FIGURE C-1. AIRPORT ALPHA: FLOWCHART FOR ASSESSING GENERAL CONCRETE PROPERTIES BASED ON VISUAL EXAMINATION
Examine the paste and air-void system

1. Are there cracks in the paste? [Yes/No]
   - Yes: Consider possible bad sample preparation or shrinkage cracks.
   - No: Continue with the next questions.

2. Does freeze-thaw occur? [Yes/No]
   - Yes: Consider possible paste freeze-thaw.
   - No: Continue with the next questions.

3. Are there cracks in the paste? [Yes/No]
   - Yes: Consider possible aggregate freeze-thaw.
   - No: Continue with the next questions.

4. Are the gaps filled? [Yes/No]
   - Yes: Consider possible sulfate attack.
   - No: Continue with the next questions.

5. Cracks or voids filled? [Yes/No]
   - Yes: Consider possible sulfate attack.
   - No: Continue with the next questions.

6. Possible paste freeze-thaw [Yes/No]
   - Yes: Consider possible deicer attack.
   - No: Continue with the next questions.

7. Are the gaps filled? [Yes/No]
   - Yes: Consider possible sulfate attack.
   - No: Continue with the next questions.

8. Are there gaps around the aggregates? [Yes/No]
   - Yes: Consider possible paste freeze-thaw.
   - No: Continue with the next questions.

9. Nonuniform gaps around coarse aggregates? [Yes/No]
   - Yes: Consider possible paste freeze-thaw.
   - No: Continue with the next questions.

10. Gap width proportional to aggregate size? [Yes/No]
    - Yes: Consider possible paste freeze-thaw.
    - No: Continue with the next questions.

11. Identify the infilling material [Yes/No]
    - Yes: Consider possible sulfate attack.
    - No: Continue with the next questions.

12. Are there cracks in the paste? [Yes/No]
    - Yes: Consider possible aggregate freeze-thaw.
    - No: Continue with the next questions.

13. Are there cracks in the paste? [Yes/No]
    - Yes: Consider possible bad sample preparation or shrinkage cracks.
    - No: Continue with the next questions.

14. Rust stains around embedded items? [Yes/No]
    - Yes: Consider possible corrosion of embedded steel.
    - No: Continue with the next questions.

15. Poor air-void system in concrete near road surface? [Yes/No]
    - Yes: Consider possible paste freeze-thaw.
    - No: Continue with the next questions.

16. Are the gaps filled? [Yes/No]
    - Yes: Consider possible sulfate attack.
    - No: Continue with the next questions.

17. Cracks extend through aggregates into paste? [Yes/No]
    - Yes: Consider possible aggregate freeze-thaw.
    - No: Continue with the next questions.

18. Are the gaps filled? [Yes/No]
    - Yes: Consider possible sulfate attack.
    - No: Continue with the next questions.

19. Does freeze-thaw occur? [Yes/No]
    - Yes: Consider possible paste freeze-thaw.
    - No: Continue with the next questions.

20. Is the original (unfilled) air-void system adequate? [Yes/No]
    - Yes: Consider possible paste freeze-thaw.
    - No: Continue with the next questions.

21. Air-void spacing factor >0.20 mm due to infilling? [Yes/No]
    - Yes: Consider possible paste freeze-thaw.
    - No: Continue with the next questions.

22. Are there cracks in the paste? [Yes/No]
    - Yes: Consider possible aggregate freeze-thaw.
    - No: Continue with the next questions.

23. Examine the aggregates [Yes/No]
    - Yes: Consider possible sulfate attack.
    - No: Continue with the next questions.

24. Identify the infilling material [Yes/No]
    - Yes: Consider possible sulfate attack.
    - No: Continue with the next questions.

25. Paste softening or degradation? [Yes/No]
    - Yes: Consider possible sulfate attack.
    - No: Continue with the next questions.

26. Rust stains around embedded items? [Yes/No]
    - Yes: Consider possible corrosion of embedded steel.
    - No: Continue with the next questions.

27. Poor air-void system in concrete near road surface? [Yes/No]
    - Yes: Consider possible paste freeze-thaw.
    - No: Continue with the next questions.

28. Cracks extend through aggregates into paste? [Yes/No]
    - Yes: Consider possible aggregate freeze-thaw.
    - No: Continue with the next questions.

29. Are there cracks in the paste? [Yes/No]
    - Yes: Consider possible aggregate freeze-thaw.
    - No: Continue with the next questions.

30. Examine the paste and air-void system [Yes/No]
    - Yes: Consider possible sulfate attack.
    - No: Continue with the next questions.

31. Possible Paste Freeze-Thaw [Yes/No]
    - Yes: Consider possible deicer attack.
    - No: Continue with the next questions.

32. Are there gaps around the aggregates? [Yes/No]
    - Yes: Consider possible paste freeze-thaw.
    - No: Continue with the next questions.

33. Nonuniform gaps around coarse aggregates? [Yes/No]
    - Yes: Consider possible paste freeze-thaw.
    - No: Continue with the next questions.

