

CHAPTER 9 APPROXIMATELY COST ESTIMATION OF COUNTERMEASURE

9.1 Basic principle of preparation of cost sheet

On the subject of slope disaster management for roads, it is very important to accurately estimate the cost of countermeasures.

Table 6.4.1 shows the types of works, specifications and approximate unit rate.

The table gives a comprehensive list of the possible types of works and specifications, so some types listed are rare and may not normally be constructed in Malaysia.

There are many specifications for a given work type, and the cost can differ according to the particular specifications, so in the table, the most important specification is listed and the unit rate estimated.

The unit rates are estimates only for use in slope disaster management. Therefore, at the time of construction of countermeasures, detailed investigation should be done and an expert engineer would decide the suitable countermeasure, specifications and actual cost.

9.2 Procedures of fixing of typical cost in the list

Unit rate of countermeasures were determined by discussion between members of JICA study team and JKR staff. The JICA study team also investigated the unit rate with other engineers in Malaysia.

Unit rate includes all costs, such as labour, material, machinery, temporary works, overheads, and benefits etc.

Unit rate is local cost in Malaysia, and at the year 2001.

It is difficult to estimate the unit rate for types of works that have not been constructed in Malaysia. So, the ratio of unit rate of works known in both Malaysia and Japan was calculated, and then this ratio applied to the Japanese unit rate for works unknown in Malaysia to obtain an estimate of the unit rate for Malaysia.

9.3 Suggested policy for future periodical review of pricing

These unit rates should be reviewed at least once a year for use in SIMS.

The method of review should depend on the ratio of a price index.

In this case it is advisable to separate the cost into labour costs and other costs, such as material costs, machinery costs, and review the unit rate.

Table 9.3.1 Countermeasure Options

Work Item	ID	Countermeasure (Type of works)	Description (Specification)	Unit	Rate (RM)
1 Earthwork	11	Removal	--	m ³	2.00
	12	Rock Cutting	Rock Excavation	m ³	15.00
	13	Rock Pre-Splitting	Rock Blasting	m ²	70.00
	14	Soil Cutting	Soil Excavation (bulk quantity)	m ³	5.00
	15	Embankment	Backfill & Import Suitable Fill	m ³	8.00
2 Vegetation	21a	Re-Vegetation	Supply & lay spot turfing including 100mm thick top soil	m ²	3.00
	21b	Re-Vegetation	Close turfing	m ²	3.50
	22	Hydroseeding	--	--	2.50
3 Water Drainage	31	Drain Ditch and Cascade	Concrete G15 cast-in-situ at any inclination along the berm of slopes including excavation, BRC A7 joints with existing drain	m	160.00
	32a	Subsoil Drainage Hole	Layer of coarse sand as subsoil drainage blanket	m ³	35.00
	32b	Subsoil Drainage Hole	Approved filter media layer	m ³	45.00
	33a	Horizontal Drain Hole	Supply, drill & install ϕ 75mm perforated PVC pipe wrapped with a layer of Geotextile filter fabric of 3.0m into rock slopes	nos.	450.00
	33b	Horizontal Drain Hole	Supply, drill & install ϕ 50mm perforated PVC pipe wrapped with a layer of Geotextile filter fabric of 9.0m length including construct drain outlet to existing berm drain	nos.	600.00
	34	Drainage Well	(To be estimated each case)	--	--
	35	Drainage Tunnel	(To be estimated each case)	--	--
4 Slope work	41a	Shotcrete (Mortar)	Minimum 75mm thickness shotcrete facing c/w one layer welded steel mesh ; supply BRC, ϕ 50mm PVC pipe with geotextile	m ²	100.00
	41b	Shotcrete (Mortar)	Minimum 125mm thickness shotcrete facing c/w two layers welded steel mesh	m ²	150.00
	42	Shotcrete (Concrete)	--	m ²	300.00
	43	Cribwork (Precast)	--	m ²	200.00
	44	Stone Pitching	--	m ²	500.00
5 Anchoring	51a	Soil Nailing	60 kN working load with minimum required length of 6 m inclusive of 0.5 m fixed length into rock	nos.	600.00
	51b	Soil Nailing	--ditto--with minimum required length of 9m	nos.	850.00
	51c	Soil Nailing	--ditto--with minimum required length of 12m	nos.	1,200.00
	51d	Soil Nailing	--ditto--with minimum required length of 12m in soil	nos.	1,000.00
	52	Rock Bolt	200 kN working load with minimum required length of 4.0 m	nos.	1,500.00
	53	Ground Anchor	Design & construct post-tensioned trial permanent ground anchors ; 300 kN working load	nos.	5,000.00
6 Wall	61a	Gabion Wall	Galvanized (For dry application)	m ³	45.00
	61b	Gabion Wall	PVC coated (For wet condition)	m ³	65.00
	62	Stone Pitching	--	m ³	70.00
	63	Concrete Block Wall	Precast concrete block	m ³	280.00
	64	Retaining Wall (Supported Type)	Concrete + reinforcement	m	400.00
	65a	Crib Wall (Precast)	Single header (4.5 m – 5.0 m)	m	210.00
	65b	Crib Wall (Precast)	Double header (5.0 m – 8.0 m)	m	300.00
	65c	Crib Wall (Precast)	Triple header (8.0 m – 12.0 m)	m	500.00
	66	Pile Wall (PC / RC)	Spun pile ϕ 800 mm : Supply + install	m	260.00
	67	Pile Wall (PC/RC)	RC pile (400 x 400) : Supply + install	m	110.00
	68a	Pile Wall (in-place)	Bored pile ϕ 600 mm : Concrete + Reinforcement + Link + Boring	m	170.00
	68b	Pile Wall (in-place)	Bored pile ϕ 750 mm : Concrete + Reinforcement + Link + Boring	m	250.00
	68c	Pile Wall (in-place)	Bored pile ϕ 900 mm : Concrete + Reinforcement + Link + Boring	m	350.00
	68d	Pile Wall (in-place)	Bored pile ϕ 1,050mm: Concrete + Reinforcement + Link + Boring	m	450.00
69a	Pile Wall (Steel Sheet Pile)	Supply & deliver to site Type FSP IIIA steel sheet pile	kg	2.10	
69b	Pile Wall (Steel Sheet Pile)	Handle, pitch and drive steel sheet pile	nos.	100.00	
7 Piling	71	Steel Pipe Pile	Steel pipe ϕ 400 mm	m	2,000.00
	72	H Steel Pile	H steel (400 x 400) --	m	2,000.00
	73	Shaft Work for Resistance Slide	(To be estimated each case)	--	--
8 Protection Work	81	Rock Fall Catch Net	--	m ²	100.00
	82	Rock Fall Catch Fence	Supply & erect PVC coated chain link fence including concrete kerbs, posts, struts, staining wires, barbed wires etc. (Reservoir compound)	m ²	200.00
	83	Rock Shed	--	m ³	400.00
	84	Debris Shed	--	m ³	400.00
	85	Slit Dam	--	m ³	300.00
	86	Check Dam (Sabo Dam)	--	m ³	300.00
9 Others	91	Diversion (Shifting)	(Earth work and structure work should be estimated each case)	m	300.00
	92	Route Relocation	(To be estimated each case)	m	--

CHAPTER 10 EXAMPLES OF COUNTERMEASURE DESIGN

This section shows the examples of countermeasure in Malaysia and Japan.

Table 10.1.1 shows countermeasures for each failure types.

