TEM / HEEP AREA V 2017
ANNUAL MEETING
04 - 07 June 2017
Dubrovnik / CROATIA
1 GENERAL OVERVIEW of HIGHWAY NETWORK
ROAD NETWORK IN TURKEY

Type: Village and Forest roads  
Responsibility: Special Provincial Administration

Type: Urban roads  
Responsibility: Municipal Authorities

Type: Motorways, State & Provincial roads  
Responsibility: General Directorate of Turkish Highways

The road network excluding urban roads is about 385,000 km in length
NATIONAL HIGHWAY NETWORK

- Total road network is 67.313 km.
- 37.5% of total road network (25.235 km) is dual carriageway

- Total Replacement Value: 67 Billion $
- Road Density: 50 km / 100 km² (Excl.Urban Roads)
- Motorway Density: 3.26/1000 km²

### Highway Network (Km)

- Provincial Roads: 33.689 km (50.0%)
- Motorways: 2.542 km (3.8%)
- State Roads: 31.082 km (46.2%)

### Surface Type (67.313 km)

- Asphalric Concrete: 21.161 km
- Surface Treatment: 42.119 km
- Stone Block: 295 km
- Stabilized: 642 km
- Other: 3.096 km

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NATIONAL HIGHWAY NETWORK (67,313 km)

- Turkish Road Network under General Directorate of Turkish Highways’ responsibility.
DOMESTIC PASSENGER & FREIGHT TRANSPORT 2015

**PASSENGER TRANSPORT**
- Railways: 1,1%
- Airlines: 9,1%
- Highways: 89,2%
- Sea Routes: 0,6%

**FREIGHT TRANSPORT**
- Railways: 3,9%
- Sea Routes: 6,3%
- Highways: 89,8%

**Passenger Transport**
Highways: 89,8 %

**Freight Transport**
Highways: 89,5%
PERCENTAGE OF GDP USED FOR HIGHWAY INFRASTRUCTURE INVESTMENT

INVESTMENT 2016 Fixed Price (Billion $)  Perc. Of GDP (%)

2005: 3.15 Billion $  0.52%
2006: 3.80 Billion $  0.60%
2007: 4.14 Billion $  0.53%
2008: 6.30 Billion $  0.74%
2009: 5.93 Billion $  0.87%
2010: 8.52 Billion $  1.05%
2011: 8.88 Billion $  1.06%
2012: 7.54 Billion $  0.91%
2013: 7.62 Billion $  0.90%
2014: 7.24 Billion $  0.89%
2015: 7.79 Billion $  1.08%
2016: 6.35 Billion $  0.74%

700 Million $ of this budget used for routine maintenance works, snow and ice removal, traffic signals and signs, guardrail construction, road marking.
REGIONAL DIVISIONS OF GDH

- 18 Regional Divisions
- 118 Subdivisions
- 277 Maintenance Houses
- 25 Motorway Maintenance and Operation Offices
- 2 Equipment and Supply Directories

GDH headquarter in Ankara

RD of PPP (Bursa)
ROAD MAINTENANCE WORKS

ROUTINE MAINTENANCE
Removing surface deformation on asphalt roads, corrugation and rutting on surface of stabilized road, repairing structures, such as, bridge, culvert, structures, clearing drainage systems, ditch and culverts as well as vegetation, etc.

SNOW AND ICE REMOVAL
Snow and ice removal has a considerable place in maintenance works. Removing snow and ice on roads during winter and providing a secure and smooth traffic flow are among these works.

EMERGENCY REPAIR
Maintenance in case of emergency and disasters

PERIODIC MAINTENANCE
To preserve the structural integrity of the road, or to enable the road to carry increased axle loadings.
ROUTINE MAINTENANCE

- Patching
- Surface Treatment
- Ditch Cleaning
- Maintenance of traffic signs and engineering structures
- Verge Cutting
# ROUTINE MAINTENANCE WORKS IN 2016

