

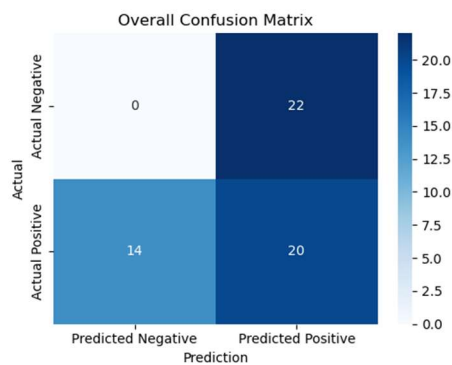
## Appendix I: Void detection results in different threshold values

Confidence level:0.45 and IoU:0.5

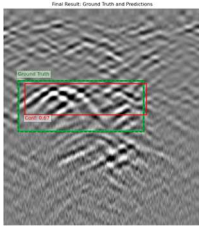
### Overall Performance Metrics

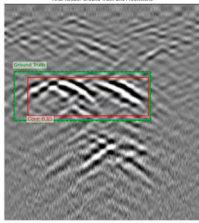
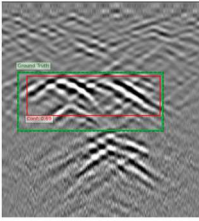
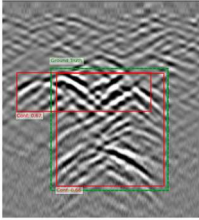
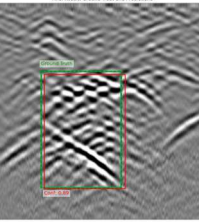
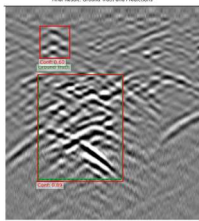
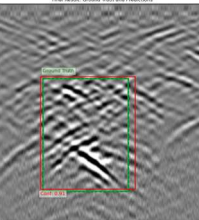
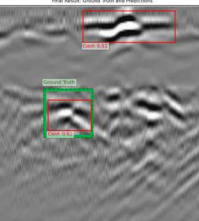
Metric	Value
TP	20
FP	22
FN	14
Precision	0.476
Recall	0.588
F1 Score	0.526
Average Precision (AP)	0.476

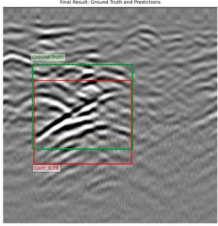
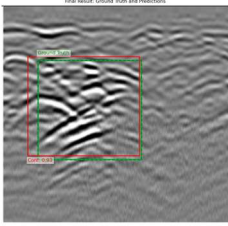
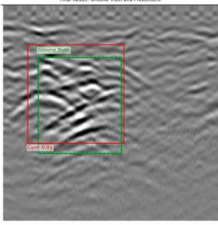
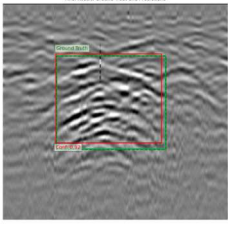
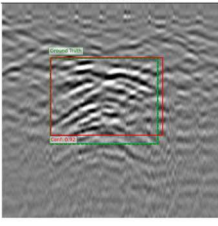
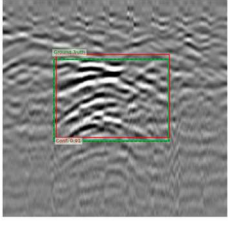
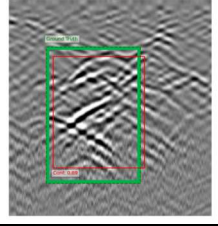
### Confusion Matrix

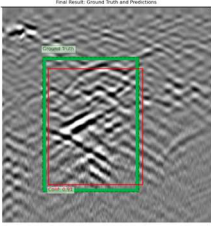
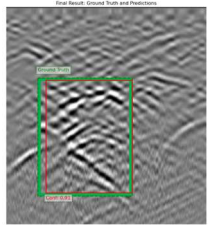
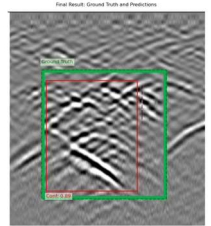
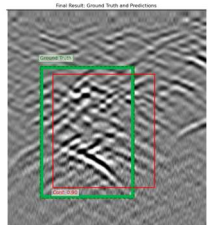
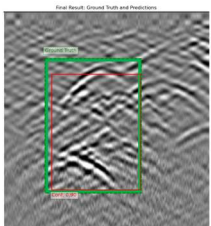


### Per-Image True Positives

Image Name	Predicted Image	Avg IoU	Avg Confidence
018-1xx-red brick.png		0.571	0.671

018-3xx-Red brick.png		0.690	0.853
018-4xx-Red brick.png		0.616	0.690
018-8xx-Red brick.png		0.842	0.663
023-4yy-Red brick.png		0.891	0.893
023-5yy-Red brick.png		0.978	0.894
023-6yy-Red brick.png		0.873	0.913
026-6xx asphalt.png		0.557	0.916

043-1-xx-sand.png		0.679	0.781
043-2-xx-sand.png		0.830	0.927
043-3-xx-sand.png		0.692	0.927
047-6yy-sand.png		0.873	0.923
047-7yy-sand.png		0.854	0.923
047-8yy-sand.png		0.882	0.913
3_19_2025 101236 red brick yy_022-1.png		0.736	0.892

3_19_2025 101236 red brick yy_022-2.png		0.782	0.908
3_19_2025 101236 red brick yy_023-1.png		0.874	0.914
3_19_2025 101236 red brick yy_023-3.png		0.628	0.889
3_19_2025 101236 red brick yy_023-7.png		0.627	0.899
3_19_2025 101236 red brick yy_023-8.png		0.793	0.904

