

Sabo Methods and Facilities made of Natural Materials

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1. Introduction

1-1 Preparation of the systematic chart

During the investigation for the application of the historical Sabo works at present, it will be easy to judge on which construction method should have been used, if it is classified according to the type of construction or the according to the purpose. In addition, due to the understanding on the improvements and changes of each construction with the age, it is possible to select more effective construction method.

Therefore, a systematic chart with the rearrangement of the changes in each type of the construction by age was prepared, as shown in Table 2.2.1. Data of hillside construction is mainly based on the 'History of Sabo Works in Japanese (1981), Japan Sabo Association'. Regarding the dams, it is mainly based on 'Steps of the Setagawa Sabo works'.

Attention should be given to the following points during the preparation of the systematic chart.

1. At first, methods of historical Sabo works were broadly classified into two groups i.e. hillside works and torrent control works.
2. Next, each construction was subdivided into construction methods. That was further classified into types of the construction and at last, classification was done upto the detailed construction.
3. Construction methods that have been continued to the next generation after improvements and renaming were rearranged, by arranging them at the side according to the order of the age and connecting with the arrows in the way that the changes of construction methods can be understood, The column for 'Present construction method' shows historical Sabo works that have been continued to the present by changing the part of the materials, construction methods etc..
4. The superscript number mentioned at the right of the construction method shows the survey sheet No. (refer the next section).
5. The erosion and sediment control facilities constructed until the Meiji era were of small scale and the same construction method was used in both the hillside and the valley. Therefore, in the systematic chart, the armoured retention work, embankment retention work, stone retention work of the Edo era and the earthen dam, stone dam of Meiji era were mentioned both in the hillside works (small check dams) and torrent control works (dam works). However, among the hillside and the torrent, survey sheet number is mentioned at the frequently used one.
6. Regarding the earth retention works, hillside grading works, hillside drainage channel works and hillside terracing works from Edo to Meiji era, division of these four construction types were not clear from Edo era to Meiji era and one construction method was used for many construction types. For example wooden post fenced retention works of survey sheet no. 9 was used both in the earth retention works and hillside stepped dam works and is mentioned twice in the systematic chart.
7. Regarding 'Nursary tree planting' from Taisho to Meiji era, although it is not clearly mentioned with the phrase 'Nursary tree planting' was continued until Taisho era' in the records of the construction method of Meiji era, name of 'Nursary tree planting' was

appeared in the records of the construction methods from Taisho to Showa era. Therefore, () was attached in the survey sheet No. for Taisho to Showa era.

8. The fertilizer spreading construction method of Meiji era does not fit with the items of the survey sheet (as it is just to spread the fertilizer). Therefore, the survey sheet was not prepared.
9. Regarding the present 'earth dam works' and 'stone dam works', although earth dam and earth dam works, similarly, stone dam and stone dam works are arranged to one column, they are not connected with the arrows. The materials and the construction methods were reflected on the name of the construction method until Meiji era. For example, the 'earth dam' was 'the dam which was made of the earth'. While, 'earth dam works' of the present construction method is 'the dam which used the earth'. In addition, 'earth dam' and 'stone dam' were allowed to be destroyed by the sediment discharge. However, 'earth dam works' and 'stone dam works' are not allowed to be destroyed by the sediment discharge. In this way, although the material to be used is partially consistent, expected effect differs. Hence, these construction methods are considered not to be connected with the arrow.

1-2 Preparation of the survey sheet

Due to the application conditions for setting locations, materials etc. in each construction method, those methods are to be understood itemwise. Therefore, when it is applied at present, suitable construction method can be selected for the application from the local condition.

Therefore, in order to understand that characteristics for each construction method, survey sheets were prepared on the following items, based on the collected / rearranged samples. Further, survey sheet No. is same as the superscript number written on the right side of the systematic chart of Table 2. 2. 1, described in the previous section.

Function, structural characteristics and locality, setting location and application condition

Historical methods of Sabo works can not be set up anywhere and at any condition as it generally has inferior strength and durability in comparison to the present construction methods. Therefore, in order to select the most effective construction method for the application of historical Sabo works, rearrangements of the above mentioned items were done on the basis of the facts mentioned in the literature.

■ Materials and construction method, structural image

In order to apply the methods of historical Sabo works at present, it is necessary to understand the materials and construction method. In addition, through the clear understanding on the structural images, construction methods can be understood in more detail. These items were rearranged on the basis of the facts mentioned in the literature. However, the structural images of some methods are not available in the literature and they were left blank.

■ Durability

As the methods of historical Sabo works, in many cases, are inferior in durability in comparison to the present construction methods, it is necessary to understand the durability degree of that construction method, while applying it near the proposed conservation areas. Therefore, durability is described within the capacity understood from the literature. Items not mentioned in the literatures were left blank.

■ Points to give attention while applying the types of construction methods

As the methods of historical Sabo works have various methods of construction in comparison to the uniform construction methods at present, it is necessary to be clear on the points to pay attention for each construction method while applying them at present. Therefore, rearrangements were done within the capacity that was understood from the literatures. Those, which are not in the literatures were left blank.

■ Effect to the ecosystem

Generally, historical Sabo works are supposed to have only a little effect to ecosystem. Therefore, rearrangements were done regarding the difference between the effect of present and historical Sabo works in the ecosystem. However, almost all of the mentioned comments are made based on the estimation.