Table 10.1.1 Example of Countermeasure Works

Original	Figure	Failure Type	Size/ Volume	Countermeasure Works	Notes
Proposed Slope Stabilisation Works at KM17.4, Jaran Serian/ Tebedu, Samarahan Div., Sawarak, Malaysia	10.1.1	CL	Length 40m	- Gunnite Grid and Soil nail	-
	10.1.2		Width 20m	- Gabion Wall - Vegetation - Geotextile - Drainage	
Progress Mitigation Works Against Debris Flow for slopes at KM 39, Route 68, Kuala Lumpur-Bentong Road, Gombak, Serangor Darul Ehsan, Malaysia	10.1.3	DF/CL	Height 30m	- Road Relocation	-
	10.1.4		Width 10m	- Geotextile - Catch Gabion - Drainage	
Cadangan Kerja-Kerja Pembaikan Cerun Dan Kerja-Kerja Berkaitan DiLaLuan 4, Jaran Timur-Barat Design Drawings	10.1.5	CL	Length 100m	- Bore Pile with Ground Anchor - Vegetation	-
	10.1.6	CL/RF	Height 20m	- Remove/cutting	-
	10.1.7		Width 50m	- Gunnite - Retaining wall - Ground Anchor - Catch Drain	
Countermeasure for cutting in 2 nd Tomei Highway at Okabe area, Shizuoka pref. Japan	10.1.8	CL	Height 40m	- Precast Crib	-
	10.1.9		Width 200m	- In-Cast Crib - Ground Anchor - Soil Nail - Vegetation	
Landslide Prevention Project at Sumoto area, Osaka, Japan	10.1.10	LS	Length 250m	- Road Relocation	-
	10.1.11		Width 170m	- Countermeasure Embankment - Ground Anchor - Steel Pipe Pile - Gunnite Crib - Rock Bolt - Drainage Well - Horizontal Drain Hole - Drainage (With Rock Gabion)	
Road Disaster Mitigation Project at Route 140, Oodawara area, ChiChibu, Saitama pref, Japan	10.1.12	RM	Height 50m	- Ground Anchor	-
	10.1.13		Width 35m	- Rock Bolt - Gunnite Crib	

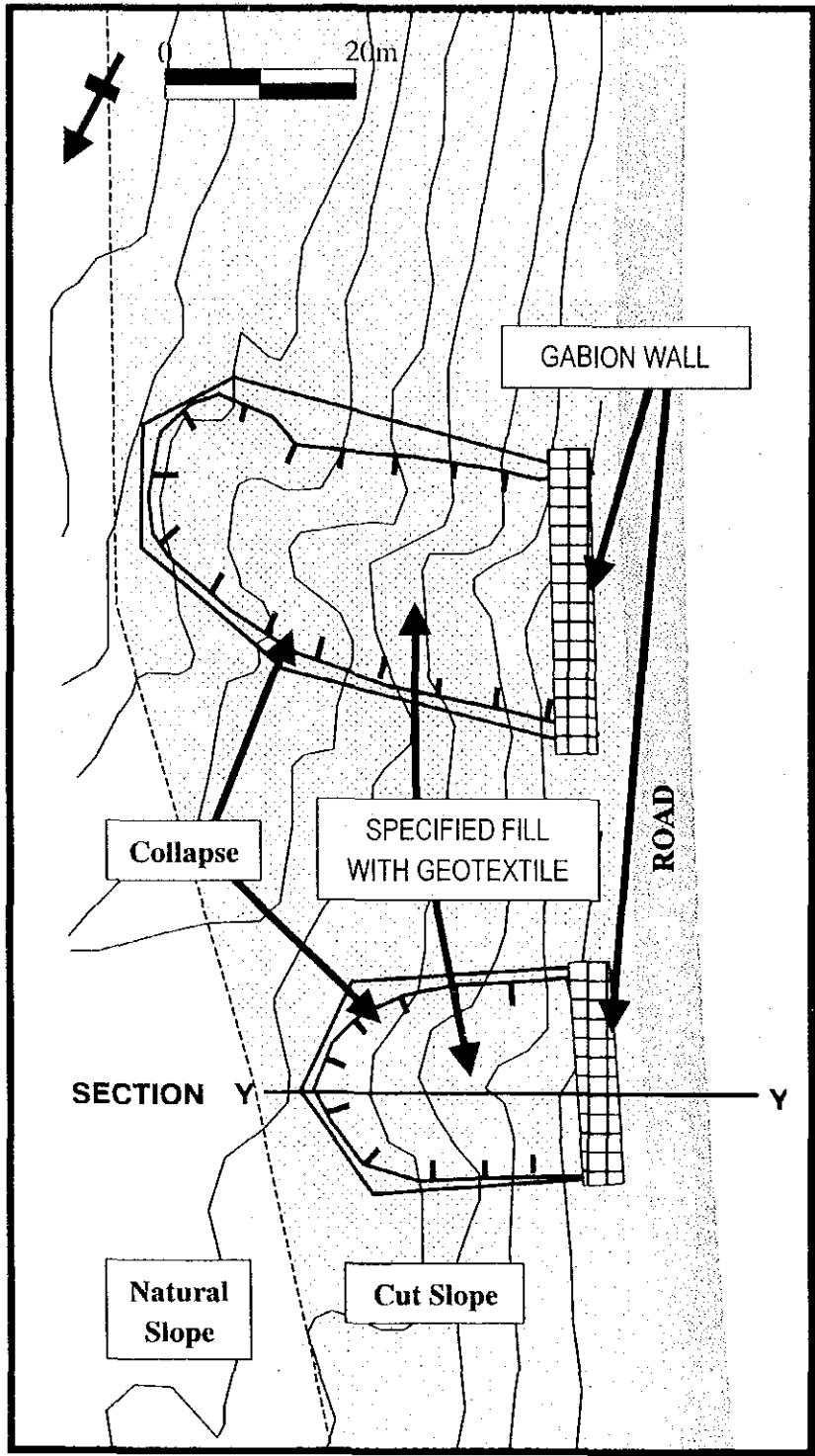


Figure 10.1.1 Countermeasure of Collapsed Slope (CL)

(After Final Design Report of Proposed Repair to Bukit Binong Slope along Jalan Serian/Tebedu Samarahan Division, Sarawak)