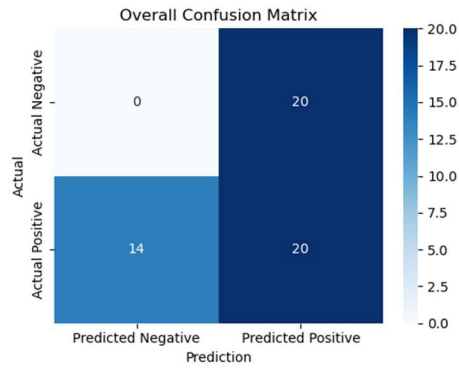
Confidence level:0. 5 and IoU:0.5

#### Overall Performance Metrics

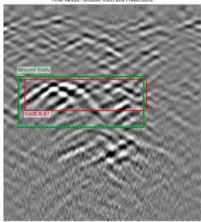
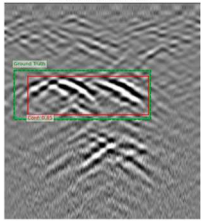
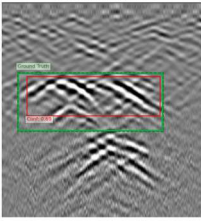
Metric	Value
TP	20
FP	20
FN	14
Precision	0.500

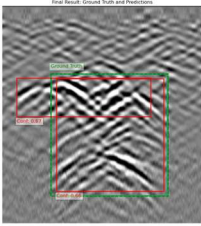
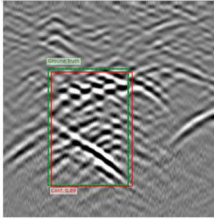
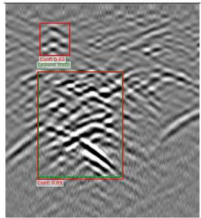
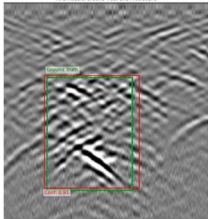
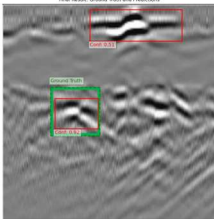
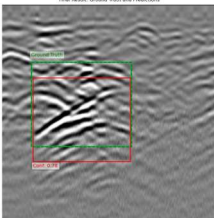
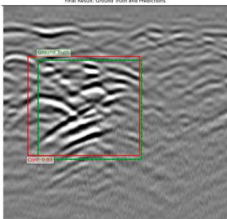
Recall	0.588
F1 Score	0.541
Average Precision (AP)	0.500

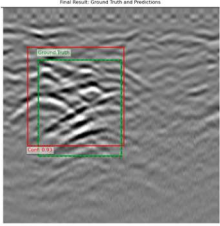
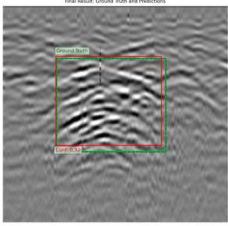
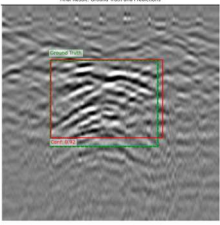
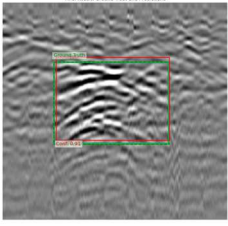
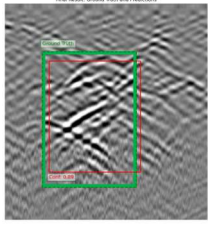
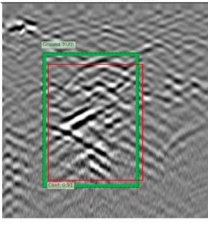
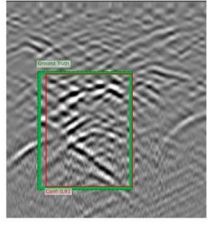
## Confusion Matrix

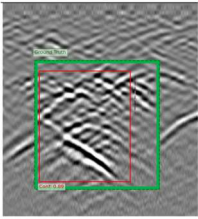
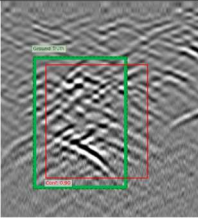
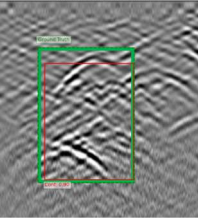


## Per-Image True Positives

Image Name	Predicted Image	Avg IoU	Avg Confidence
018-1xx-red brick.png		0.571	0.671
018-3xx-Red brick.png		0.690	0.853
018-4xx-Red brick.png		0.616	0.690

018-8xx-Red brick.png		0.842	0.663
023-4yy-Red brick.png		0.891	0.893
023-5yy-Red brick.png		0.978	0.894
023-6yy-Red brick.png		0.873	0.913
026-6xx asphalt.png		0.557	0.916
043-1-xx- sand.png		0.679	0.781
043-2-xx- sand.png		0.830	0.927

043-3-xx-sand.png		0.692	0.927
047-6yy-sand.png		0.873	0.923
047-7yy-sand.png		0.854	0.923
047-8yy-sand.png		0.882	0.913
3_19_2025 101236 red brick yy_022-1.png		0.736	0.892
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3_19_2025 101236 red brick yy_023-1.png		0.874	0.914

3_19_2025 101236 red brick yy_023-3.png		0.628	0.889
3_19_2025 101236 red brick yy_023-7.png		0.627	0.899
3_19_2025 101236 red brick yy_023-8.png		0.793	0.904

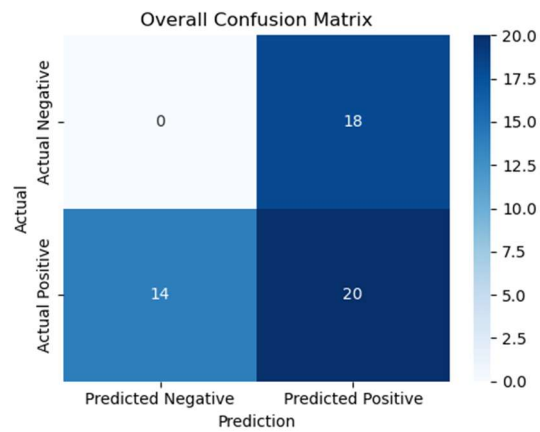
Confidence level:0.6 and IoU:0.5

#### Overall Performance Metrics

Metric	Value
TP	20
FP	18
FN	14
Precision	0.526
Recall	0.588
F1 Score	0.556
Average Precision (AP)	0.526