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance Works carried out by</td>
<td>395 (118 Subdivision, 277 Maintenance Houses)</td>
</tr>
<tr>
<td>Maintenance Crew</td>
<td>7,833</td>
</tr>
<tr>
<td>Machinery &amp; Equipment</td>
<td>6,011 &amp; 752</td>
</tr>
<tr>
<td>Aggregates used for asphalt patching</td>
<td>1,192,000 m³</td>
</tr>
<tr>
<td>Bitumen used for asphalt patching</td>
<td>130,000 Tonnes</td>
</tr>
<tr>
<td>Number of Planted Seedling (yearly average)</td>
<td>2,500,000</td>
</tr>
<tr>
<td>Number of GRP (Glass Reinforced Plastic) plates</td>
<td>900,000</td>
</tr>
</tbody>
</table>
PERIODIC MAINTENANCE
SNOW & ICE REMOVAL WORKS
SNOW & ICE REMOVAL WORKS IN 2016-2017 WINTER

Network In Operation
54.723 Km

Network In Operation (If Possible)
8 626 Km

Maintenance Works carried out by

Maintenance Crew
11 119

Machinery & Equipment
7 636

Aggregates used
264 614 m3

Salt Used
247 662 Tonnes

Length of snow fence
516 Km

Chemicals used for anti icing
808 Ton
MAINTENANCE IN CASE OF EMERGENCY AND DISASTERS
ASSET MANAGEMENT SYSTEM
ASSET MANAGEMENT SYSTEMS

Data Collection
- Inventory
- Riding Quality
- Surface Distress
- Pavement Strength
- Traffic flow/loading
- Bridges/Furniture

Database
- DBMS (RIMS)

Decision Support
- Analysis Models
  e.g. HDM-4

Management Information
- Standard & Custom Reports
ORGANIZATION CHART of MANAGEMENT SYSTEMS

Implementation Units
- Department of Maintenance
- Department of R&D
- Department of Structures
- Department of Traffic Safety

Standards Setting
- Department of Maintenance
- Department of R&D
- Department of Structures
- Department of Traffic Safety

Traffic & Transportation Statistics
- Department of Traffic Safety

Budget
- Department of Strategy Development

Technological Background
- Department of Information Technologies
PAVEMENT ASSET MANAGEMENT SYSTEM

- ROAD INVENTORY
- PAVEMENT INVENTORY
- PAVEMENT PERFORMANCE
- TRAFFIC COUNTS
- CLIMATE
- COST

DATABASE

ANALYSES
PAVEMENT ASSET MANAGEMENT SYSTEM FLOW CHART

1. Database Creation
   - Inventory Data
   - Structural Condition Data
   - Functional Condition Data
   - Visual Distress Evaluations

2. Pavement Current Condition Analysis
   - Structural Condition Analysis
   - Functional Condition Analysis

3. Pavement Condition Modeling
   - IRI Modeling
   - FWD Modeling
   - Skid Resistance Modeling
   - Surface Distress Modeling

4. Determination of Maintenance – Repair Alternatives

5. Benefit / Cost Analyses and Feasibility Analyses

6. Optimum Budget Management
PAVEMENT ASSET MANAGEMENT SYSTEM
ROAD PERFORMANCE TESTS
# PAVEMENT ASSET MANAGEMENT SYSTEM

## Pavement Pointing Table

<table>
<thead>
<tr>
<th>Personel Information</th>
<th>Points (A)</th>
<th>Distress Severity (A)</th>
<th>Distress Density (C)</th>
<th>Damage D = Ax B x C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LOW (0,4)</td>
<td>MEDIUM (0,7)</td>
<td>HIGH (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LOW (0,7)</td>
<td>MEDIUM (0,8)</td>
<td>HIGH (0,9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LOW (0,6)</td>
<td>MEDIUM (0,7)</td>
<td>HIGH (0,9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alligator Crack</td>
<td>10</td>
<td>X</td>
<td></td>
<td>2.8</td>
</tr>
<tr>
<td>Edge Craking</td>
<td>5</td>
<td>X</td>
<td></td>
<td>2.8</td>
</tr>
<tr>
<td>Transverse Crack</td>
<td>10</td>
<td>X</td>
<td></td>
<td>3.2</td>
</tr>
<tr>
<td>Longitudinal Crack</td>
<td>15</td>
<td>X</td>
<td></td>
<td>4.8</td>
</tr>
<tr>
<td>Block Cracking</td>
<td>10</td>
<td>X</td>
<td>X</td>
<td>9</td>
</tr>
<tr>
<td>Rutting</td>
<td>10</td>
<td>X</td>
<td></td>
<td>X 10</td>
</tr>
<tr>
<td>Waves</td>
<td>5</td>
<td>X</td>
<td>X</td>
<td>2.45</td>
</tr>
<tr>
<td>Local Settlement</td>
<td>5</td>
<td>X</td>
<td></td>
<td>2.45</td>
</tr>
<tr>
<td>Patch</td>
<td>5</td>
<td>X</td>
<td>X</td>
<td>1.2</td>
</tr>
<tr>
<td>Pathol</td>
<td>10</td>
<td>X</td>
<td></td>
<td>2.4</td>
</tr>
<tr>
<td>Bleeding</td>
<td>5</td>
<td>X</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Stripping</td>
<td>10</td>
<td>X</td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