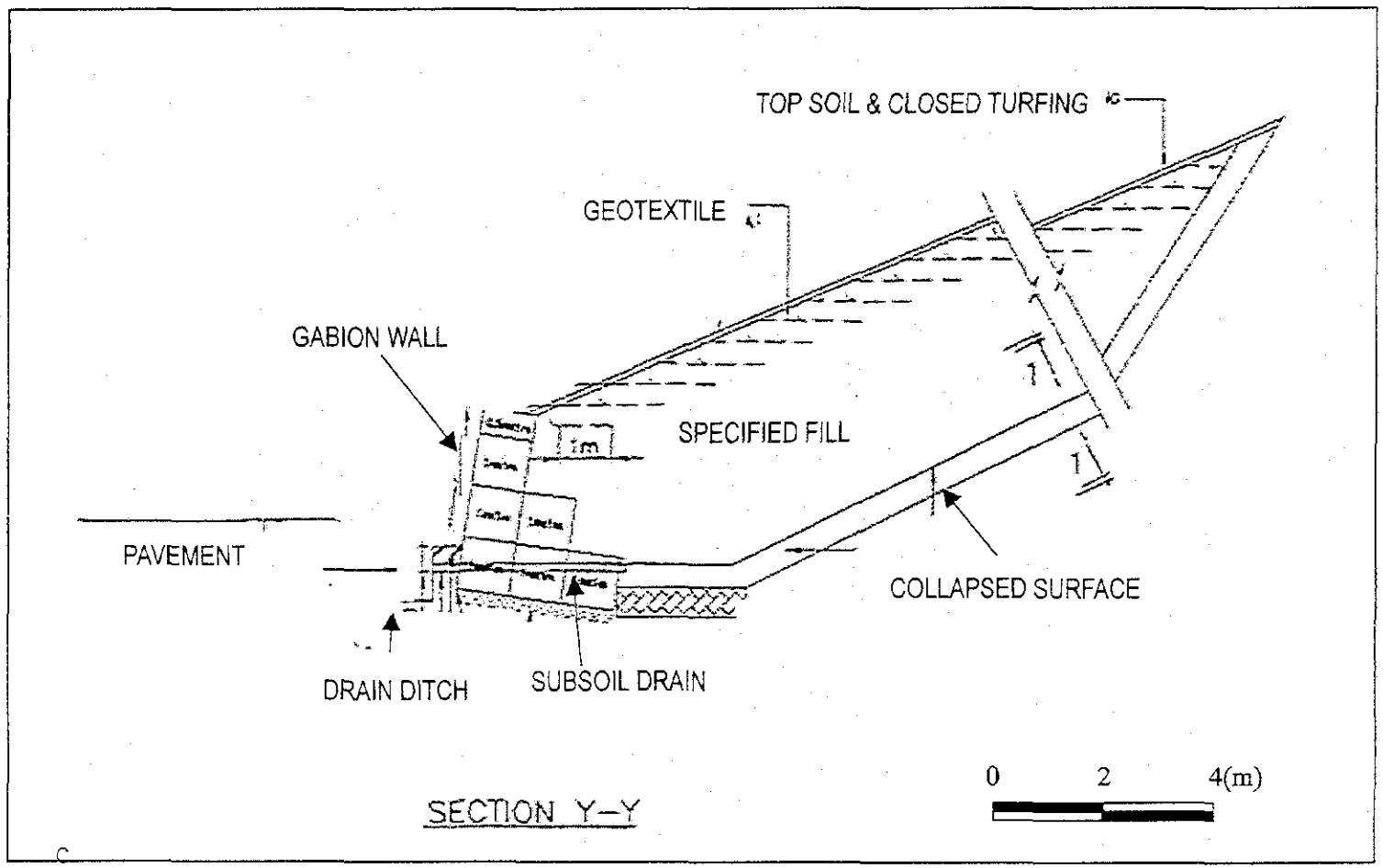


Figure 10.1.2 Design Details of Countermeasure in Section. (DF)

(After Final Design Report of Proposed Repair to Bukit Binong Slope along Jalan Serian/Tebedu Samarahan Division, Sarawak)

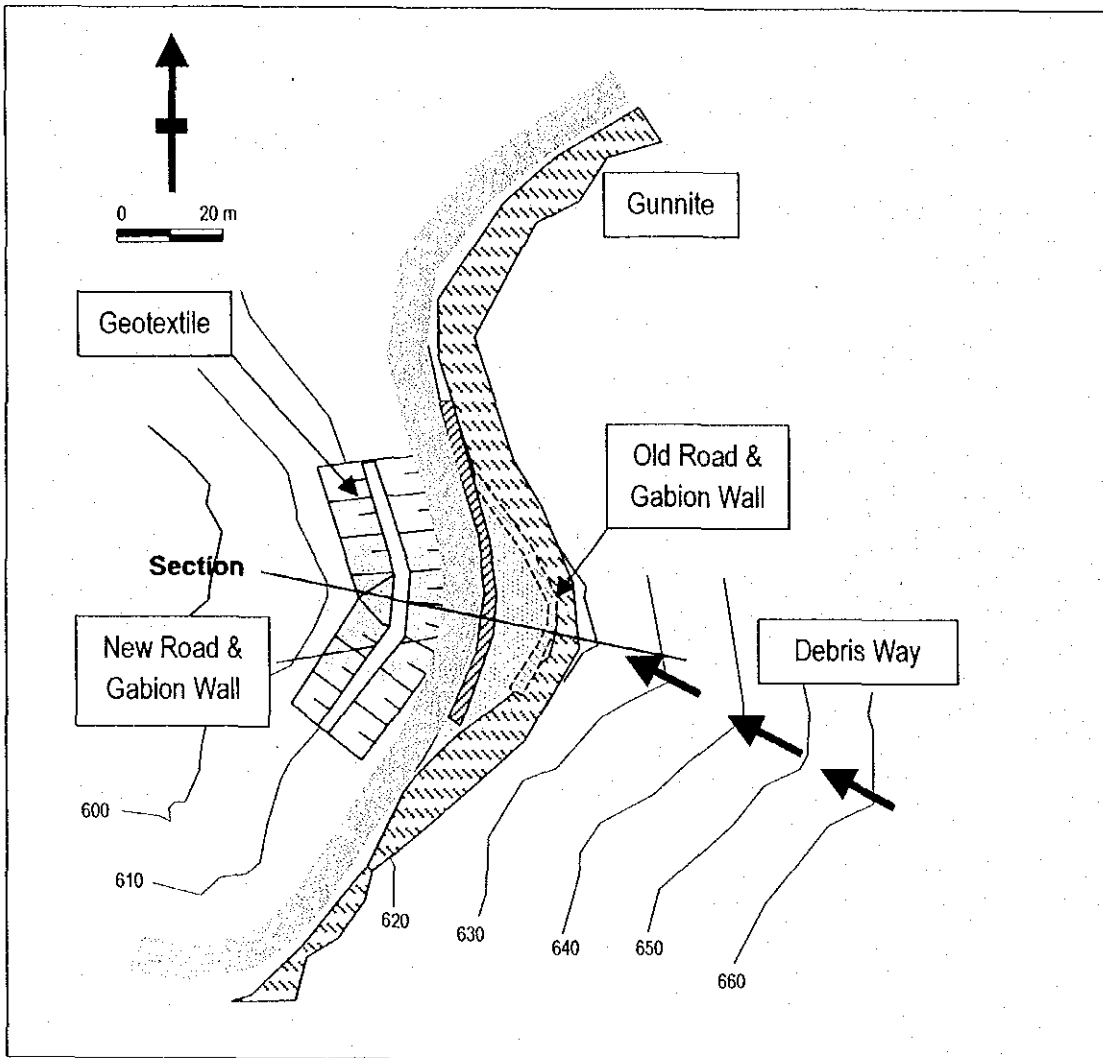


Figure 10.1.3 Designs of Countermeasure against Debris Flow. (DF)

(After Progress Mitigation Works against Debris Flow for Slopes at KM 38.4 & KM 39, Route 68, Kuala Lumpur – Bentong Road, Gombak, Serangor Darul Ehsan)