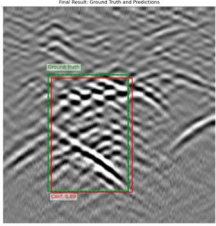
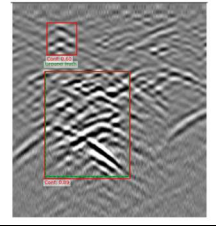
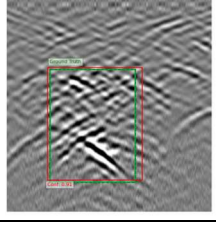
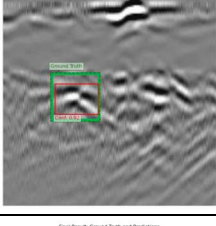
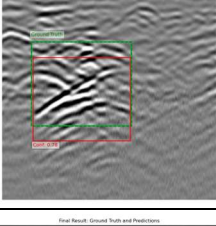
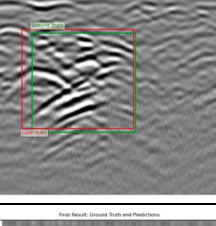
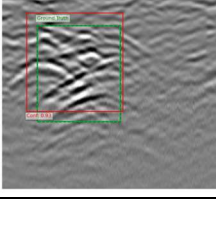
#### Confusion Matrix

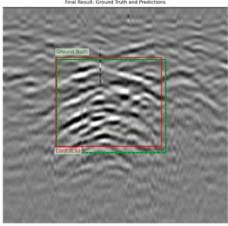
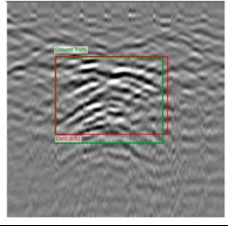
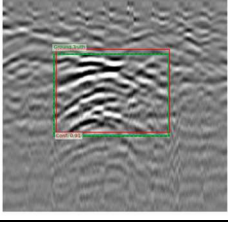
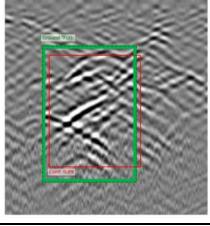
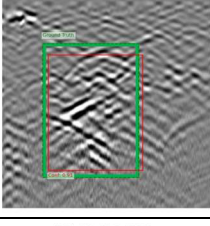
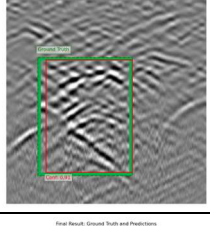
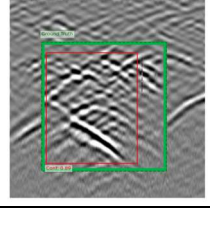


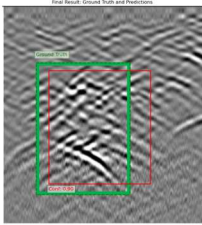
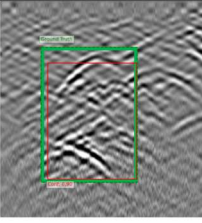


### Per-Image True Positives

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018-1xx-red brick.png		0.571	0.671
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023-6yy-Red brick.png		0.873	0.913
026-6xx asphalt.png		0.557	0.916
043-1-xx- sand.png		0.679	0.781
043-2-xx- sand.png		0.830	0.927
043-3-xx- sand.png		0.692	0.927

047-6yy-sand.png		0.873	0.923
047-7yy-sand.png		0.854	0.923
047-8yy-sand.png		0.882	0.913
3_19_2025 101236 red brick yy_022-1.png		0.736	0.892
3_19_2025 101236 red brick yy_022-2.png		0.782	0.908
3_19_2025 101236 red brick yy_023-1.png		0.874	0.914
3_19_2025 101236 red brick yy_023-3.png		0.628	0.889

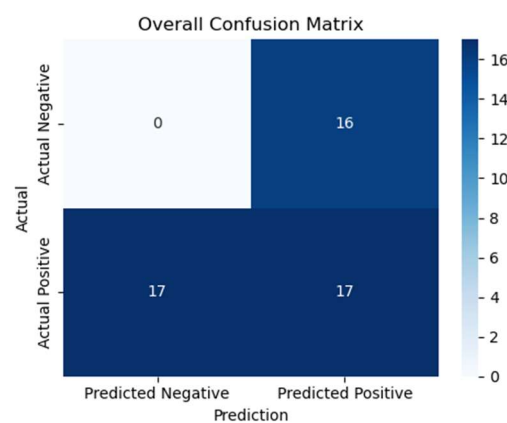
3_19_2025 101236 red brick yy_023-7.png		0.627	0.899
3_19_2025 101236 red brick yy_023-8.png		0.793	0.904

Confidence level:0.7 and IoU:0.5

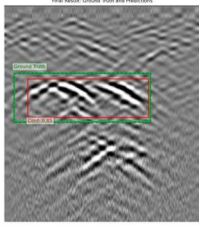
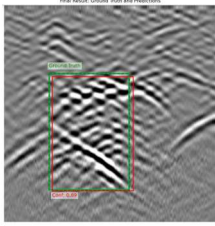
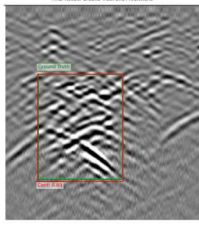
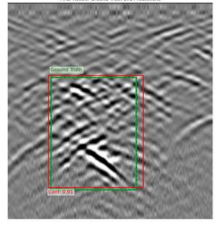
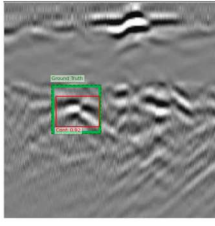
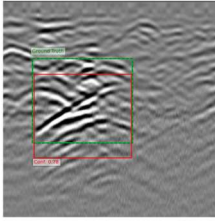
#### Overall Performance Metrics

