

HDM-4 Version 2 – Practical Exercises

The following exercises are intended to be completed by the student to gain some familiarity with using HDM-4 and navigating through the user interface.

Where all the data is not explicitly specified you should make your own assumptions to enable you to complete the exercise.

CREATING ROAD SECTIONS

Add 2 new sections to the **Rural Roads** road network with the following characteristics:

- **Both Sections** have a carriageway width of 7 metres (shoulders of 1 metre), 2-lane roads with traffic flow in both directions.
- Geometry – ‘Mostly straight and gently undulating’
- Structural Adequacy and Compaction Quality – Good

Section 1

- Length = 34.8 km, overlaid with 40mm of asphalt in 2003 on an existing asphalt pavement of 50mm which was constructed in 1984, carrying 2500 vehicles/day in 2006.
- The adjusted structural number of the pavement (SNP) is 3.4.
- The drains are ‘surface lined’ which are in Fair condition.

Section 2

- Length = 25.7 km, resealed with 25mm of double surface dressing in 2002 on an existing 50mm asphalt surfacing which was constructed in 1993, carrying 1850 vehicles/day in 2006.
- The adjusted structural number of the pavement (SNP) is 2.8.
- The drains are ‘V shaped hard’ which are in Poor condition.

Pavement Condition

The condition of the sections in 2006 are as given in Table 1.

Table 1
Surface Condition

	Cracking (%)	Potholes (no.)	Edge Break (m ² /km)	Rut Depth (mm)	Ravelling (%)	Roughness IRI
Section 1	0	0	0	3	0	4.0
Section 2	2.0	0	0	5	0	4.7

CREATING VEHICLE FLEETS

Create a Vehicle Fleet called 'Test Vehicles' using the vehicle characteristics and unit costs shown below.

Table 2 - Motorised Vehicle Characteristics

Parameter	Car 4WD	Bus	Medium Goods	Heavy Goods
PCSE	1	1.6	1.4	1.6
No. of wheels	4	6	6	14
No. of axles	2	2	2	4
Tyre type	Radial	Radial	Radial	Radial
Base no. of recaps	1.3	1.3	1.3	1.3
Retread cost (%)	15	15	15	15
Annual km	22500	75000	80000	100000
Working hours	450	1200	1500	1800
Average life (yr)	9	10	8	8
Private use (%)	50	0	0	0
Passengers	3	50	6	4
Work related trips (%)	35	10	25	25
ESALF	0	2.5	4.3	4.6
Operating weight (kg)	2150	12600	12300	40000

Table 3 - Motorised Vehicle Economic Unit Costs

Parameter	Car 4WD	Bus	Medium Goods	Heavy Goods
New vehicle	18591	76408	59919	96639
Replacement tyre	98.5	230	355	420
Fuel / litre	0.55	0.59	0.59	0.59
Lubricating oil / litre	3.11	3.11	3.11	3.11
Maintenance labour / hr	1.94	1.94	1.94	1.94
Crew wages / hr	0	1.66	1.11	1.11
Annual overhead	275	1713	669	1291
Annual interest (%)	12	12	12	12
Passenger work time / hr	0.07	0.07	0.07	0.07
Passenger non-work time	0	0	0	0
Cargo / hr	0	0	0.02	0.02

Table 4 - Non Motorised Vehicle Characteristics

Parameter	Animal Cart	Cycle
Wheel type	Wooden	Pneumatic
No. of wheels	2	2
Wheel diameter (m)	1	0.7
Operating weight (kg)	1700	109
Payload (kg)	900	9
Average life (yr)	3	10
Working hrs	1300	530
Annual km	2500	4800
Passengers	1	0

Table 5 - Non Motorised Vehicle Economic Unit Costs

Parameter	Animal Cart	Cycle
Purchase cost	500	45
Crew wages / hr	0.07	0.07
Passenger time / hr	0.07	0.07
Cargo holding time / hr	0.01	0.01
Energy used (MJ)	0.25	0.2
Annual interest (%)	12	12

CONFIGURATION

Traffic Flow Pattern

Create a Traffic Flow Pattern with 3 periods as follows:

- Peak Time – 4 hrs a day – 5 days a week – 52 weeks a year 25% of AADT
- Off-Peak – 10 hrs a day – 6 days a week – 52 weeks a year 60% of AADT
- 3rd Period - remainder of traffic