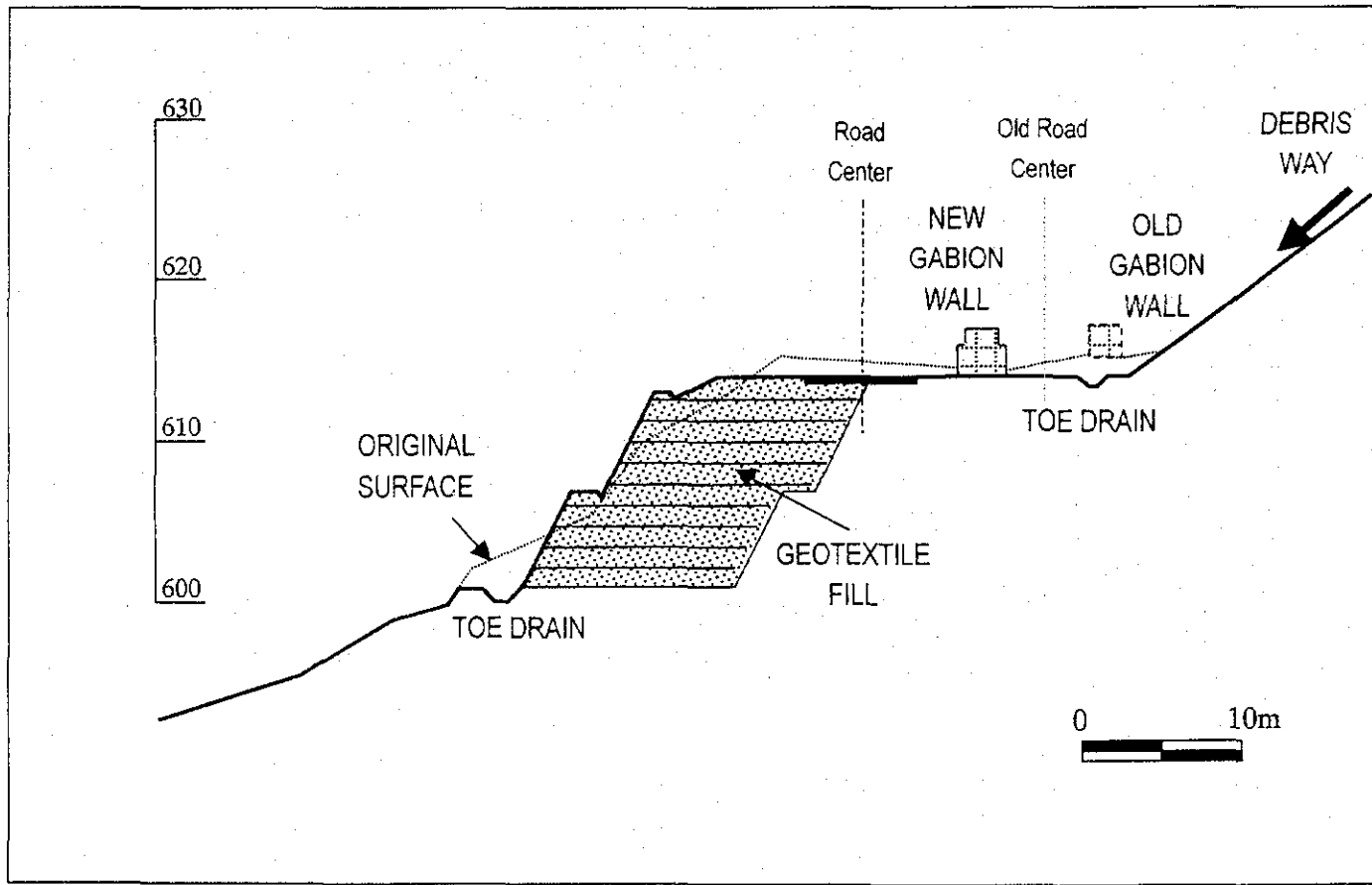


Figure 10.1.4 Design Details of Countermeasure in Section.

(After Progress Mitigation Works against Debris Flow for Slopes at KM 38.4 & KM 39, Route 68, Kuala Lumpur -Bentong Road, Gombak, Serangor Darul Ehsan)

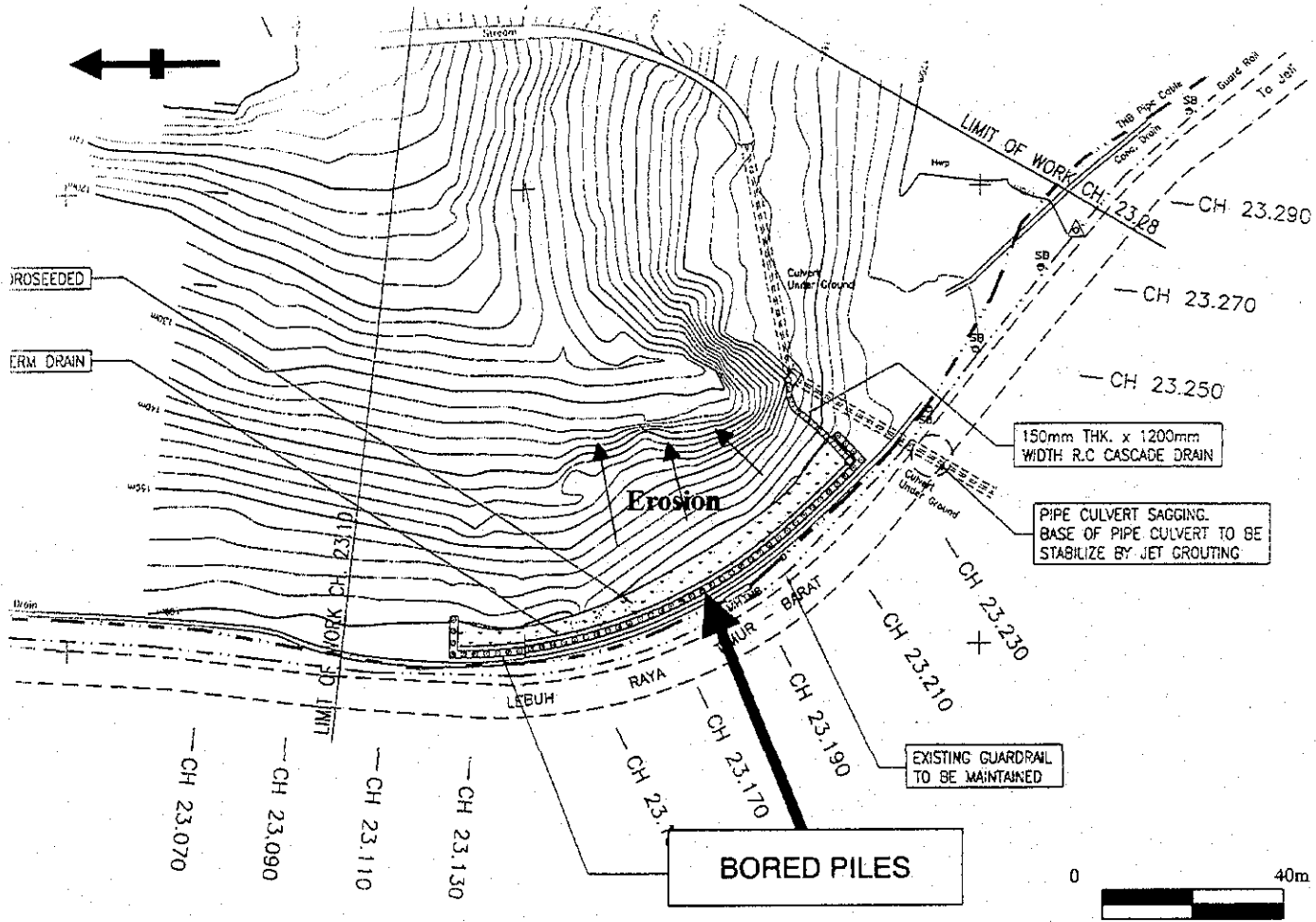


Figure 10.15 General Plan of Slope

(After Cadangan Kerja-Kerja Pembaikan Cerun Dan Kerja-Kerja Berkaitan DiLaLuan 4, Jaran Timur-Barat Design Drawings)

