


Concrete Pavement Preservation and Repair

Regional Local Roads Conference
Sioux Falls, SD


Jason Reaves, P.E.
Executive Director
SD Chapter - ACPA
jreaves.sdacpa@midconetwork.com



1

Resources and Publications



Federal Highway Administration
CP Tech Center
American Concrete Pavement Association
International Grooving and Grinding Association



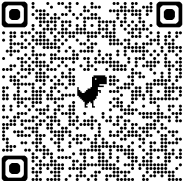
2

Concrete Pavement Preservation Guide – 3rd Edition

CONCRETE PAVEMENT PRESERVATION GUIDE THIRD EDITION

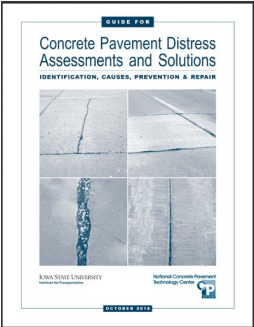


https://intrans.iastate.edu/app/uploads/2022/08/concrete_pvmnt_preservation_guide_3rd_edition_web.pdf



3

Concrete Pavement Distress Assessments and Solutions Guide



1. Surface Defects
2. Surface Delamination
3. Material Related Cracks
4. Transverse & Diagonal Cracking
5. Longitudinal Cracking
6. Corner Cracking
7. Spalling
8. Faulting
9. Joint Warping and Curling
10. Blowups
11. Settlement and Heaves
12. Subgrades & Base Support Conditions
13. CRCP
14. Concrete Overlays, BCOA, BCOC, UBCOA, UBCOC
15. Laboratory & Field Testing

Focus:

- Identification
- Causes
- Prevention
- Rehabilitation


https://intrans.iastate.edu/app/uploads/2018/12/concrete_pvmnt_distress_assessments_and_solutions_guide_w_cvr.pdf

4

Preventive Maintenance and Pavement Preservation Concepts for Concrete Pavement


CONCRETE PAVEMENT
PRESERVATION GUIDE

THIRD EDITION




IOWA STATE UNIVERSITY
August 2022

National Concrete Pavement
Technology Center



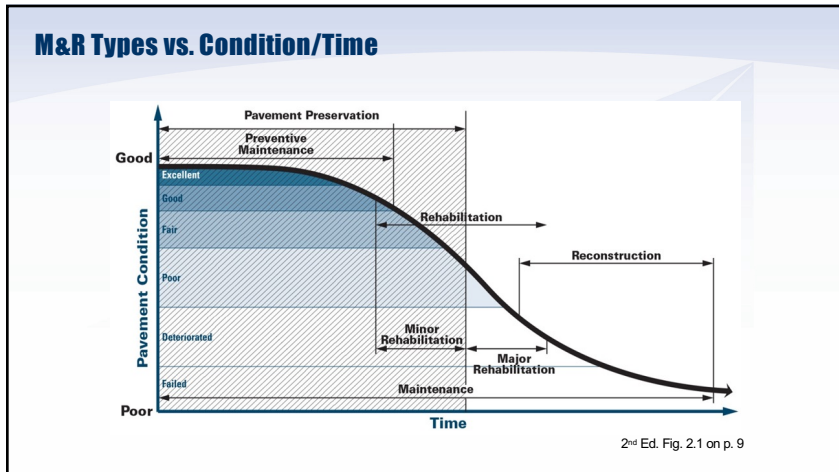
10

Pavement Preservation Philosophy



Keeping good pavements in good condition!

11




12

Favorable Characteristics for Preservation

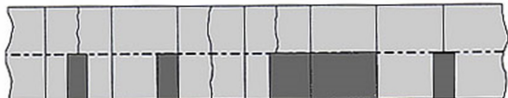
- Few or limited structural problems
- No materials-related distress
- Pavements in overall relatively good condition (minimal distress)

Before



L, M, H = Low-, Medium-, High-Severity

After



NOTES

a - Minimum length is 1.8 m (6 ft)

b - Check distance between patches and nearby joints

c - Replace the entire slab if there are multiple intersecting cracks

13

Concrete Pavement Preservation Treatments

- Slab stabilization
- Slab jacking
- Partial-depth repairs
- Full-depth repairs
- Retrofitted edge drains
- Load transfer restoration
- Cross stitching
- Diamond grinding
- Diamond grooving
- Joint resealing
- Crack sealing
- Thin concrete overlay

14

Treatment Sequencing for Concurrent Application

Not all projects but this sequence

Tied PCC Shoulders

Cross-Stitching/Slot-Stitching

Dowel Bar Retrofit

Full-Depth Repair

2nd Ed. Pg. 257

15

Pavement Evaluation or What Are My Distresses Telling Me?