Speed Flow Type

Create a Speed Flow Type with the following capacities:

Free Flow – 150; Nominal – 1200; Ultimate – 1450; Jam Speed – 30 km/h

Climate Zone

Create the following Climate Zones:

1. Sub-Humid with rainfall of 85 mm/month, 5 months of wet season
2. Sub-Tropical with Mean temp of 23 deg C and a range of 16 deg C

Aggregate Data

Add the following with appropriate representative values:

- Traffic – Very Low, Very High
- Road Class – District
- Roughness for District road class
- Add Surface Distress (Gravel Thickness) values for the 2 new traffic classes

RD Calibration Sets

In the Calibration Set 'Rural', add a new calibration item 'Test' for an **asphalt mix on an asphalt pavement**. Leave the calibration factors as the default values.

CREATING WORKS STANDARDS

1. Maintenance Standards

a) Create a Routine Maintenance Standard – called RM1 - that comprises the following:

- i) Drainage clearance – once a year
- ii) Miscellaneous – once a year
- iii) Patching Potholes – patch 90% when no. of potholes > 15
- iv) Sealing Wide Cracks – seal 75% of wide cracks when wide cracking > 10%

The costs of these works activities are given in Table 6.

Table 6 - Costs of Routine Works Activities

Activity	Economic	Financial	Units
Drainage	52.40	74.60	per km
Miscellaneous	198.40	283.40	per km per year
Patching	16.20	23.15	per m ²
Sealing	5.90	8.40	per m ²

b) To the Maintenance Standard created above and a new work item which consists of an 80mm thick Overlay (strength coefficient of 0.35) when Roughness > 7 IRI and the above Routine activities.

The costs of the overlay and the preparatory works activities are given in Table 7.

Table 7 - Cost of Overlay Activities

Activity	Economic	Financial	Units
80mm Overlay	17.60	24.35	per m ²
Patching	16.20	23.15	per m ²
Edge Repair	14.50	19.75	per m ²

2. Improvement Standards

a) Create an Improvement Standard that Upgrades a Gravel road by Sealing when the AADT > 500. The Seal is:

- i) 25mm double surface dressing, Structural Number = 3.2 (95% compaction)
- ii) The road is widened from 6.1m to 6.7m – i.e. by 0.6 metres
- iii) Duration of the construction is one year
- iv) The costs are 243,000 (economic) & 348,000 (financial) per km

b) Create an Improvement Standard that Widens an existing Asphalt 2-lane road to 4-lanes (i.e. widens by 6.7 metres) when the Volume/Capacity Ratio > 0.7. The construction is:

- i) 50mm of AC, Structural Number = 4.3 (97% compaction)
- ii) Duration of the construction is one year
- iii) The costs are 950,000 (economic) & 1,134,000 (financial) per km
- iv) The costs of the preparatory works (patching, sealing, edge break are as given in Table 6 and Table 7)

Project Analysis

See separate document

Calibration

In the Calibration Set 'National' create a new calibration item for bituminous pavements 'Calib M' – pavement type is AMAP. Leave values as defaults.

In Route 1 road network create a new section 'Calib M' based on the M-Fair-2 section, using Calib M calibration item.

Change the following condition values:

All Structural Cracking = 0

Ravelling = 0

Mean Rut Depth = 3

Rut Depth Standard Deviation = 1

All other parameters remain unaltered.

Create a new Project Analysis (by Section) 'Calibration'. Select Route 1 road network.

- i) Analysis Period = 8 years, starting in 2006
- ii) Output currency in US\$

Select the Calib M section for analysis. Assign Project 2 as the traffic growth rate. No maintenance specified for the analysis period.

Run the analysis and note the condition at end of year 8 (2013):

Roughness (IRI)

Total Cracking (ACRA)

No. of Potholes (NPT)

Edge Break (AEB)

Mean Rut Depth (RDM)

The objective is to calibrate the deterioration models so that the condition at the end of year 2013 is as follows:

Roughness (IRI) = 5.0 Kgm

Total Cracking (ACRA) = 30 Kcpa

No. of Potholes (NPT) = 50 Kpp

Edge Break (AEB) = 250 Keb

Mean Rut Depth (RDM) = 4.0 Krst