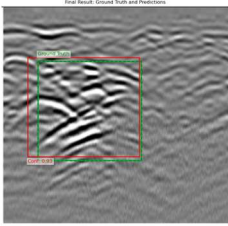
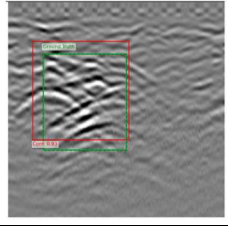
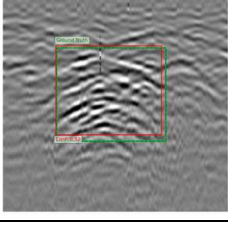
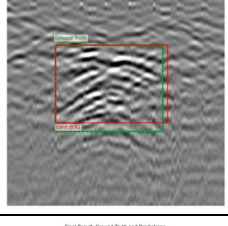
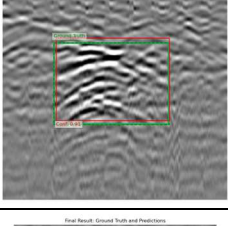
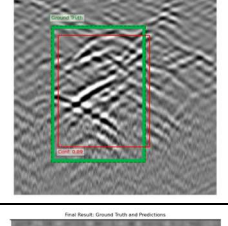
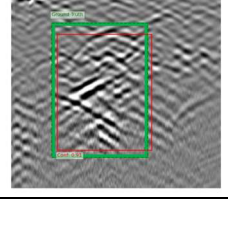
Metric	Value
TP	17
FP	16
FN	17
Precision	0.515
Recall	0.500
F1 Score	0.507
Average Precision (AP)	0.515

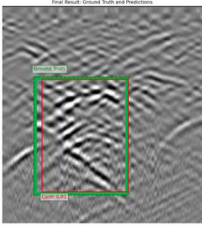
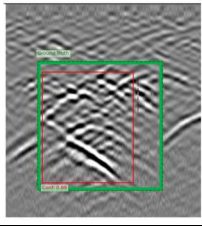
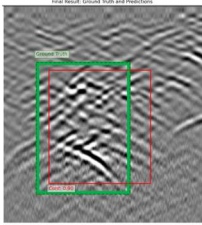
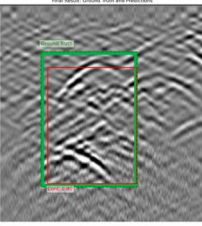
#### Confusion Matrix



# Per-Image True Positives

Image Name	Predicted Image	Avg IoU	Avg Confidence
018-3xx-Red brick.png		0.690	0.853
023-4yy-Red brick.png		0.891	0.893
023-5yy-Red brick.png		0.978	0.894
023-6yy-Red brick.png		0.873	0.913
026-6xx asphalt.png		0.557	0.916
043-1-xx- sand.png		0.679	0.781

043-2-xx-sand.png		0.830	0.927
043-3-xx-sand.png		0.692	0.927
047-6yy-sand.png		0.873	0.923
047-7yy-sand.png		0.854	0.923
047-8yy-sand.png		0.882	0.913
3_19_2025 101236 red brick yy_022-1.png		0.736	0.892
3_19_2025 101236 red brick yy_022-2.png		0.782	0.908

3_19_2025 101236 red brick yy_023-1.png		0.874	0.914
3_19_2025 101236 red brick yy_023-3.png		0.628	0.889
3_19_2025 101236 red brick yy_023-7.png		0.627	0.899
3_19_2025 101236 red brick yy_023-8.png		0.793	0.904

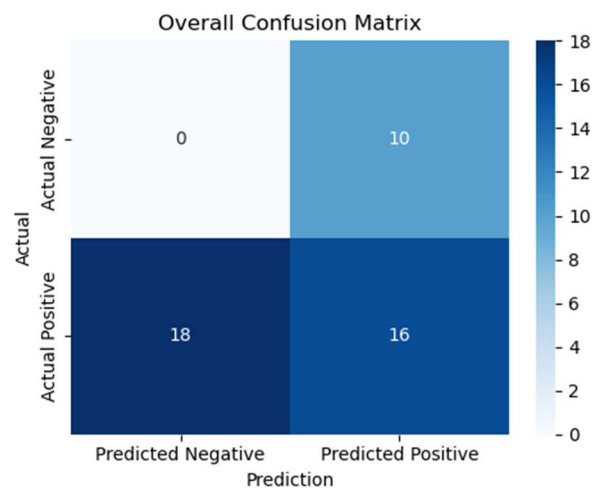
Confidence level:0.75 and IoU:0.55

#### Overall Performance Metrics

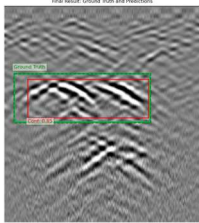
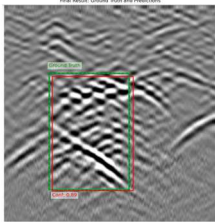
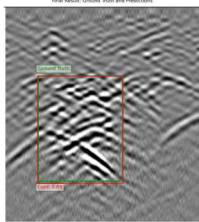
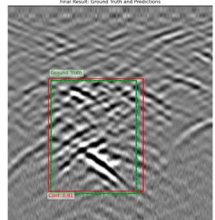
Metric	Value
TP	16
FP	10
FN	18
Precision	0.615
Recall	0.471
F1 Score	0.533
Average Precision (AP)	0.615