16

Pavement Evaluation Overview

- Historical Data Collection
- Records Review
- Initial Site Visit and Assessment
- Field Testing Activities
- Laboratory Materials Characterization
- Data Analysis
- Final Field Evaluation Report

Table 3.4. Overview of selected NDT technologies

NDT device	Image	Measurement capabilities				
		Load transfer efficiency	Depth to steel	Layer thickness	Void detection	Structural assessment
Falling weight deflectometer		Yes	No	Possible, if you know portland cement concrete (PCC) modulus	Generally yes (dependent upon temperature and curling of slab)	Yes
Ground-penetrating radar		No	Yes	Yes	Generally yes (dependent on moisture content at time of testing; better at larger voids that are air filled)	No
MIRA		No	Yes	Yes	Yes	Yes, to detect delamination
MIT-SCAN2-BT		No	Yes	No	No	No
MIT-SCAN-T3		No	No	Yes, for new construction only	No	No

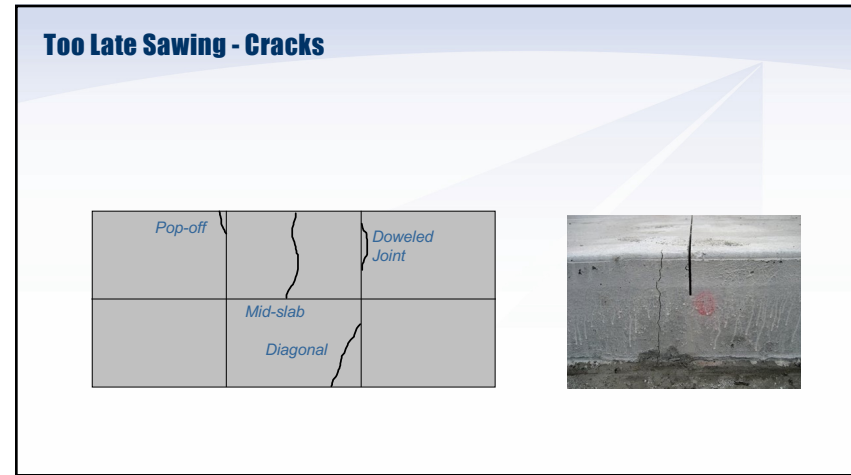
17

Table 2.1. Suggested data collection needs for concrete pavement preservation treatment alternatives

