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IV. Maintenance Works

In line with governmental directives of government reengineering, streamlining of workforce and increasing of managed road lengths and to introduce the concept of private sector management, contract works of similar nature are combined as well as outsourcing more non-emergency projects to contractors to reduce official procedure for the purchasing department.



1) Maintenance Works

To upgrade the service quality of national expressway and to ensure traffic safety, the regular maintenance operation shall focus on repairing of roadbed, pavement and shoulder, operation and maintenance of bridges and tunnels, and maintenance of drainage facilities, road landscape, traffic safety facilities, etc. All levels of maintenance staffs periodically inspect his/her authorized section, in order to propose maintenance plan according to road condition and actual needs, and to deliver and conduct each maintenance works properly. By the end of 2008, total maintenance mileage was approximately 990 kilometers.

Maintenance facility statistic

Freeway/ Highway	Length (Kilometer)	Toll station (Each)	Interchange (Each)	Service area (Each)	Note
Freeway No.1	393.40	11	63	6	Including The Sijhih –Wugu Viaduct road section 20.7 Kilometre
Freeway No.2	20.40	-	4	-	
Freeway No.3	432.90	11	62	7	Including Nangang access road 1.4 Kilometres, Linbian extension to Dapingwan for 1km.
Freeway No.3A	5.60	-	1	-	
Freeway No.4	17.20	-	2	-	
Freeway No.5	54.20	1	6	1	
Freeway No.6	13.00	-	3	-	
Freeway No.8	15.50	-	2	-	
Freeway No.10	33.80	-	3	-	
No.2 Provincial Highway F	4.00	-	2	-	
Total	990.00	23	148	14	



2) Tunnel Maintenance and Management

There are 52 tunnels situated on Freeway sections that are already opened for traffic, including 2 tunnels in Freeway No.1, 4 in Freeway No.3A, 30 in Freeway No.3, 10 in Freeway No.5, 6 in Provincial Highway No.2F, with a total length of 72.8 kilometers. Normally, each area's Traffic Control Center monitors traffic in tunnels and if any accident occurs it will report for appropriate actions to be taken. Vehicles carrying dangerous cargos are stopped from entering the tunnel (exception for applied permit holders).

Aside from the daily patrols and monthly night road cleanliness schedule, all tunnel electrical and traffic control facilities are scheduled for weekly, fortnightly, monthly seasonally or yearly routine inspections and maintenance according to the facilities characteristic, functions and safety. Each year a full test is carried out to test functionality of all equipments to ensure safety and comfort to road users.



Freeway No.5 Hsuehshan tunnel



Freeway No.5 Hsuehshan tunnel north opening

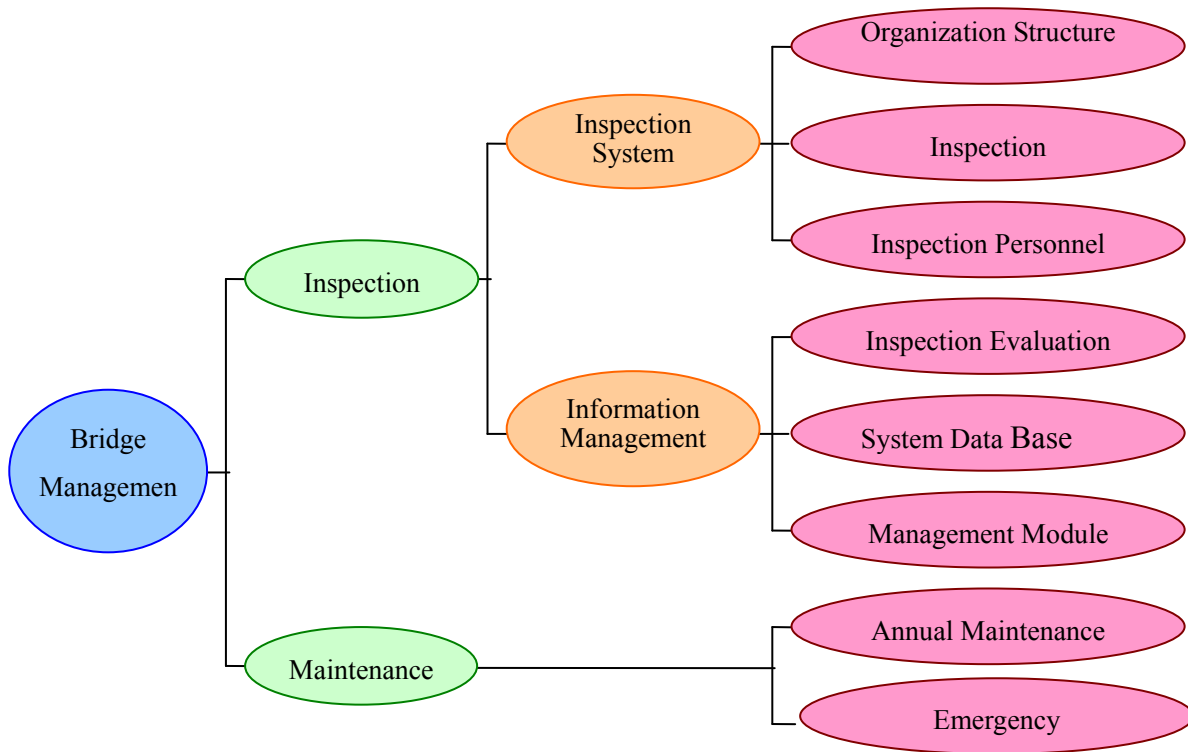
3) Bridge inspection, maintenance and management