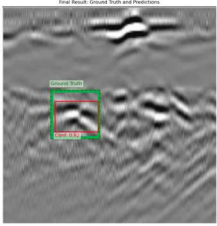
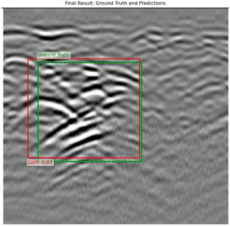
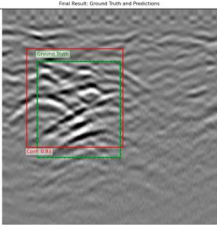
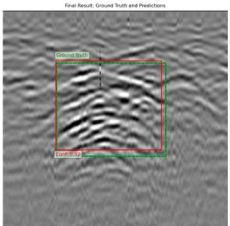
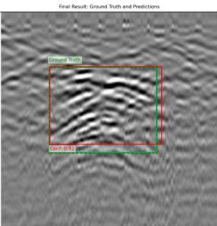
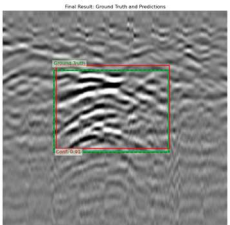
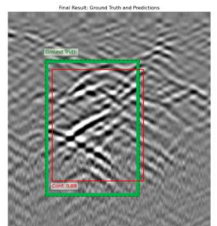
## Confusion Matrix

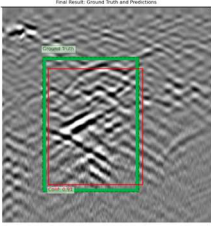
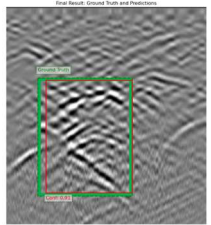
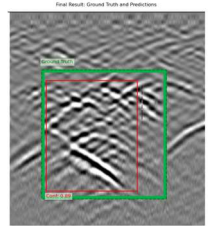
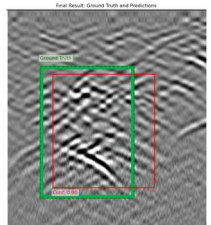
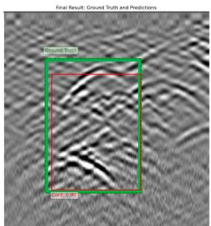


## Per-Image True Positives

Image Name	Predicted Image	Avg IoU	Avg Confidence
018-3xx-Red brick.png		0.690	0.853
023-4yy-Red brick.png		0.891	0.893
023-5yy-Red brick.png		0.978	0.894
023-6yy-Red brick.png		0.873	0.913



026-6xx asphalt.png		0.557	0.916
043-2-xx- sand.png		0.830	0.927
043-3-xx- sand.png		0.692	0.927
047-6yy-sand.png		0.873	0.923
047-7yy-sand.png		0.854	0.923
047-8yy-sand.png		0.882	0.913
3_19_2025 101236 red brick yy_022-1.png		0.736	0.892

3_19_2025 101236 red brick yy_022-2.png		0.782	0.908
3_19_2025 101236 red brick yy_023-1.png		0.874	0.914
3_19_2025 101236 red brick yy_023-3.png		0.628	0.889
3_19_2025 101236 red brick yy_023-7.png		0.627	0.899
3_19_2025 101236 red brick yy_023-8.png		0.793	0.904

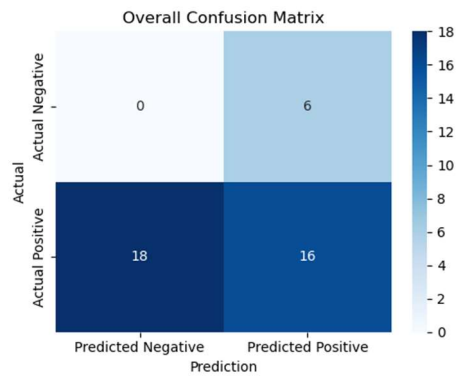
Confidence level:0.85 and IoU:0.55

#### Overall Performance Metrics

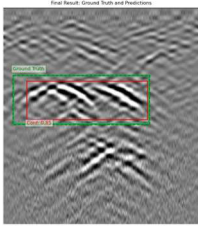
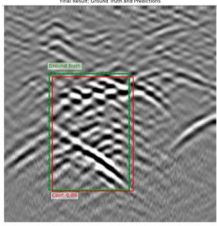
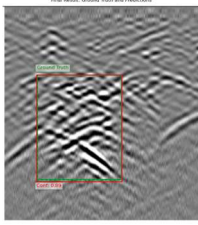
Metric	Value
TP	16
FP	6
FN	18
Precision	0.727

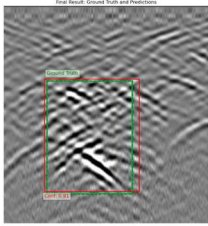
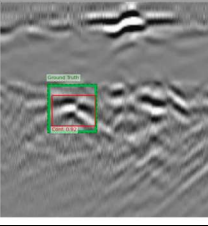
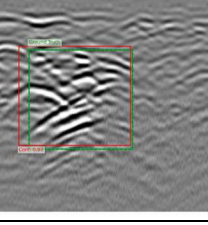
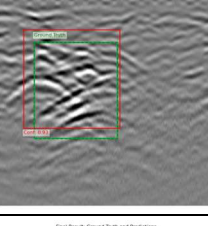
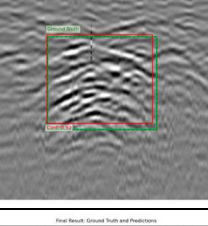
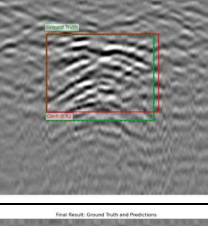
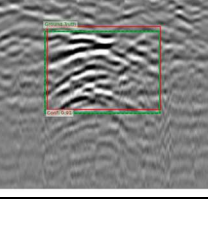
Recall	0.471
F1 Score	0.571
Average Precision (AP)	0.727