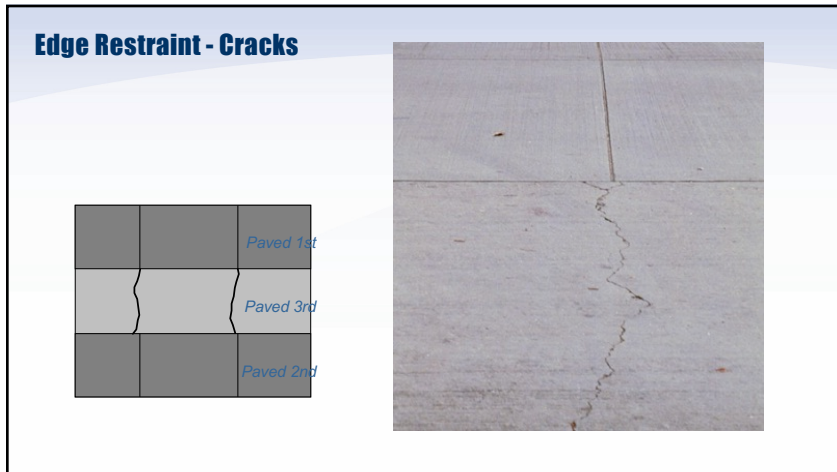
3rd Ed. Table 3.1

Data collection item	Fall-depth repair	Partial-depth repair	Concrete overlay	Diamond grinding	Diamond grooving	Slab stabilization	Slab jacking	Reinforced edge drains	Joint resealing	Crack sealing	Downed bar retrofit	Cross stitching	Slit stitching
Pavement design	Yes	Yes	Yes	Helpful	Helpful	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
As-constructed thickness	Helpful	Helpful	Helpful	Yes	No	Helpful	Helpful	No	No	No	Yes	Yes	Yes
Age	Helpful	Helpful	Helpful	Helpful	Helpful	No	No	Helpful	No	No	No	No	No
Materials properties	Helpful	No	Yes	Yes	Yes	Helpful	Helpful	Yes	Yes	Yes	Helpful	Helpful	Helpful
Subgrade	Helpful	Yes	No	No	No	Helpful	Helpful	Yes	Yes	Yes	No	No	No
Climate	No	No	Yes	No	No	No	No	Yes	Yes	Yes	Helpful	No	No
Traffic loads and volumes	Helpful	Helpful	Yes	Yes	Yes	Helpful	Helpful	Helpful	Helpful	Helpful	Yes	Helpful	Yes
Distress	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Safety (friction, texture, cracks)	No	No	Helpful	Yes	Yes	No	No	No	No	No	No	No	No
Potential NDT	Helpful (FWD, GPR, MIT, MIRA)	No	Yes (FWD) Helpful (GPR, MIT, MIRA)	Yes (friction)	Yes (friction)	Yes (FWD) Helpful (GPR, MIRA)	Yes (FWD) Helpful (GPR, MIRA)	Yes (FWD, GPR, MIT, MIRA)	No	No	Yes (FWD) Helpful (GPR, MIRA)	Helpful (FWD, GPR, MIT, MIRA)	Yes (FWD) Helpful (GPR, MIT, MIRA)
Potential destructive testing/sampling	Yes (coring)	Yes (coring)	Yes (coring, DCP, SMT/C, ST, MRD)	Helpful (coring)	Helpful (coring, ST, MRD)	Helpful (coring, DCP, SMT/C)	Helpful (coring, DCP, SMT/C)	Yes (coring, DCP, SMT/C)	No	No	Helpful (coring, DCP, SMT/C, ST, MRD)	Helpful (coring, ST, MRD)	Helpful (coring, ST, MRD)
Roughness	No	No	Helpful	Yes	Helpful	Helpful	Helpful	No	No	No	No	No	No
Transverse surface profile	No	No	Yes	Yes	Helpful	Helpful	Helpful	No	No	No	No	No	No
Drainage (roadway and subsurface)	Helpful	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Helpful	Helpful	Helpful
Previous maintenance	Helpful	Helpful	Helpful	Helpful	Helpful	Helpful	Helpful	Helpful	Helpful	Helpful	Helpful	Helpful	Helpful
Bridge transitions	Helpful	Helpful	Yes	No	No	Helpful	Yes	No	Yes	No	Helpful	Helpful	Helpful
Utilities	Yes	No	Yes	No	No	Yes	Yes	Yes	No	No	No	No	No
Traffic control options	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vertical clearances	Helpful	No	Yes	Helpful	Helpful	No	No	No	No	No	No	No	No
Geometrics	No	No	Yes	No	No	No	No	Yes	No	No	No	No	No