As developing traffic infrastructure, the importance of river-crossing bridges and viaducts is increasing. However, domestic bridges are often threatened by human damages, such as car accidents and fires, and natural disasters, such as earthquakes and floods. Thus, present bridges shall be periodically inspected and completely filed, in order to perform safety evaluation per present damage situation and to propose maintenance and repair programs for the bridges.

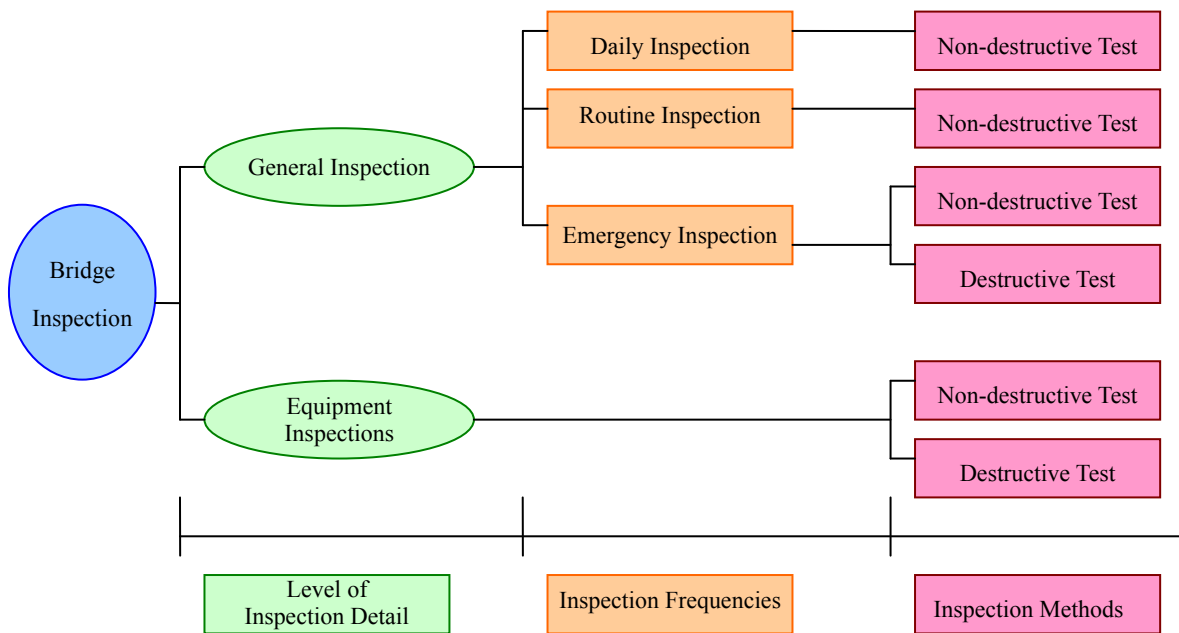
From 245 bridges on Freeway No.1 in 1978 to 2,160 bridges today, the responsibility of the Bureau is greater than before, especially on Freeway No. 1 as the freeway has been in use for 20 years and aging is evident, further stressing the need for regular inspections.