34. Gap width proportional to aggregate size? [Yes/No]
    - Yes: Consider possible paste freeze-thaw.
    - No: Continue with the next questions.

35. Identify the infilling material [Yes/No]
    - Yes: Consider possible sulfate attack.
    - No: Continue with the next questions.

36. Are the gaps filled? [Yes/No]
    - Yes: Consider possible sulfate attack.
    - No: Continue with the next questions.

37. FIGURE C-2. AIRPORT ALPHA: FLOWCHART FOR ASSESSING THE CONDITION OF THE CONCRETE PASTE AND AIR

---

<table>
<thead>
<tr>
<th>Possible Distress</th>
<th>Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrinkage cracks or sample preparation cracks</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Corrosion of embedded steel</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Paste freeze-thaw</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Aggregate freeze-thaw</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Sulfate attack</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Deicer attack</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Infilling material</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>
Staining techniques

Petrographic microscope and/or SEM analysis

Sulfates?

Yes

Possible sulfate attack

Verify the presence/absence of other diagnostic features

No

Chloro-aluminates or calcium hydroxide?

Yes

Possible deicer attack

Verify the presence/absence of other diagnostic features

No

Calcite or magnesium silicate hydrates?

Yes

Possible ACR

Verify the presence/absence of other diagnostic features

No

Alkali-silica reaction products?

Yes

Possible ASR

Verify the presence/absence of other diagnostic features

No

Iron oxide?

Yes

Possible corrosion of embedded steel, ASR, or ACR

Verify the presence/absence of other diagnostic features

No

Other?

Yes

Possible co-deposition of various phases

Verify the presence/absence of other diagnostic features

Establish a cause and effect for each/any possible MRD

Possible Distress | Present
---|---
Corrosion of embedded steel | Yes | No
Sulfate attack | Yes | No
Deicer attack | Yes | No
Alkali–silica reaction | Yes | No
Alkali–carbonate reaction | Yes | No

FIGURE C-3. AIRPORT ALPHA: FLOWCHART FOR IDENTIFYING INFILLING MATERIALS IN CRACKS AND VOIDS
FIGURE C-4. AIRPORT ALPHA: FLOWCHART FOR ASSESSING THE CONDITION OF THE CONCRETE AGGREGATES

### Table: Possible Distress

<table>
<thead>
<tr>
<th>Distress</th>
<th>Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural cracking of aggregate</td>
<td>Yes</td>
</tr>
<tr>
<td>Sample preparation cracks</td>
<td>No</td>
</tr>
<tr>
<td>Aggregate freeze-thaw</td>
<td>Yes</td>
</tr>
<tr>
<td>Natural weathering of aggregates</td>
<td>No</td>
</tr>
<tr>
<td>Alkali–silica reaction</td>
<td>Yes</td>
</tr>
<tr>
<td>Alkali–carbonate reaction</td>
<td>No</td>
</tr>
<tr>
<td>Infilling material</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

---

**Legend:**
- Yes
- No
Possible Distress | Present
---|---
Error in mix proportioning | Yes | No
Poor placement | Yes | No
Poor finishing/curing | Yes | No
Poor steel placement | Yes | No
Carbonation at depths > 5-10 mm | Yes | No

FIGURE C-5. AIRPORT DELTA: FLOWCHART FOR ASSESSING GENERAL CONCRETE PROPERTIES BASED ON VISUAL EXAMINATION
FIGURE C-6. AIRPORT DELTA: FLOWCHART FOR ASSESSING THE CONDITION OF THE CONCRETE PASTE AND AIR

<table>
<thead>
<tr>
<th>Possible Distress</th>
<th>Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrinkage cracks or sample preparation cracks</td>
<td>Yes</td>
</tr>
<tr>
<td>Corrosion of embedded steel</td>
<td>Yes</td>
</tr>
<tr>
<td>Paste freeze-thaw</td>
<td>Yes</td>
</tr>
<tr>
<td>Aggregate freeze-thaw</td>
<td>Yes</td>
</tr>
<tr>
<td>Sulfate attack</td>
<td>Yes</td>
</tr>
<tr>
<td>Deicer attack</td>
<td>Yes</td>
</tr>
<tr>
<td>Infilling material</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Staining techniques

Petrographic microscope and/or SEM analysis

Sulfates?

Chloro-aluminates or calcium hydroxide?

Calcite or magnesium silicate hydrates?