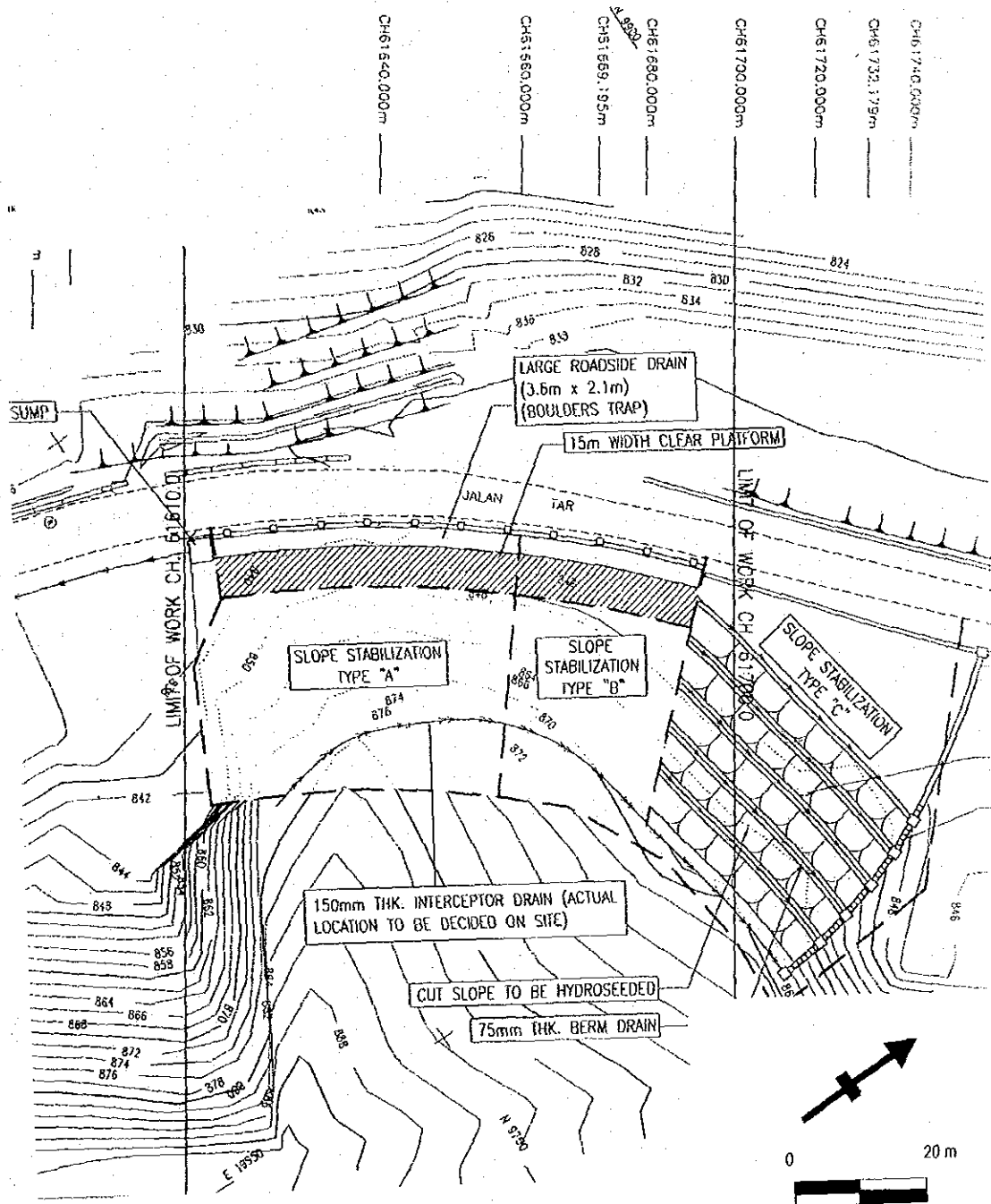


Figure 10.1.6 Designs of Countermeasure against Collapse and Rock Fall (CL/RF)
(After Cadangan Kerja-Kerja Pembaikan Cerun Dan Kerja-Kerja Berkaitan Di Laluan 4, Jalanraya Timur-Barat-Pakej 3F)

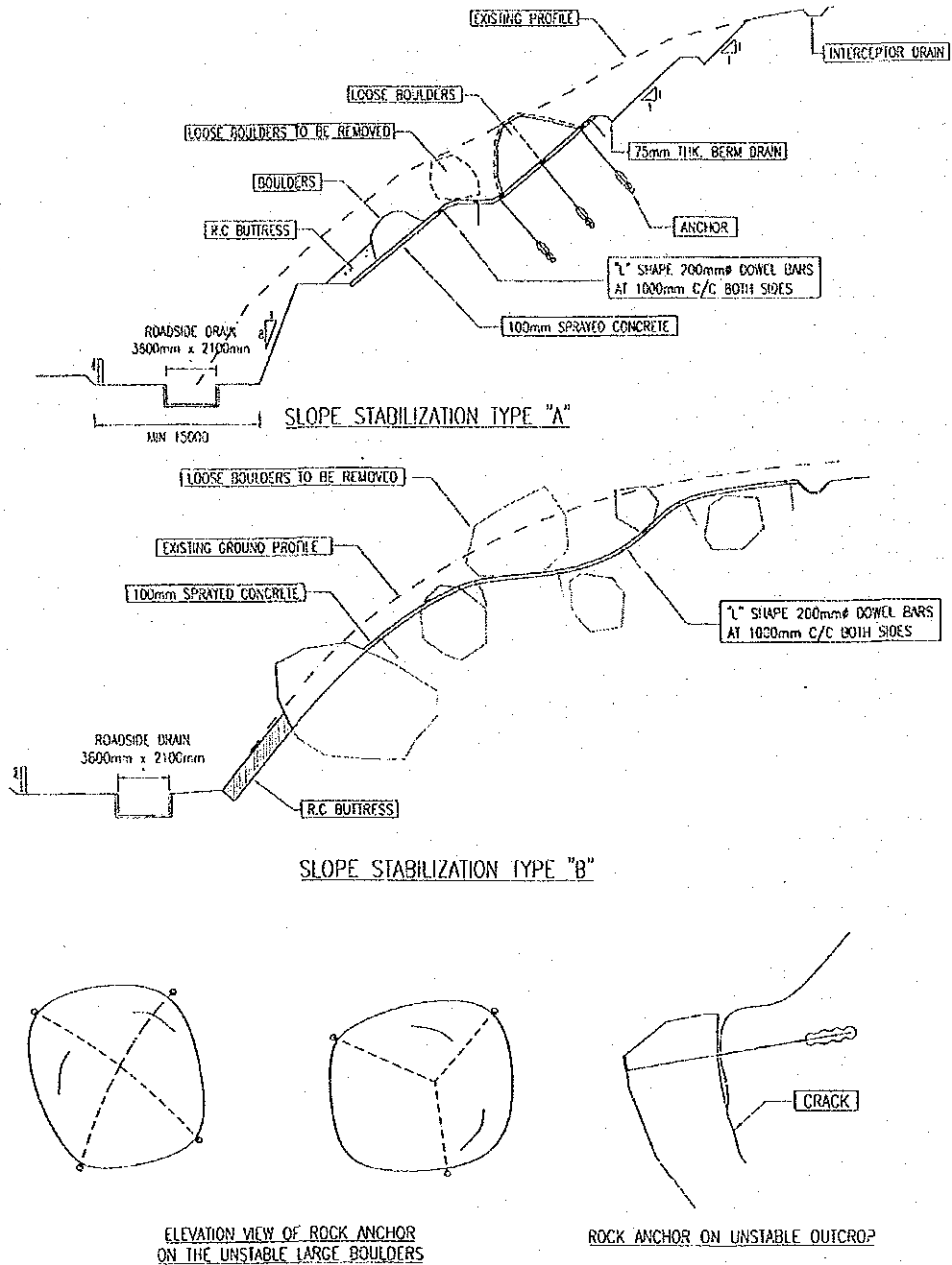


Figure 10.1.7 Design Details of Countermeasure against Collapse and Rock Fall (CL/RF)

(After Cadangan Kerja-Kerja Pembaikan Cerun Dan Kerja-Kerja Berkaitan Di Laluan 4, Jalanraya Timur-Barat-Pakej 3F)