The structure diagram of bridge management system is shown below:



Structure Diagram of Bridge Management System



Category of National Highway Bridge Inspection



4) Freeway Environment

(1) Landscape and Vegetation

The Bureau manages the greenery on its lands, estimated total greenery coverage to be 2,626 hectares, 369 thousand trees and 1.75 million shrubs. Main works on landscape and vegetation includes:

a. Roadside Cleanliness and Vegetation Maintenance

In addition to the currently scheduled daily outer road shoulder sweeps by the work groups, they now combine inner road shoulder sweeps and garbage collection, the inner roadside cleanliness frequency was reduced to 2~4 times per month. During the operation, the work group needs to report to the central traffic control centre every 5km on their location so as to change the Changeable Message Sign (CMS) display to notify the public of the progress of work.

b. Overall Landscape Improvement Projects: Planning, Design and Constructions

Key focus on urban regional sections to improve the scenery of newly take-over regions, including National Freeway No.3 Gukeng – Linbian, National Freeway No. 8 and 10 landscape improvement projects and National Freeway No.3 Wurih interchange improvement project.

c. Landscape Improvement Projects along Freeway Widening Construction

To preserve our green resources and to reduce the impact of construction projects have on the vegetation, the planning of transplantation and new vegetation had been processed incorporating with the widening construction. This year's works include:

- (a) National Freeway No.1 Yunlin to Kaohsiung widening projects No. 540B(Tsenwen, Jishuei, Ba-Chan three river bridges), 543C (Singyin to Guanmiao), 551B 552B combined contract (Tainan urban area) have been completed.
- (b) Project of transplantation has been contracted incorporation with National Freeway No.2 widening project from Dayuan interchange to Dachu interchange.



d. Prevention and Removal of Foreign Invasive Species

Invasive species such as *Mikania micrantha*, *Eupatorium odoratum* Linn and *Leucaena leucocephala* not only grow quickly, they also spread rapidly to cause a major threat to the local flora.

The Freeway Bureau has followed the recommendations by the Forestry Bureau and is actively removing invasive species and accelerate vegetation restoration on slopes to establish biodiversity to prevent reinvasion.

Limited by labor and funding, unperiodically hacking away is conducted on *Leucaena leucocephala* growth regions. Hacking away area also includes sowing native arbor and shrub species to prevent reinvasion. Other invasive plants treatments are outlined below.

(a) *Mikania micrantha* :

According to the *Mikania micrantha* removal plan of the Bureau set down since May 2005, the spread and location of the specie are to be identified in the growth season in May each year, from July to September the areas are hacked away once per month and in its flowering season in October to November the remaining plants are hacked away and a review is taken to assess the effect of the works.

These studies and data are taken in January to February each year to the Endemic Species Research Institute of Council of Agriculture to assess progress of actual species spread and total removal areas to closely monitor the scale of the invasion. In 2006 the Bureau hacked away 4.95 hectares, with 9.87 hectare invasive area remained, which covering Baihe, Pingdong, Nantou regions. In 2007 the Bureau hacked away 16.89 hectares, with 8.29 hectares invasive area remained, covering Baihe, Pingdong, Nantou and Miaoli regions. In 2008 the Bureau hacked away 23.58 hectares, with 1.53 hectares invasive area remained, covering Baihe, Pingdong, Nantou and Miaoli regions.



(b) *Eupatorium ordoatum* Linn :

Referring to the timing of *Mikania micrantha* removal plans and assessments, the spread and location of the species are to be identified in the growth season in May to June each year, from August to October the areas are hacked away once per month and in its flowering season in December to January of next year the remaining *Eupatorium ordoatum* are hacked away and a review is taken to assess the effect of the works. In 2006 the Bureau hacked away 3.21 hectares, with 0.95 hectare invasive area remained. In 2007 the Bureau hacked away 1.17 hectares, with 1.65 hectares invasive area remained. In 2008 the Bureau hacked away 3.72 hectares, with 22.85 hectares invasive area remained, which covering Guansi, Baihe, Pingdong, Nantou and Miaoli regions.

e. Research and Development

To understand environmental impacts of freeway facilities and landscaping, a sustainable development strategy is needed for the road facilities and landscape plantings so that they can better harmonize with the environment. The Bureau has operated “Research of Sustainable Development and Environmental Restoration in the Operation Phase of Freeway” The 3-years plan from December 2008 will provide the suggestion of sustainable development and environmental ecology to maintenance management policy. The plan will also draft the methods of establishing the roadside ecological database regularly and related researches. It will provide environmental friendly proposals, reducing the fragmentation effect of freeway to the surrounding areas and ecology.



