanding the **nature and severity** of defects in additive Manufacturing.

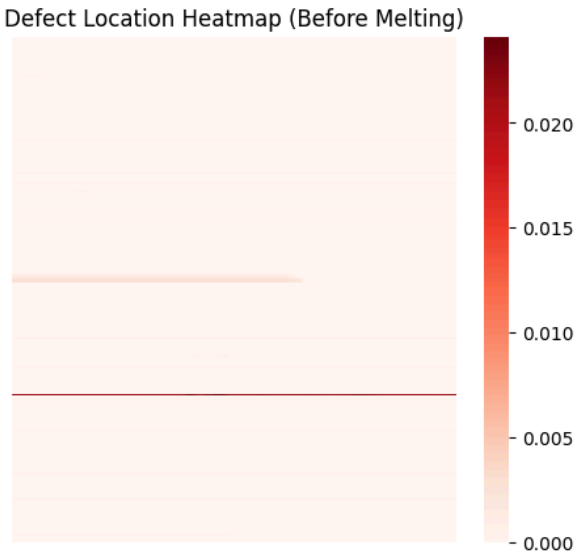
Defect Area Distribution (Before Melting):
{'/content/drive/MyDrive/Info_Project/Defect_Detection/DataSets/Processed_Data/Defect_Class2': 0,
'/content/drive/MyDrive/Info_Project/Defect_Detection/DataSets/Processed_Data/Defect_Class3': 3965232,
'/content/drive/MyDrive/Info_Project/Defect_Detection/DataSets/Processed_Data/Defect_Class4': 1175512,
'/content/drive/MyDrive/Info_Project/Defect_Detection/DataSets/Processed_Data/Defect_Class6': 0,
'/content/drive/MyDrive/Info_Project/Defect_Detection/DataSets/Processed_Data/Defect_Class7': 10}
Defect Area Distribution (After Melting):
{'/content/drive/MyDrive/Info_Project/Defect_Detection/DataSets/Processed_Data/Defect_Class5': 3021601,
'/content/drive/MyDrive/Info_Project/Defect_Detection/DataSets/Processed_Data/Defect_Class8': 110397626,
'/content/drive/MyDrive/Info_Project/Defect_Detection/DataSets/Processed_Data/Defect_Class9': 8124,
'/content/drive/MyDrive/Info_Project/Defect_Detection/DataSets/Processed_Data/Defect_Class10': 0,
'/content/drive/MyDrive/Info_Project/Defect_Detection/DataSets/Processed_Data/Defect_Class11': 0}

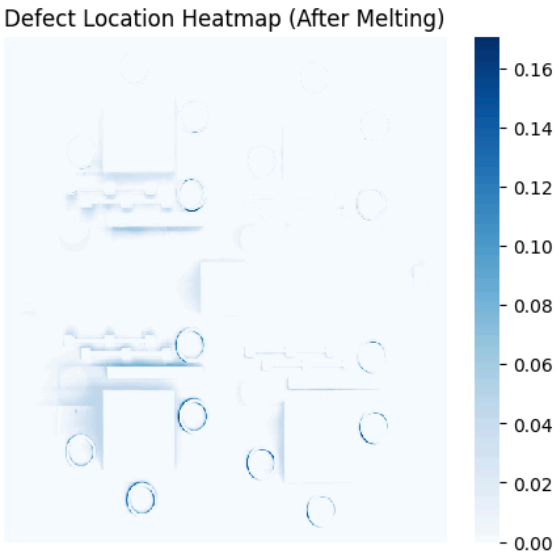
Execution Time: 36 min



4. Defect Location Heatmaps

Overlay defect masks onto the original images to visualize common defect regions.
Create a heatmap showing defect density across all images.
Execution time: 29 min





5. Defect Class Frequency Analysis

This Analysis helps determine how often each defect type occurs in the dataset.

- **Understanding Manufacturing Issues**

  >> Frequent defects can indicate underlying process issues in additive manufacturing

  >> Certain defects (e.g., recoater streaking(3), Incomplete Spreading(4)) occur more than others, it could point to equipment malfunctions.

- **Setting Priorities for Quality Control**

  >> Some defects are very rare; they may not be a major concern in quality inspection.

  Ex. Over Melting(10), Under Melting(11), Recoater Hopping(2), Debris(6), Super-Elevation(7)

  >> Helps decide **which defects require immediate attention** in real-world Applications.

  Ex. Swelling(5), Spatter(8), Misprint(9), Recoater Streaking(3), Incomplete Spreading(4)

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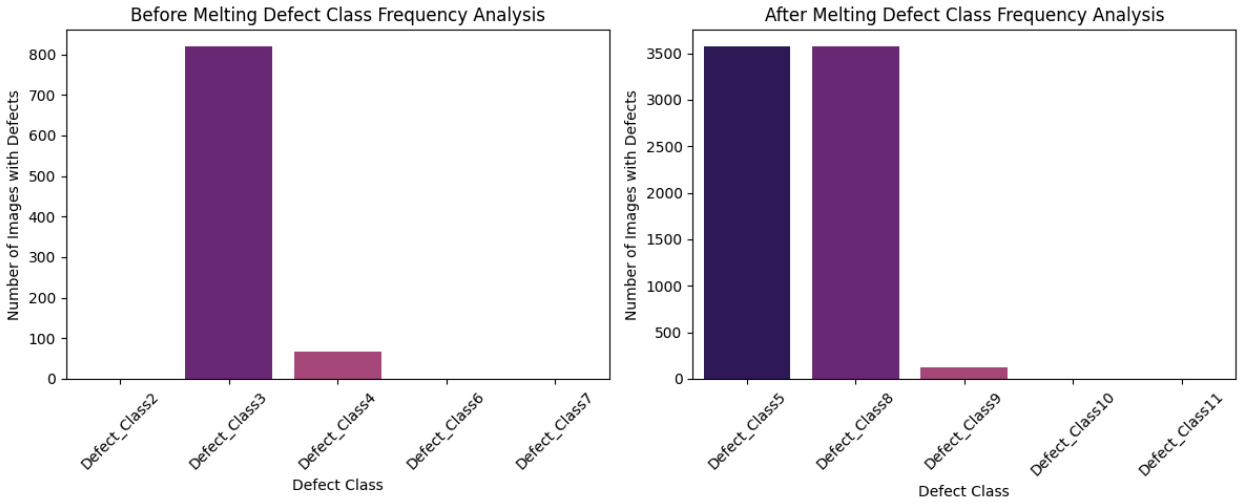
After Melting Defect Class:

{'Defect_Class5': 3573,
 'Defect_Class8': 3573,
 'Defect_Class9': 119,
 'Defect_Class10': 0,
 'Defect_Class11': 0}

Powder Bed (Before Melting) Defect Class:

{'Defect_Class2': 0,
 'Defect_Class3': 819,
 'Defect_Class4': 67,
 'Defect_Class6': 0,
 'Defect_Class7': 1}

Execution Time: 17 min


Before Melting Defect Class Frequency Analysis
Number of Images with Defects
0
100
200
300
400
500
600
700
800
Defect_Class2
Defect_Class3
Defect_Class4
Defect_Class6
Defect_Class7
Defect Class
After Melting Defect Class Frequency Analysis
Number of Images with Defects
0
500
1000
1500
2000
2500
3000
3500
Defect_Class5
Defect_Class8
Defect_Class9
Defect_Class10
Defect_Class11
Defect Class