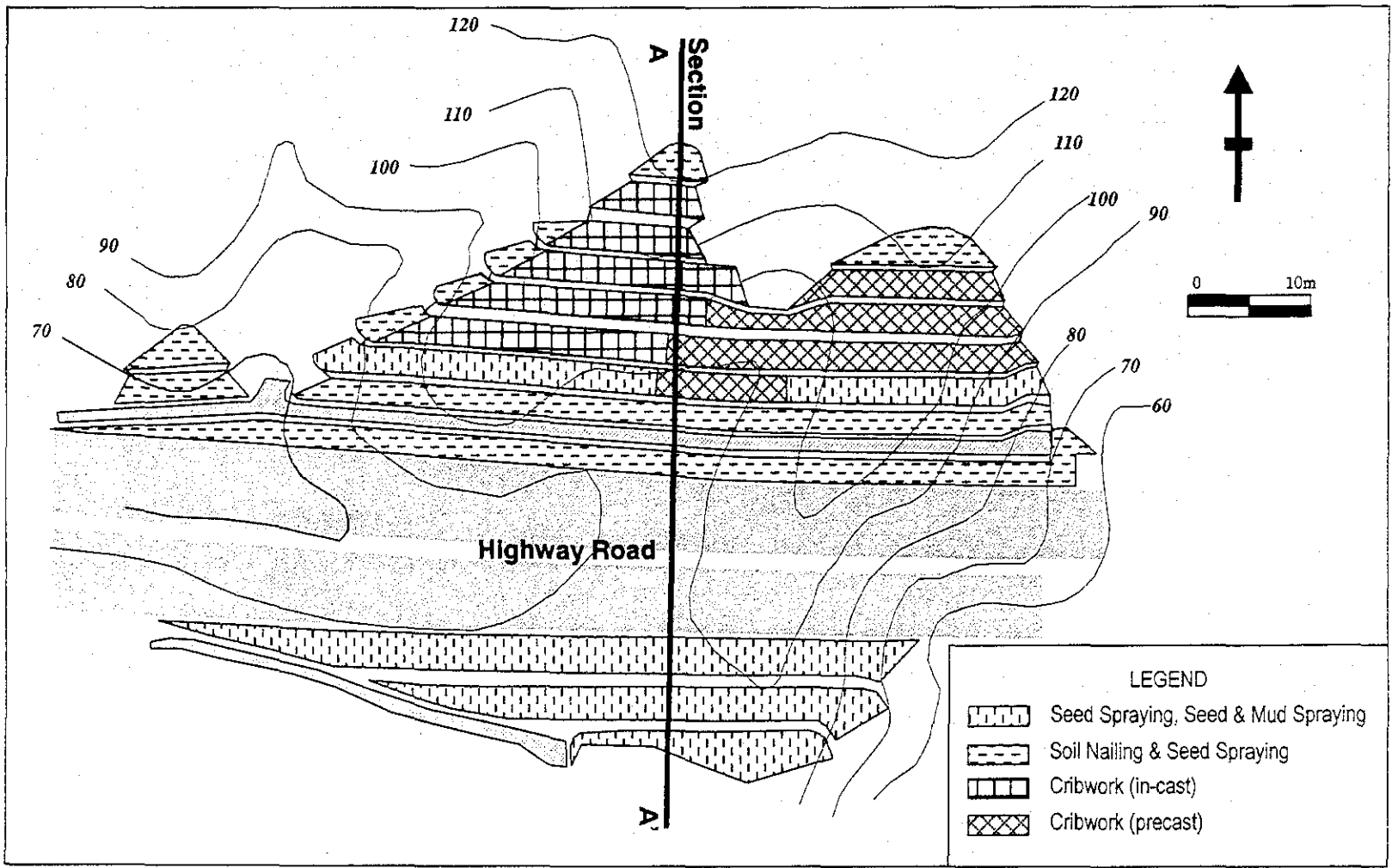


Figure 10.1.8 Schematic Diagram of Cutting Slopes(CL)
(After Countermeasure for cutting in 2nd Tomei Highway at Okabe area, Shizuoka pref. Japan)

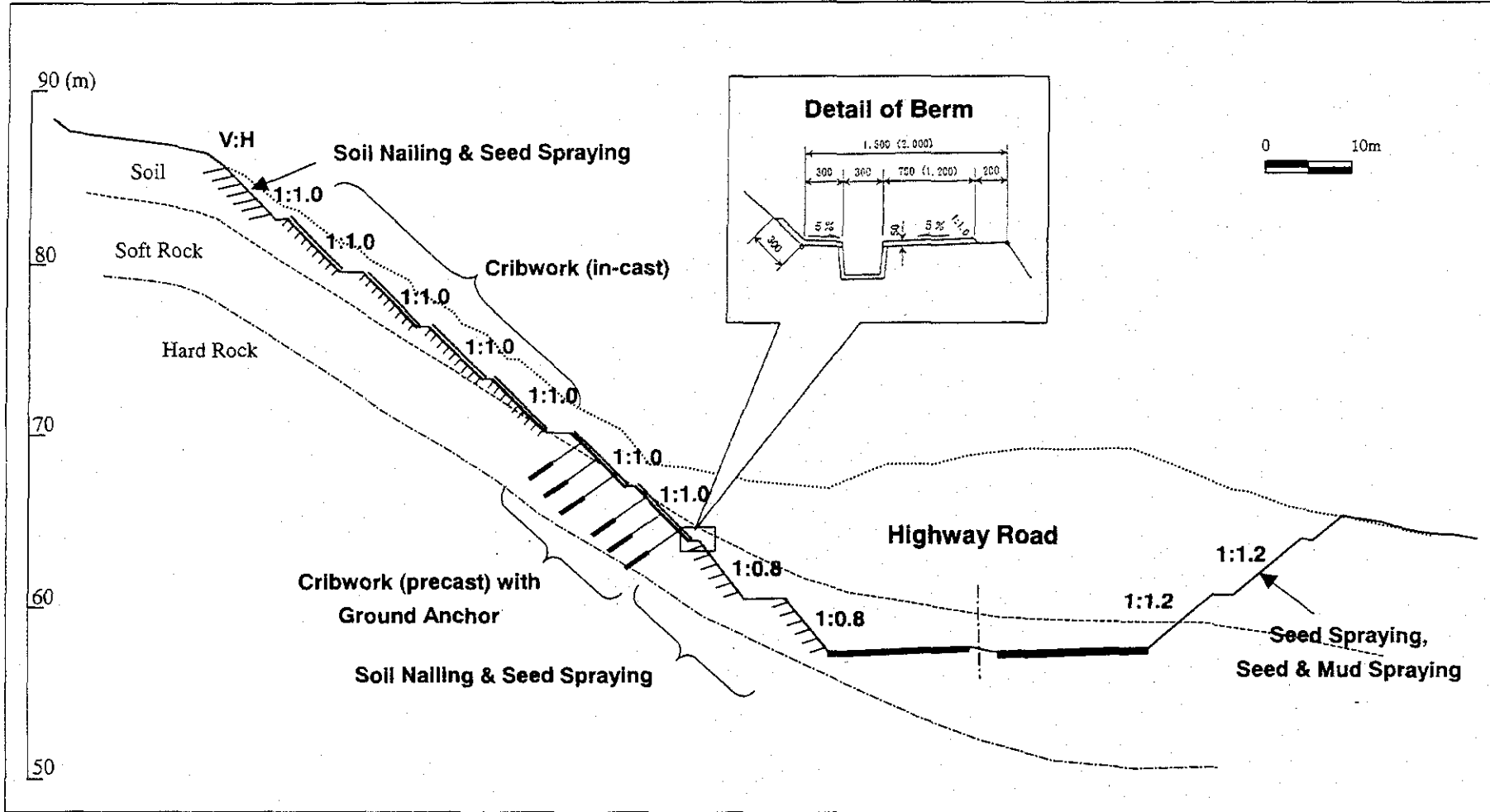


Figure. 10.1.9 Section of Countermeasure Design in Cutting Slopes(CL)
 (After Countermeasure for cutting in 2nd Tomei Highway at Okabe area, Shizuoka pref. Japan)