Guansi interchange ramp scenery



Bletilla striata in Dajia region roadside slope



(2) Red Imported Fire Ants (RIFA) Control

Since the first prevention meeting from May 2004. The Bureau identified 25 areas of fire ant infestation and a total infestation area of 110 hectares. Through the efforts of the engineering office, invasive identified sites of RIFA have been reduced to 9 locations with total area coverage of 87.4 hectares (75.6 hectares in National Freeway No. 1 and 11.8 hectares in National Freeway No. 2).

Currently the bureau has included RIFA detection into regular maintenance and patrols. Once RIFA invasion is identified, control measures will be implemented within 1 week, in the next 2 weeks the area is inspected once a week. The Bureau fills out the result monthly on the “Plant Health Surveillance Web”. The non-invasive sites are still inspected and applied pesticide regularly to prevent re-infestation. Also all plantation projects and movement of soil are also checked for RIFA presence to prevent spread.

(3) In accordance to the 2008 “Strengthening Local Construction Expanding Internal Demand” Operations

- a. Taichung City: Interchange and expressway traffic island improvement (freeway section)
- b. Changhua County: Chunghua interchange space utilization plan
- c. Pingdong County: National Freeway No. 3 under bridge (Nanchou-Linbian) roadside landscape project (Stage 2)
- d. Pingdong County: National Freeway No. 3 under-bridge (Provincial highway 1- 24) roadside landscape project.
- e. Pingdong County: Pingdong transportation and tourism improvement plan, Freeway No. 3 under-bridge (Northern Chutian) roadside landscape project.
- f. Taipei County: Sanchong Yong-an road culvert underpass National Freeway project (including roadside improvement works)



5) Pavement Rehabilitation Works

Asphalt concrete pavement usually have a service life about 7 years, however with Taiwan located in the tropical regions with high moisture and temperatures, the pavement deterioration out faster and require maintenance in about 5 years. Freeway No. 1 has since 1982 began its 5-year rehabilitation plan, and in 1992 began its second rehabilitation schedule. Each plan is broken down into sections and was completed by 1996. To maintain the quality and safety of the freeway, the budget continues to include pavement rehabilitation funds and repairs deterioration to the freeway.