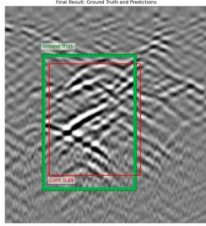
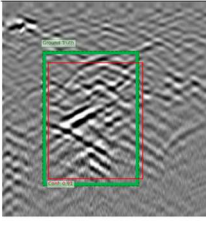
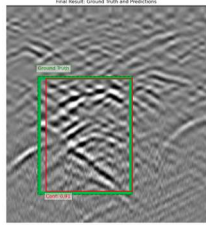
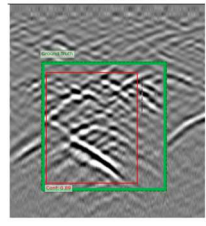
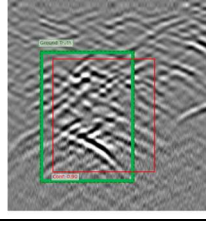
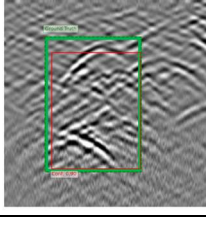
## Confusion Matrix



## Per-Image True Positives

Image Name	Predicted Image	Avg IoU	Avg Confidence
018-3xx-Red brick.png		0.690	0.853
023-4yy-Red brick.png		0.891	0.893
023-5yy-Red brick.png		0.978	0.894

023-6yy-Red brick.png		0.873	0.913
026-6xx asphalt.png		0.557	0.916
043-2-xx- sand.png		0.830	0.927
043-3-xx- sand.png		0.692	0.927
047-6yy-sand.png		0.873	0.923
047-7yy-sand.png		0.854	0.923
047-8yy-sand.png		0.882	0.913

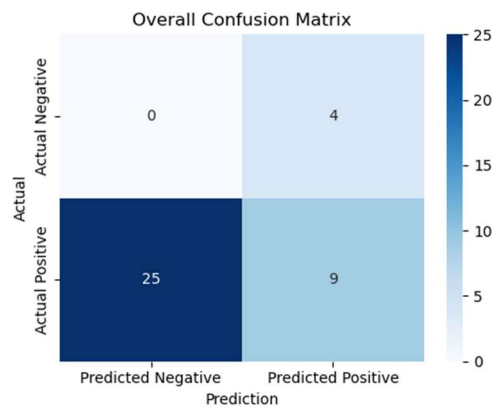
3_19_2025 101236 red brick yy_022-1.png		0.736	0.892
3_19_2025 101236 red brick yy_022-2.png		0.782	0.908
3_19_2025 101236 red brick yy_023-1.png		0.874	0.914
3_19_2025 101236 red brick yy_023-3.png		0.628	0.889
3_19_2025 101236 red brick yy_023-7.png		0.627	0.899
3_19_2025 101236 red brick yy_023-8.png		0.793	0.904

Confidence level:0.9 and IoU:0.6

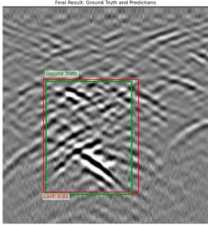
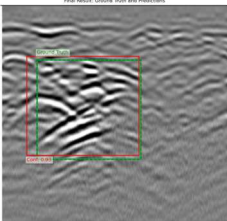
Overall Performance Metrics

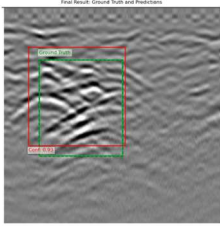
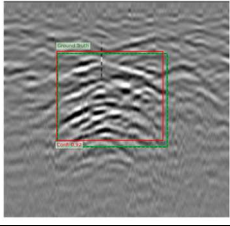
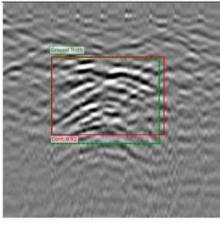
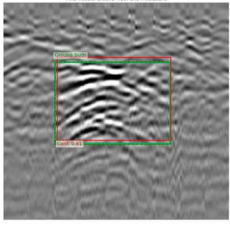
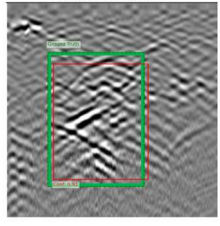
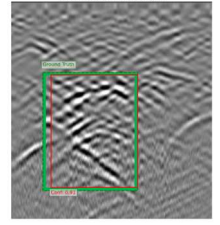
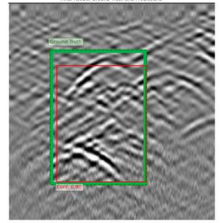
Metric	Value
TP	9
FP	4
FN	25
Precision	0.692
Recall	0.265
F1 Score	0.383
Average Precision (AP)	0.692

### Confusion Matrix



### Per-Image True Positives

Image Name	Predicted Image	Avg IoU	Avg Confidence
023-6yy-Red brick.png		0.873	0.913
043-2-xx-sand.png		0.830	0.927

043-3-xx-sand.png		0.692	0.927
047-6yy-sand.png		0.873	0.923
047-7yy-sand.png		0.854	0.923
047-8yy-sand.png		0.882	0.913
3_19_2025 101236 red brick yy_022-2.png		0.782	0.908
3_19_2025 101236 red brick yy_023-1.png		0.874	0.914
3_19_2025 101236 red brick yy_023-8.png		0.793	0.904

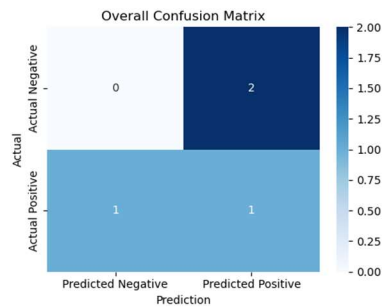
## Appendix II: Void detection results in different pavements in 0.5 IoU and 0.6 confidence level

### Asphalt:

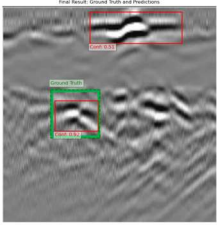
#### Overall Performance Metrics

Metric	Value
TP	1
FP	2
FN	1
Precision	0.333
Recall	0.500
F1 Score	0.400
Average Precision (AP)	0.333

#### Confusion Matrix



#### Per-Image True Positives

Image Name	Predicted Image	Avg IoU	Avg Confidence
026-6xx asphalt.png		0.557	0.916