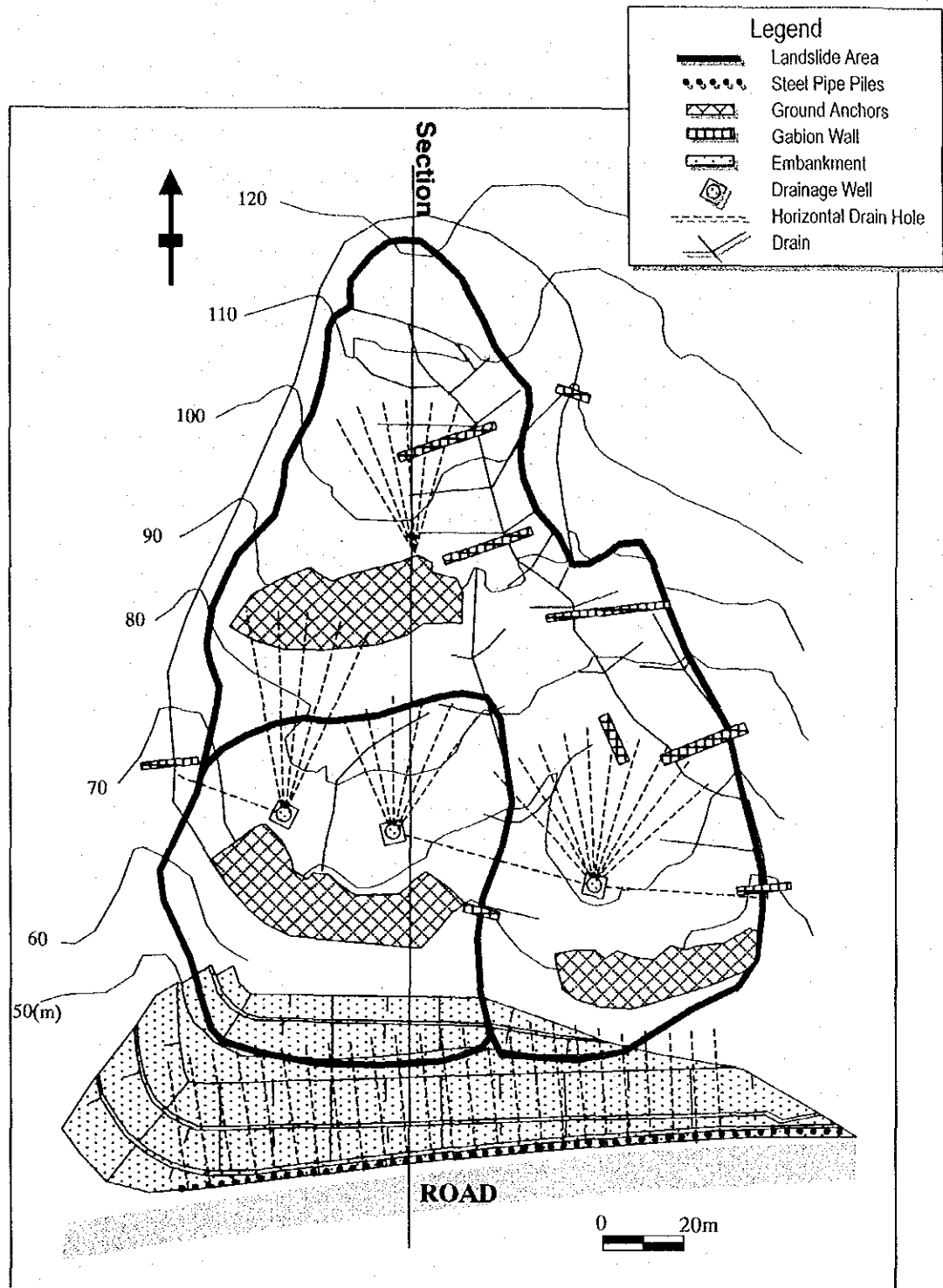


Figure 10.1.10 Schematic Diagram of Countermeasure Design against Landslide (LS)
(After Landslide Prevention Project at Sumoto area, Osaka, Japan)

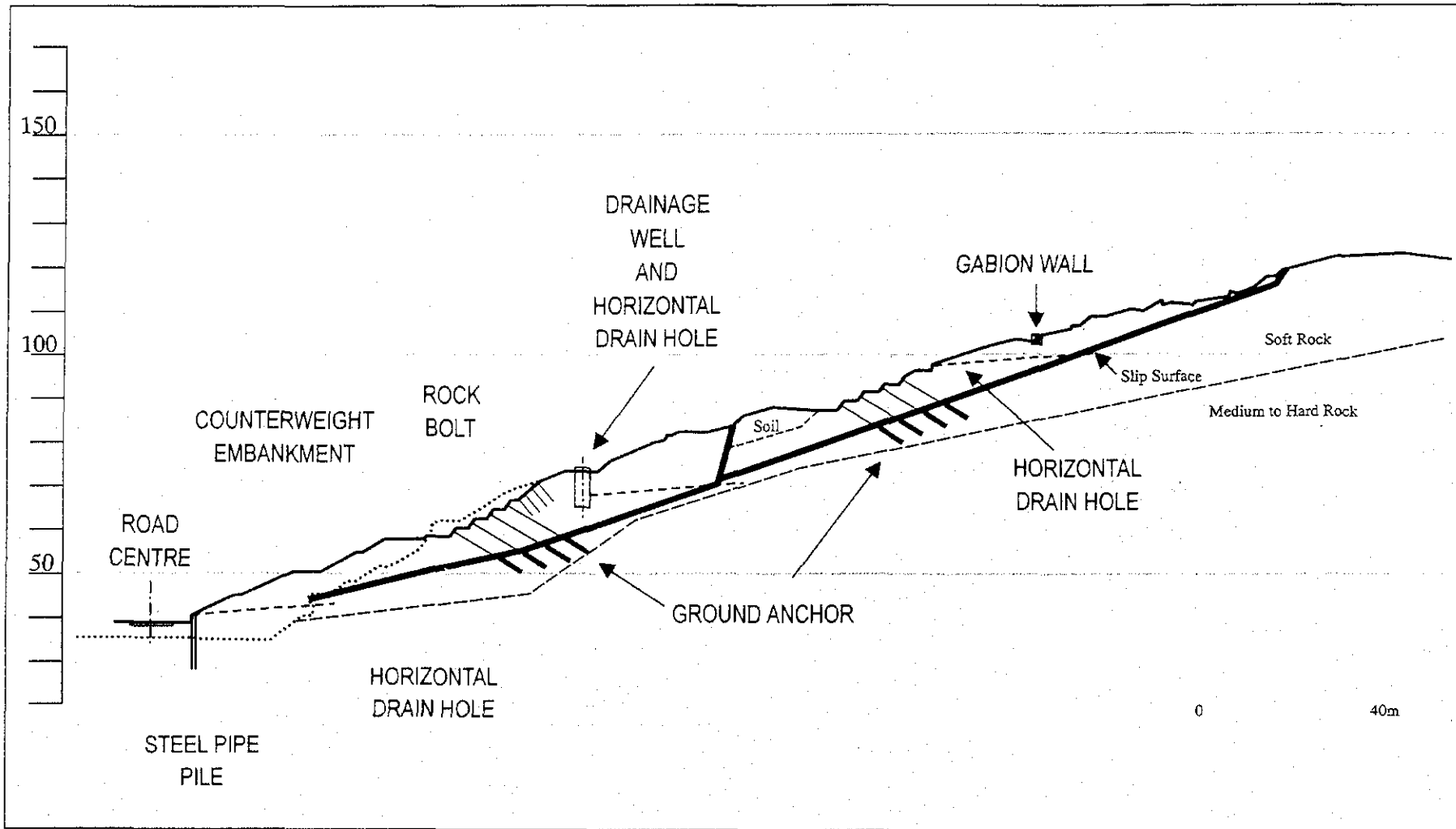


Figure 10.1.11 Section of Countermeasure Design against Landslide (LS)
(After Landslide Prevention Project at Sumoto area, Osaka, Japan)