Major Road maintenance works in 2008

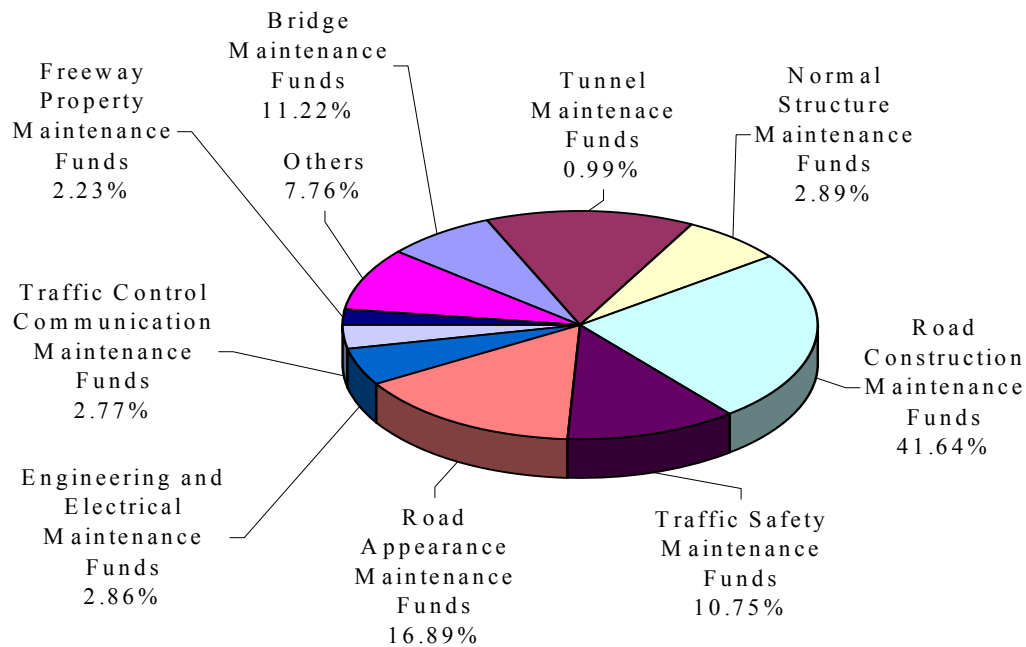
Type	Project Name	Length(m)	Area(m ²)	Budget (1000 NTD)
1	National Freeway No.1 Sanchong-Linko section AC pavement restoration.	56,460	211,726	47,440
2	National Freeway No.1 Keelung- Neihu section AC pavement restoration works	30,444	114,166	47,500
3	Neihu Section Concrete pavement restoration.	647	1,941	4,987
4	National Freeway No.1 Jhongli Section (1) AC pavement restoration.	33,904	127,140	44,200
5	National Freeway No.1 Jhongli Section (2) AC pavement restoration.	39,685	148,817	48,600
6	2007 Annual Guansi section National Freeway No. 3 Guansi to Siangshan and National Freeway No.1 Hsinchu AC pavement restoration works	37,097	138,638	40,450
7	Guansi section Tucheng-Guansi AC pavement restoration.	31,378	117,917	45,600
8	2008 Annual Guansi section National Freeway No. 3 Guansi to Siangshan and National Freeway No.1 Hsinchu AC pavement restoration.	21,933	82,864	17,550
9	Guansi section concrete pavement restoration works	130	468	5,060
10	National Freeway No. 3 Muzha to Jhonghe section AC pavement restoration works	3,000	92,395	46,190
11	Dawuluan tunnel northern entrance concrete pavement restoration works	43	473	2,447
12	National Freeway No.1 Baoshan to Gongguan section pavement restoration maintenance.	45,779	169,382	45,253
13	Miaoli section Houli to Tanzih National Freeway No.4 pavement restoration works	44,067	182,348	48,210
14	National Freeway No.3 Sibin to Dajia road section pavement restoration.	32,191	127,482	44,059
15	National Freeway No.3 Holong to Sihu section pavement restoration.	5,245	19,144	13,994
16	National Freeway No.3 Dajia section pavement restoration works	9,440	35,371	22,580
17	National Freeway No.3 Dajia section concrete pavement restoration works	193	703	2,342



18	National Freeway No.1 Wangtian to Changhua section asphalt pavement restoration	20,908	163,653	24,939
19	Yunlin and Tounan toll station concrete pavement restoration works	1,313	114,492	6,820
20	National Freeway No.1 Changhua to Yunlin section asphalt and concrete pavement restoration	38,302	148,702	31,802
21	National Freeway No.1 Yunlin system asphalt and pavement restoration	18,900	70,812	31,360
22	National Freeway No.1234k- 237k asphalt pavement restoration	8,300	29,135	8,923
23	National Freeway No.1 Daya, Taichung, Nantun interchange asphalt pavement restoration	8,739	48,940	19,150
24	National Freeway No.3 Taichung Changhua section asphalt pavement restoration	40,658	148,402	20,180
25	National Freeway No.3 Nantou to Yunlin section asphalt pavement restoration	58,451	213,346	39,350
26	National Freeway No.3 Nantou section concrete pavement restoration	620	3,570	18,200
27	National Freeway No.3 Chushan interchange access road and southern off ramp asphalt pavement restoration	1,250	9,371	6,327
28	Sinying section concrete pavement restoration works	12,900	49,000	2,730
29	Sinying section asphalt pavement restoration	1,500	5,700	19,450
30	Sinying service station asphalt pavement restoration	2,204	26,896	5,930
31	Sinying service station large vehicle parking space concrete pavement restoration works	218	1,080	18,200
32	National Freeway No.1 Yongkang-Kaohsiung widening roads section original lane pavement restoration	29,174	111,162	39,670
33	National Freeway No.10 Dingji- Yenchao road section asphalt pavement restoration	34,930	134,632	24,239
34	Gangshan section concrete pavement restoration works	245	931	6,054
35	Gangshan section add pavement maintenance works	1,094	4,224	6,310
36	National Freeway No.3 Gukang-Baihe section asphalt pavement restoration	18,500	205,035	22,850
37	National Freeway No.3 Baihe section concrete pavement restoration works	13,000	5,000	13,970
38	National Freeway No.3 Baihe-Guangmiao section asphalt pavement restoration	12,000	138,000	23,200
39	National Freeway No.3 Baihe section add pavement maintenance works	88,000	19,000	10,557
40	National Freeway No.3 358k- 430k asphalt pavement restoration	59,998	227,994	29,500
41	National Freeway No.10 18k- 33k asphalt pavement restoration	32,545	123,675	16,500
42	Pingdong section concrete pavement restoration works	186	708	6,781
43	Pingdong section add pavement maintenance works	1,545	5,873	10,950
Total		897,116	3,580,308	990,404