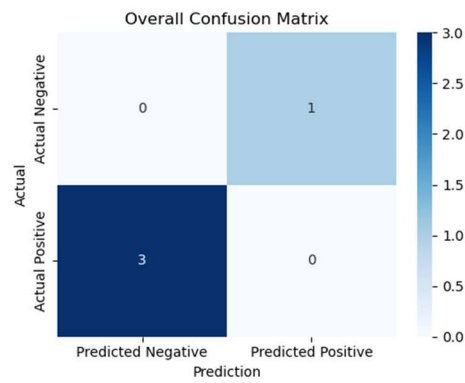


concrete:

Overall Performance Metrics

Metric	Value
TP	0
FP	1
FN	3
Precision	0.000
Recall	0.000
F1 Score	0
Average Precision (AP)	0.000

Confusion Matrix



Per-Image True Positives

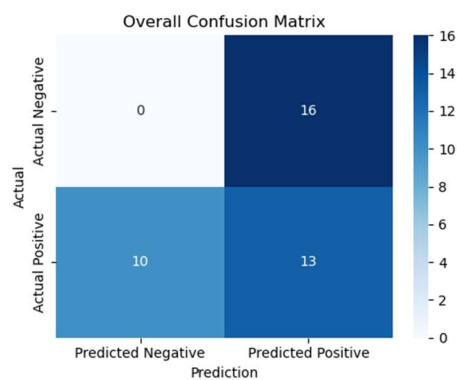
Image Name	Predicted Image	Avg IoU	Avg Confidence
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## Red brick

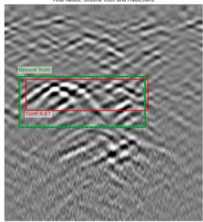
### Overall Performance Metrics

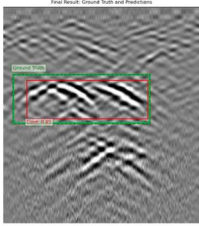
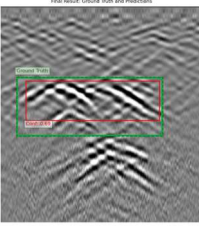
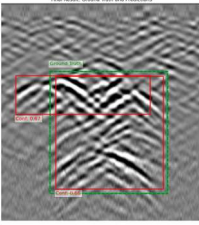
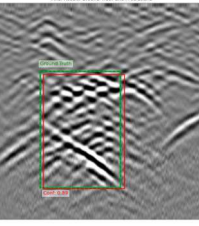
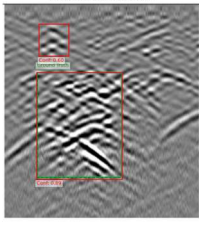
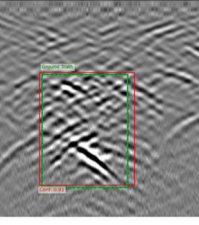
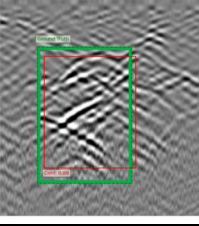
Metric	Value
TP	13
FP	16
FN	10
Precision	0.448
Recall	0.565
F1 Score	0.500
Average Precision (AP)	0.448

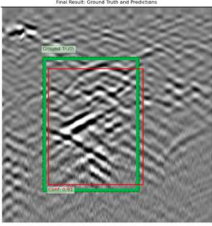
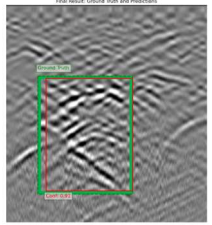
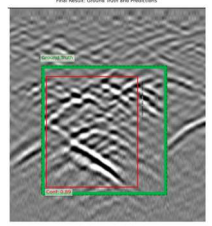
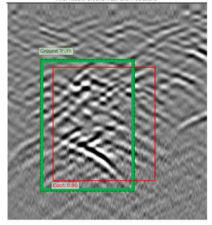
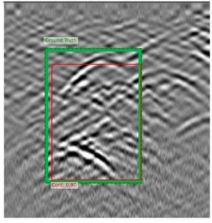
### Confusion Matrix



### Per-Image True Positives

Image Name	Predicted Image	Avg IoU	Avg Confidence
018-1xx-red brick.png		0.571	0.671

018-3xx-Red brick.png		0.690	0.853
018-4xx-Red brick.png		0.616	0.690
018-8xx-Red brick.png		0.842	0.663
023-4yy-Red brick.png		0.891	0.893
023-5yy-Red brick.png		0.978	0.894
023-6yy-Red brick.png		0.873	0.913
3_19_2025 101236 red brick yy_022-1.png		0.736	0.892

3_19_2025 101236 red brick yy_022-2.png		0.782	0.908
3_19_2025 101236 red brick yy_023-1.png		0.874	0.914
3_19_2025 101236 red brick yy_023-3.png		0.628	0.889
3_19_2025 101236 red brick yy_023-7.png		0.627	0.899
3_19_2025 101236 red brick yy_023-8.png		0.793	0.904

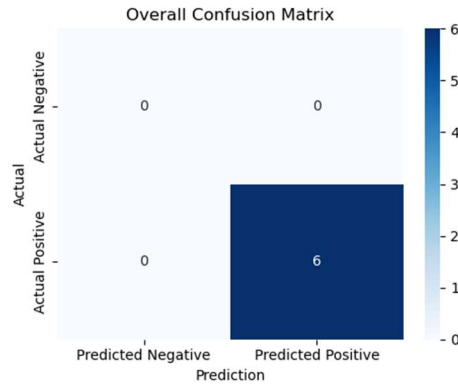
## sand brick

### Overall Performance Metrics

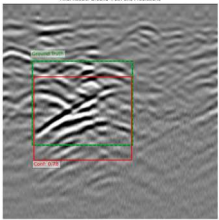
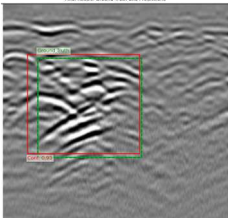
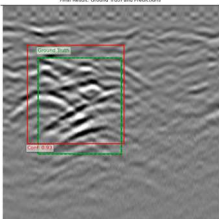
Metric	Value
TP	6
FP	0
FN	0
Precision	1.000
Recall	1.000