Possible sulfate attack

Possible deicer attack

Possible ACR

Possible ASR

Possible corrosion of embedded steel, ASR, or ACR

Possible co-deposition of various phases

Establish a cause and effect for each/any possible MRD

Verify the presence/absence of other diagnostic features

Verify the presence/absence of other diagnostic features

Verify the presence/absence of other diagnostic features

Verify the presence/absence of other diagnostic features

FIGURE C-7. AIRPORT DELTA: FLOWCHART FOR IDENTIFYING INFILLING MATERIALS IN CRACKS AND VOIDS

<table>
<thead>
<tr>
<th>Possible Distress</th>
<th>Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion of embedded steel</td>
<td>Yes</td>
</tr>
<tr>
<td>Sulfate attack</td>
<td>Yes</td>
</tr>
<tr>
<td>Deicer attack</td>
<td>Yes</td>
</tr>
<tr>
<td>Alkali–silica reaction</td>
<td>Yes</td>
</tr>
<tr>
<td>Alkali–carbonate reaction</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Page C-8 of 21
FIGURE C-8. AIRPORT DELTA: FLOWCHART FOR ASSESSING THE CONDITION OF THE CONCRETE AGGREGATES
FIGURE C-9. AIRPORT ECHO: FLOWCHART FOR ASSESSING GENERAL CONCRETE PROPERTIES BASED ON VISUAL EXAMINATION

### Possible Distress | Present
--- | ---
Error in mix proportioning | Yes | No
Poor placement | Yes | No
Poor finishing/curing | Yes | No
Poor steel placement | Yes | No
Carbonation at depths > 5-10 mm | Yes | No
FIGURE C-10. AIRPORT ECHO: FLOWCHART FOR ASSESSING THE CONDITION OF THE CONCRETE PASTE AND AIR
Staining techniques

Petrographic microscope and/or SEM analysis

Sulfates?

Yes

Possible sulfate attack

Verify the presence/absence of other diagnostic features

No

Chloro-aluminates or calcium hydroxide?

Yes

Possible deicer attack

Verify the presence/absence of other diagnostic features

No

Calcite or magnesium silicate hydrates?

Yes

Possible ACR

Verify the presence/absence of other diagnostic features

No

Alkali-silica reaction products?

Yes

Possible ASR

Verify the presence/absence of other diagnostic features

No

Iron oxide?

Yes

Possible corrosion of embedded steel, ASR, or ACR

Verify the presence/absence of other diagnostic features

No

Other?

Yes

Possible co-deposition of various phases

Verify the presence/absence of other diagnostic features

No

Establish a cause and effect for each/any possible MRD

Possible Distress | Present
--- | ---
Corrosion of embedded steel | Yes | No
Sulfate attack | Yes | No
Deicer attack | Yes | No
Alkali–silica reaction | Yes | No
Alkali–carbonate reaction | Yes | No

FIGURE C-11. AIRPORT ECHO: FLOWCHART FOR IDENTIFYING INFILLING MATERIALS IN CRACKS AND VOIDS
FIGURE C-12. AIRPORT ECHO: FLOWCHART FOR ASSESSING THE CONDITION OF THE CONCRETE AGGREGATES
FIGURE C-13. AIRPORT FOXTROT: FLOWCHART FOR ASSESSING GENERAL CONCRETE PROPERTIES BASED ON VISUAL EXAMINATION
FIGURE C-14. AIRPORT FOXTROT: FLOWCHART FOR ASSESSING THE CONDITION OF THE CONCRETE PASTE AND AIR
Staining techniques

Petrographic microscope and/or SEM analysis

Sulfates?
  No
  Yes
  Possible sulfate attack

Chloro-aluminates or calcium hydroxide?
  No
  Yes
  Possible deicer attack

Calcite or magnesium silicate hydrates?
  No
  Yes
  Possible ACR

Verify the presence/absence of other diagnostic features

Alkali-silica reaction products?
  No
  Yes
  Possible ASR

Iron oxide?
  No
  Yes
  Possible corrosion of embedded steel, ASR, or ACR

Other?
  No
  Yes
  Possible co-deposition of various phases

Verify the presence/absence of other diagnostic features

Establish a cause and effect for each/any possible MRD

Possible Distress | Present
---|---
Corrosion of embedded steel | Yes | No
Sulfate attack | Yes | No
Deicer attack | Yes | No
Alkali–silica reaction | Yes | No
Alkali–carbonate reaction | Yes | No

FIGURE C-15. AIRPORT FOXTROT: FLOWCHART FOR IDENTIFYING INFILLING MATERIALS IN CRACKS AND VOIDS
FIGURE C-17. AIRPORT GOLF: FLOWCHART FOR ASSESSING GENERAL CONCRETE PROPERTIES BASED ON VISUAL EXAMINATION
FIGURE C-18. AIRPORT GOLF: FLOWCHART FOR ASSESSING THE CONDITION OF THE CONCRETE PASTE AND AIR
Possible Distress | Present
--- | ---
Corrosion of embedded steel | Yes | No
Sulfate attack | Yes | No
Deicer attack | Yes | No
Alkali–silica reaction | Yes | No
Alkali–carbonate reaction | Yes | No

FIGURE C-19. AIRPORT GOLF: FLOWCHART FOR IDENTIFYING INFILLING MATERIALS IN CRACKS AND VOIDS
FIGURE C-20. AIRPORT GOLF: FLOWCHART FOR ASSESSING THE CONDITION OF THE CONCRETE AGGREGATES