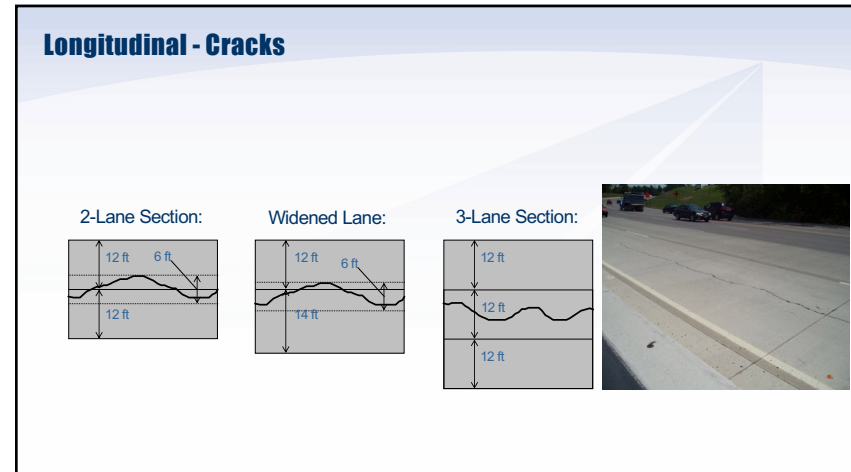
18



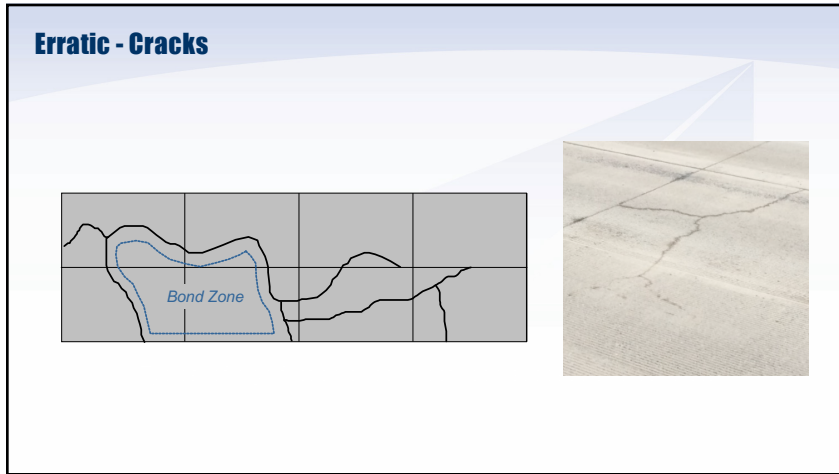
19



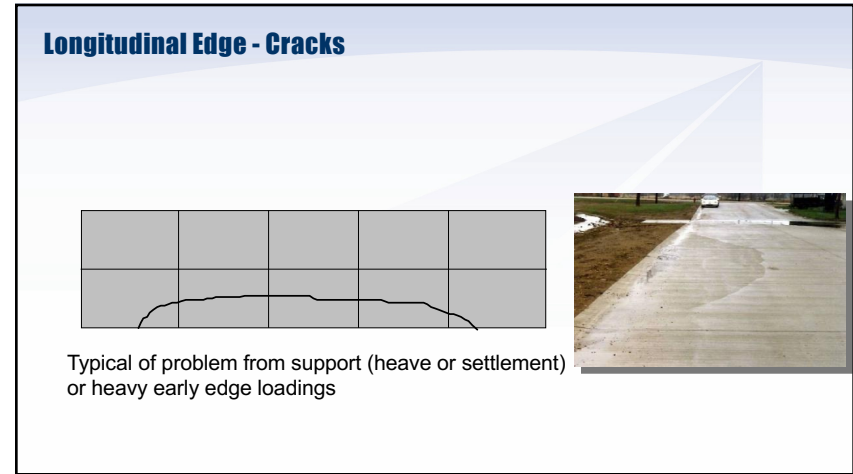
20



21



23



24



25



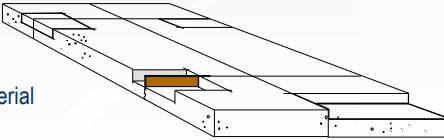
26

Partial Depth Repairs

- Removal and replacement of localized, shallow surface distress

Good Candidates Include

- Spalls caused by:
 - Incompressibles in joints
 - Localized areas of weak material
 - Joint inserts
- Surface deterioration caused by:
 - Reinforcing mesh too close to surface
 - Poor curing or finishing practices



27


Partial Depth Repair Candidates



28

Poor Candidate Projects

- Spalls due to dowel bar misalignment
- Spalls at working cracks due to shrinkage, fatigue, or vertical movement
- Spalls due to D-cracking or reactive aggregate