**Total Damage**: 63.1

**Total Structural Damage**: 23.6

**100 - Total Structural Damage = PSp = 76.4**

**100 - Total Damage = PP = 46.9**

**Pavement Condition**: Low

## Pavement Condition

<table>
<thead>
<tr>
<th>Roughness Value (IRI - m/km)</th>
<th>Roughness Classification</th>
<th>Priority Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Absolute Perfect</td>
<td>6</td>
</tr>
<tr>
<td>0.71 - 1.11</td>
<td>Very Good</td>
<td>5</td>
</tr>
<tr>
<td>1.12 - 1.58</td>
<td>Good</td>
<td>5</td>
</tr>
<tr>
<td>1.59 - 1.80</td>
<td>Average - Good</td>
<td>4</td>
</tr>
<tr>
<td>1.81 - 2.13</td>
<td>Average</td>
<td>3</td>
</tr>
<tr>
<td>&gt; 2.13</td>
<td>Bad</td>
<td>2</td>
</tr>
<tr>
<td>&gt; 30</td>
<td>Very Bad</td>
<td>1</td>
</tr>
</tbody>
</table>

## Rutting Condition

<table>
<thead>
<tr>
<th>Rutting Value (TTO - mm)</th>
<th>Rutting Classification</th>
<th>Priority Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 5</td>
<td>Good</td>
<td>4</td>
</tr>
<tr>
<td>5 - 15</td>
<td>Average</td>
<td>3</td>
</tr>
<tr>
<td>15 - 30</td>
<td>Bad</td>
<td>2</td>
</tr>
<tr>
<td>&gt; 30</td>
<td>Very Bad</td>
<td>1</td>
</tr>
</tbody>
</table>
PAVEMENT ASSET MANAGEMENT SYSTEM
DECISION TREE FOR ASPHALT CONCRETE ROADS
PAVEMENT ASSET MANAGEMENT SYSTEM

<table>
<thead>
<tr>
<th>PCI</th>
<th>Pavement Condition</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 - 90</td>
<td>Very good</td>
<td>No action</td>
</tr>
<tr>
<td>90 - 75</td>
<td>Good</td>
<td>Routine maintenance</td>
</tr>
<tr>
<td>75 - 65</td>
<td>Fair</td>
<td>Maintenance/Overlay</td>
</tr>
<tr>
<td>65 - 40</td>
<td>Poor</td>
<td>Thick Overlay</td>
</tr>
<tr>
<td>&lt; 40</td>
<td>Very poor</td>
<td>Reconstruction</td>
</tr>
</tbody>
</table>

MAINTENANCE STRATEGIES

- Crack filling
- Patch
- Seal coat
- Slurry Seal
- Surface replacement
- Thin overlay
- Thick Overlay
- Reconstruction
PAVEMENT ASSET MANAGEMENT SYSTEM

PMS provides a tool to select the right road for the right treatment at the right time and a road network operation with high performance pavement can be made with minimum cost.
CONCLUSIONS
CONCLUSION

- It is important that road maintenance works are made on time to avoid negative effects on economic life of infrastructure.

- Proper road maintenance contributes to reliable transport at reduced cost, as there is a direct link between road condition and vehicle operating costs and travel time.

- Establishing and developing Road maintenance/Pavement management systems are crucial in order to use the limited budget more efficiently.

- Combining all asset management systems is important to give better decisions for the investments considering all of the assets of our road network.
THANK YOU FOR YOUR ATTENTION!

Mücahit ARMAN
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Serkan YILMAZ
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Mehmet ÇELİKKAYA
Expert Civil Engineer

General Directorate of Turkish Highways
Ministry of Transport, Maritime Affairs and Communications