6) Maintenance Funds



●2008 National Freeway Maintenance Analysis Table

2008 National Freeway Maintenance Analysis Table

Unit : 1,000 NTD

Item	Northern Region Eng. Office N.E.B.	Central Region Eng. Office N.E.B.	South Region Eng. Office N.E.B.	Total	Scale
Bridge Maintenance Funds	61,850	205,227	57,101	324,178	11.22%
Tunnel Maintenance Funds	9,504	0	19,184	28,688	0.99%
General Structure Maintenance Funds	5,392	39,716	38,456	83,564	2.89%
Pavement Maintenance Funds	391,719	531,006	280,689	1,203,414	41.64%
Traffic Safety Maintenance Funds	90,288	126,046	94,416	310,750	10.75%
Road Landscape Maintenance Funds	145,974	206,912	135,200	488,086	16.89%
Electrical Maintenance Funds	38,838	1,916	41,858	82,612	2.86%
Traffic Control Communication Maintenance Funds	37,548	480	41,958	79,986	2.77%
Road Property Maintenance Funds	33,510	3,994	26,811	64,315	2.23%
Others	2,885	131,427	90,024	224,336	7.76%
Total	817,508	1,246,724	825,697	2,889,929	100.00%



7) Road Property

Region Eng. office			Nothern Region Eng. Office N.E.B.	Central Region Eng. Office N.E.B.	Southern Region Eng. Office N.E.B.	Total
Item						
Pavement (km)	Asphalt	4 lanes	84.550	13.460	70.240	168.250
		Concrete Pavement	44.540	73.080	0	117.620
	Concrete Pavement	5 lanes	101.058	187.180	237.080	525.318
		6 lanes	24.167	35.610	0	59.777
		7 lanes	24.497	20.010	8.620	53.127
		8 lanes	12.859	1.680	0	14.539
		9 lanes	0.150	0	3.210	0.150
		10 lanes				
	Portland Concrete Pavement		17.688	12.570	14.725	44.983
Bridge (unit)	River Bridge		152	217	164	533
	Transverse Bridge		95	88	113	296
	Crossing Bridge		222	198	246	666
	Others		148	82	90	320
	Viaduct		100	143	79	322
Tunnels (unit)			46	0	6	52
Culverts (unit)	Drainage		257	588	508	1,353
	Pass through		235	358	340	933
Pipe culvert (Meter)			16,638	11,131.5	66,055.9	93,825.4
Guard Rail (Meter)	W-bear Guardrail		630,485	773,998	520,596	1,925,079
	Concrete Barrier		526,921	230,333	467,950	1,225,204
Sign (unit)	E-shaped marking plate		1,223	814	1,566	3,603
	T-shaped marking plate		3,536	3,002	2,772	9,310
	Overhead sign		272	441	645	1,358
Interchange (unit)			64	44	42	150
Service Area (unit)			4	5	5	14
Defence Road (unit)			0	1	3	4
Toll Station (unit)			7	8	8	23
Weight Station (unit)			18	15	16	49
U-turn lane (unit)			80	51	46	177