29

Partial-Depth Repair Types

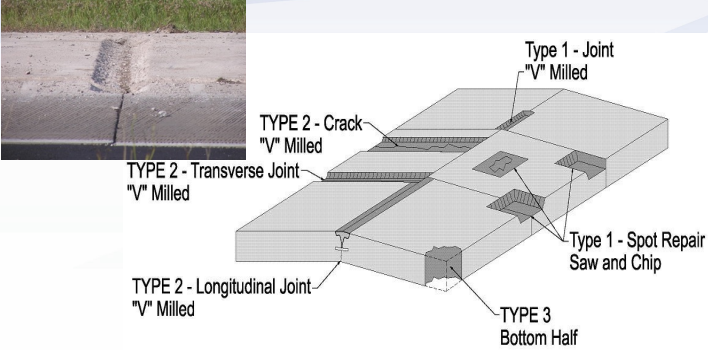


Fig. 5.1 on p. 5.2

30

Partial-Depth Repair Process

Fig. 5.8 on p. 91

31

Key Factors For Success

- Proper selection of candidate projects
- Proper material selection
- Identification of repair boundaries
- Use of joint/crack reformers
- Achieving good bond
 - Patch area clean and dry
 - Sandblasting sidewalls
 - Application of bonding agent
- Proper placement and curing

32

Full-Depth Repairs

33

Full-Depth Repairs

- Cast-in-place concrete repairs that extend the full-depth of the existing slab

Applications:

- Address structural deterioration
 - Cracks, corner breaks, shattered slabs, buckling
- Address severe spalling / joint lock up
- Utility cut repairs

34



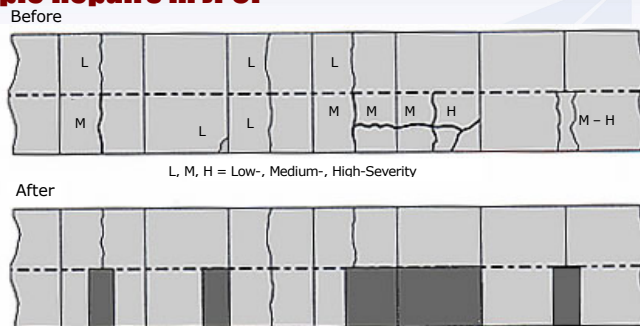
35

Full-Depth Repair – Limitations

- Does not address structural inadequacy
- Not a long-term solution for material-related distresses (e.g., ASR, D-cracking)
- Not cost-effective for widespread deterioration
- Potentially an expensive cost item

36

Full-Depth Repair Boundaries Example Repairs in JPCP



L, M, H = Low-, Medium-, High-Severity

NOTES
a – Minimum length is 4 ft
b – Check distance between patches and nearby joints

37

Load Transfer Design Example Layout

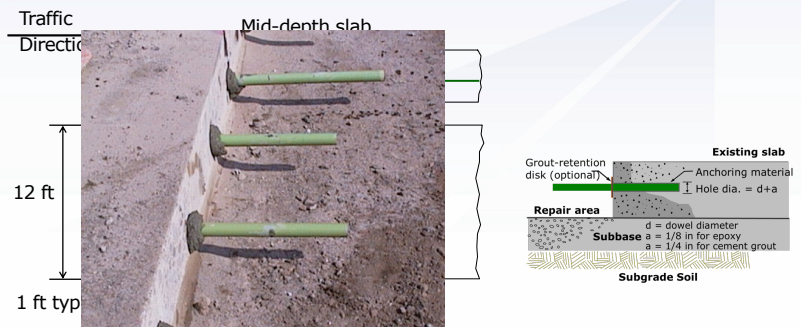


Fig. 6.5

38

Dowel Bar Retrofit (DBR)

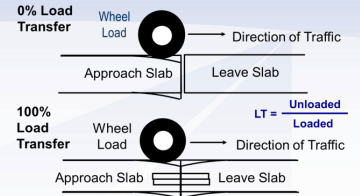




39

Dowel Bar Retrofit (DBR)

- Placement of load transfer devices across transverse joints or cracks of existing pavements



0% Load Transfer

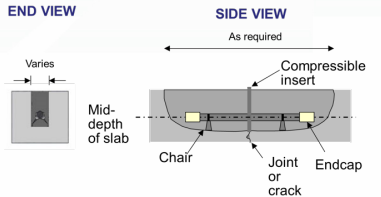
100% Load Transfer

LT = Unloaded / Loaded

Fig. 8.1 on p. 163

Applications:

- Faulted pavements and cracks
- Minimal structural issues



END VIEW

SIDE VIEW

Varies

As required

Mid-depth of slab

Chair

Joint or crack

Endcap

Compressible insert

40



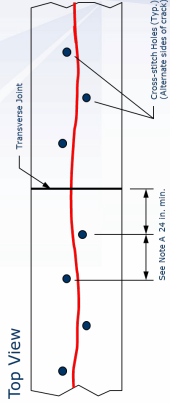
Key Factors For Success – DBR

- Selection of proper candidates
- Proper dowel bar design and layout
- Cutting of dowel bar slots
- Proper preparation of dowel bar slots
- Proper placement of dowel bar assembly
- Selection of appropriate material
- Careful material placement and curing




41

Cross Stitching

Transverse Joint

Cross-stitch-holes (Typ.) (Alternate sides of crack)

24 in. min.

See Note A

Top View

43

Diamond Grinding






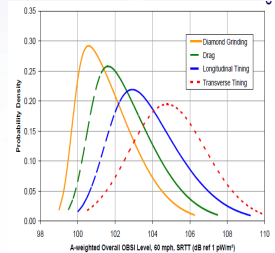
44

Diamond Grinding

- Removal of thin surface layer of concrete using closely spaced diamond saw blades

Applications:


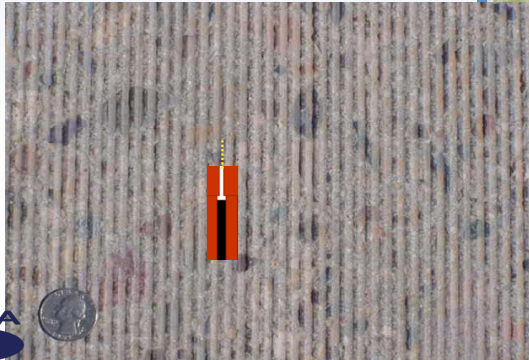

- Rough pavements
- Loud pavements
- Pavements in need of friction and safety improvements


Averagaged Overall CSI Level (dB ref 1 μW/m²)	Diamond Grinding (Probability Density)	Chig (Probability Density)	Longitudinal Tiling (Probability Density)	Transverse Tiling (Probability Density)
100	0.28	0.15	0.05	0.02
102	0.15	0.25	0.15	0.08
104	0.05	0.15	0.22	0.18
106	0.02	0.08	0.15	0.18
108	0.01	0.05	0.10	0.15
110	0.00	0.02	0.05	0.10

45

Diamond Grinding

46



47

Joint and Crack Resealing






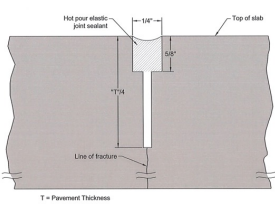
48

Joint and Crack Resealing

- Minimize water & incompressibles into pavement system

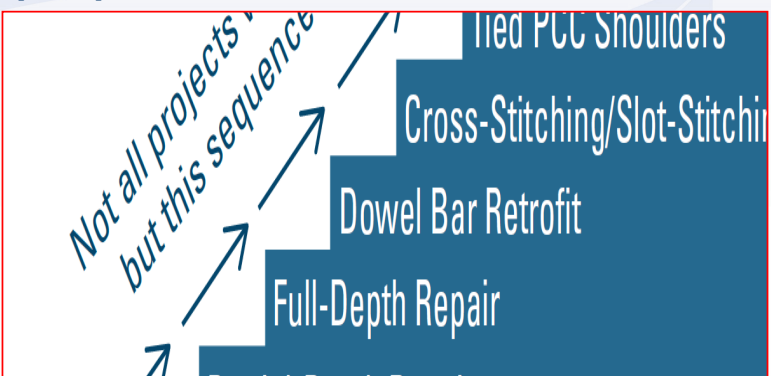
Reduces:

- Subgrade softening
- Pumping
- Erosion of fines
- Spalling

49

Utilizing these treatments appropriately helps meet and exceed expected performance life!



Not all projects but this sequence

Tied PCC Shoulders

Cross-Stitching/Slot-Stitching

Dowel Bar Retrofit

Full-Depth Repair

2nd Ed. Pg 257

50

Thank You! Questions?



Jason Reaves, P.E.
Executive Director
jreaves.sdacpa@midconetwork.com

Acknowledgement and thanks to

- IGGA
 - Larry Scofield
 - John Roberts
 - Nick Davis
- CP Tech Center



52