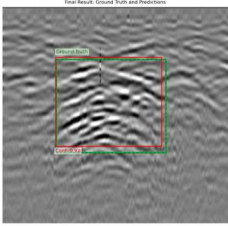
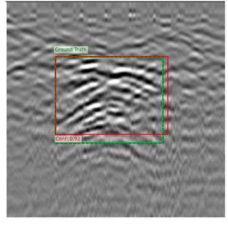
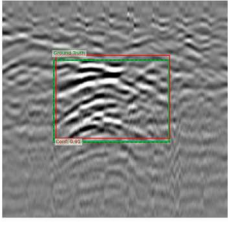
F1 Score	1.000
Average Precision (AP)	1.000

## Confusion Matrix

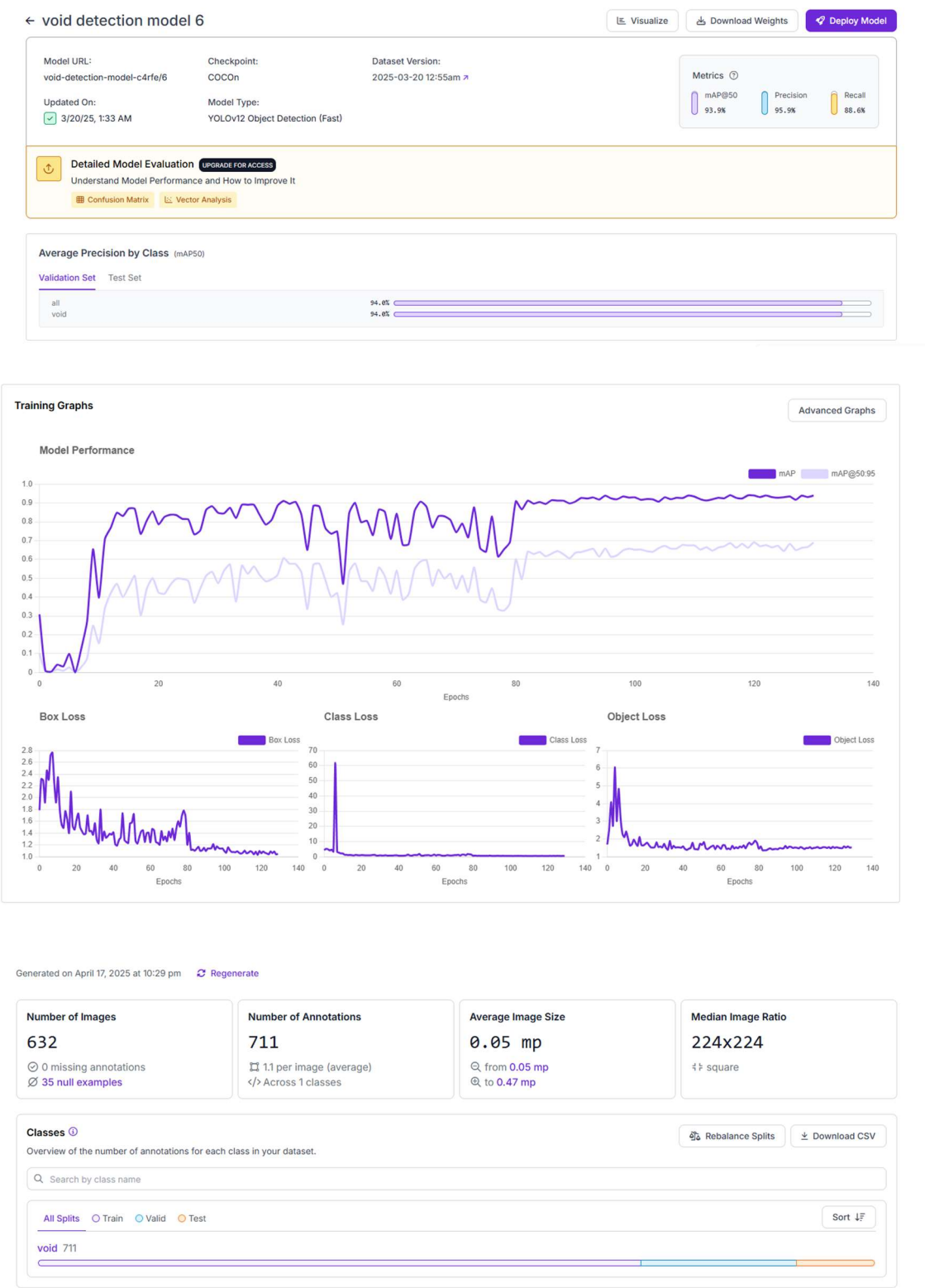


## Per-Image True Positives

Image Name	Predicted Image	Avg IoU	Avg Confidence
043-1-xx-sand.png		0.679	0.781
043-2-xx-sand.png		0.830	0.927
043-3-xx-sand.png		0.692	0.927

047-6yy-sand.png		0.873	0.923
047-7yy-sand.png		0.854	0.923
047-8yy-sand.png		0.882	0.913

Appendix III: YOLOv12 Model training performance



Average Precision by Class (mAP50)

Validation Set

Test Set

all

void

94.8%

94.8%

Training Graphs

Advanced Graphs

Model Performance

mAP

mAP@50:95

Box Loss

Class Loss

Object Loss

Generated on April 17, 2025 at 10:29 pm

🔄 Regenerate

Number of Images  
632

🕒 0 missing annotations  
🚫 35 null examples

Number of Annotations  
711

📄 1.1 per image (average)  
📄 Across 1 classes

Average Image Size  
0.05 mp

🔍 from 0.05 mp  
🔍 to 0.47 mp

Median Image Ratio  
224x224

📏 square

Classes ⓘ

Rebalance Splits

Download CSV

Overview of the number of annotations for each class in your dataset.

🔍

Search by class name

All Splits

Train

Valid

Test

Sort

📈

void 711