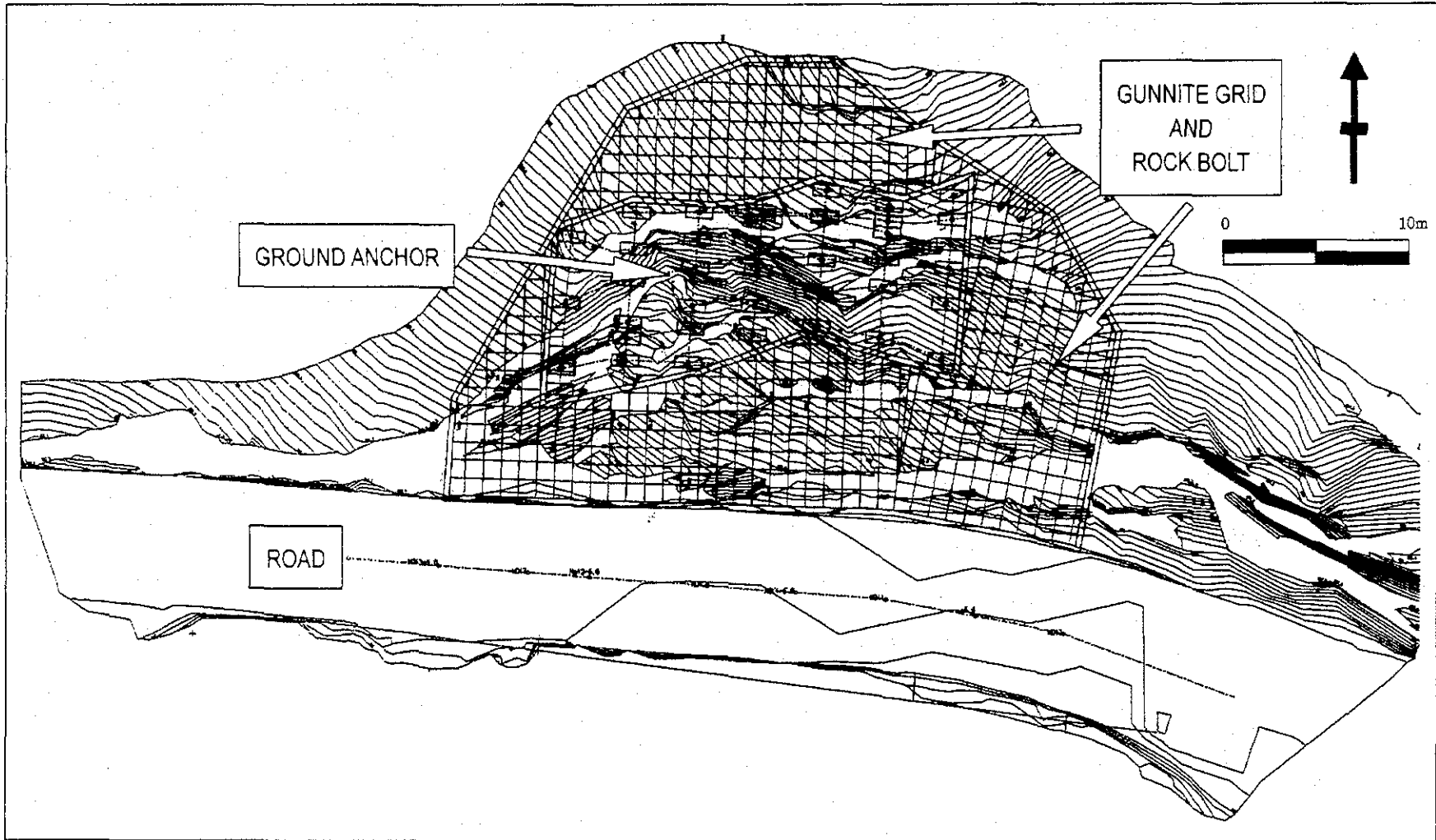


Figure 10.1.12 Countermeasure Design against Rock Mass Failure (RM)
(After Road Disaster Mitigation Project at Route 140, Oodawara area, Chichibu, Saitama pref., Japan)

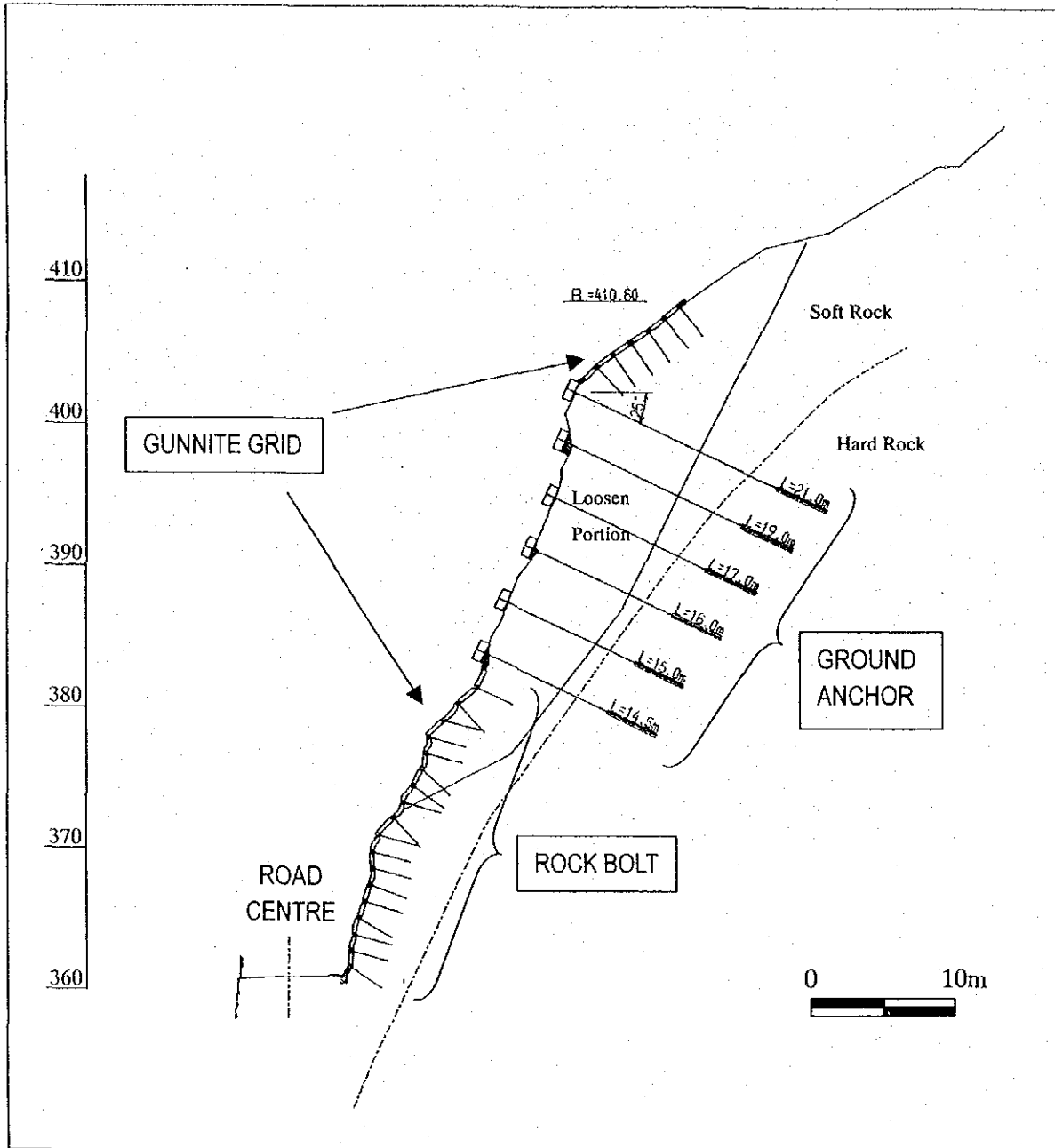


Figure 10.1.13 Section of Countermeasure Design against Rock Mass Failure (RM)

(After Road Disaster Mitigation Project at Route 140, Oodawara area, Chichibu, Saitama pref., Japan)

References

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