Table 1 System of the historical sabo construction methods

construction	method	type	before Edo era	Meiji era	Taisyo era-Showa (before 2nd world war)	present construction method
Hillside construction works	slope stabilization works	small check dams	armoured retention*1	(- M10)		
			embankment retention*2	earthen dam (-M 25)		
			stone wall retention*3	stone dam (M11-S49)		
			stone box (gabion) retention*4	(1680th-)		
			well weir retention*5	(1680th-)		
				fenced retention dam		
				sand bag retention work*16		
				sand bag basecompaction work*16		
				hillside stone masonry*17		
		earth retention works	shoveled up embankment work*6	earth dam		
			back pine retention work*7	(- M10)		
			lined brushwood works*8	(- M10)		
			wooden pile fence retention*9	(improved as fence retention bundled brushwood works)		
		hillside slope cutting works		base stone masonry works*18		
				hillside fencing works*26	—————→	knitted fencing works
		hillside drainage channel works		buried stone masonry works*19	—————→	PNC block works
				buried knitted fencing works*19	—————→	
				slope cutting works*19	—————→	slope cutting works
				channel sodding works*20	—————→	Sodded drainage channel works
				channel stone lining works*20	—————→	wet stone masonry dfrainage channel works dry stone masonry dfrainage channel works
				fascine drain works*21	—————→	gabion sub surface drainage works water collection subsurface drainage works
		hillside terracing works		nursary treeplantation works*22	plantation works*23	straw piling plantation works
				nursary plantation works*23		3 grass stub piling plantation works
			pile fencing retention*9	straw bundle (brushwood) fence retention works*24		5 stubs stepped plantation works 7 stubs stepped plantation works
					stone masonry works*25	—————→
	fencing works (knitted fencing works)*26		—————→	Knitted fencing works log fencing works		

note 1: 'present construction works' column refers to the continuation of historical sabo work method by changing part of the materials or construction method.

note 2: * mark denotes the survey sheet no.

construction	method	type	before Edo era	Meiji era	Taisyo era-Showa (before 2nd world war)	present construction method			
				straw works*27 (M30 -) thatch works*28 (M30 -) stripe works*29 (M30 -)		board fencing works			
							brushwood set works*30 (M32-M35)	→	stone stripe works
									thatch stripe
				brushwood stripe					
				plantation stripe					
				slope covering works	straw covering works (thatch retention)*10	bundled straw netting works*31 (M11-M28, improved afterwards as straw works) scattered straw*32 (M15-M25) brushwood laying works*33 (M29-M32)	→	straw laying works	
								brushwood laying works	
				afforestation works	plantation works	nursery plantation of various trees along contour*11 grass plantation along contour*12 scattered grass plantation along contour*13 scattered pine retention*14	seedling plantation*34	seedling plantation*34	natural plantation works by machines
									aerial plantation works
				sowing works	sowing retention*15	actual seeding*35	→	seeding based on helicopter	
	conservation works	fertilizer laying	→					conservation works type A	
	torrent construction works	cross works	dam works	armoured retention embankment retention stone wall retention sand retention*38	(- M10)	→	supplementary plantation*37		
					earthen dam*39 (-M 25)			earthen dam works	
					stone dam*40 (M11-S49)			stone dam works	
soil concrete dam*41									
wooden dam*42									
rawwood dam*42									

note 1: 'present construction works' column refers to the continuation of historical sabo work method by changing part of the materials or construction method.

note 2: * mark denotes the survey sheet no.

construction	method	type	before Edo era	Meiji era	Taisyo era-Showa (before 2nd world war)	present construction method
				brushwood work dam*43		
				stone low dam*44		
				stone masonry check dam works*45		
				turfing check dam works*46		
				wooden low dam*47		
				knitted fencing low dam*48		
				bundled brushwood low dam*49		
				gabion low dam*50		
					dam (wet stone masonry, boulder concrete)	boulder concrete dam works
	longitudinal works	flow channel works (bank protection works)		stone works bank protection*51	—————→	compaction works
			brushwood dam protection*52	—————→	bank protection works	
			stone works bed compaction works*53	—————→	usual works	
			brushwood works bed compaction works*54	—————→	bed protection works	
			stone lining bank protection works*55	—————→	concrete bank protection works	
			stone box bank protection works*56	—————→	concrete block bank protection works	
			stone wall bank protection works*57	—————→	iron wire box bank protection works	
			turfing works*58			
			alternatelayer of stone and brushwood works*59			
			bank protection with knitted fence works*60			
			bamboo fencing works*60			
			pile arrangement fencing works*61			
			patching works*62			
			stone throwing works*63			
			bundled/packed brushwood works*64			
			J ring type bank protection works*65			
			Metallic bank protection works (dell, rabbit, Sera De Net type)*66			
			gabion (iron wire, bamboo, brushwood gabion)*67			
			Wolf type hanging brushwood layer*68			
			De monse water cut off*69			
	Kitamura type soil concrete mattress works*70					
	sub surface drainage works		stone sub surface drainage*71			
			stone sub surface drainage with water channel*72			

note 1: 'present construction works' column refers to the continuation of historical sabo work method by changing part of the materials or construction method.

note 2: * mark denotes the survey sheet no.

construction	method	type	before Edo era	Meiji era	Taisyo era-Showa (before 2nd world war)	present construction method
				brushwood sub surface drainage*73		
				earthen sub surface drainage*74		
				earthen pipe sub surface drainage*74		
		surface drainage works		stonepaving water channel*75		
				grass paving water channel*76		
				block paving water channel*76		
				brushwood covering works*77		

note 1: 'present construction works' column refers to the continuation of historical sabo work method by changing part of the materials or construction method.

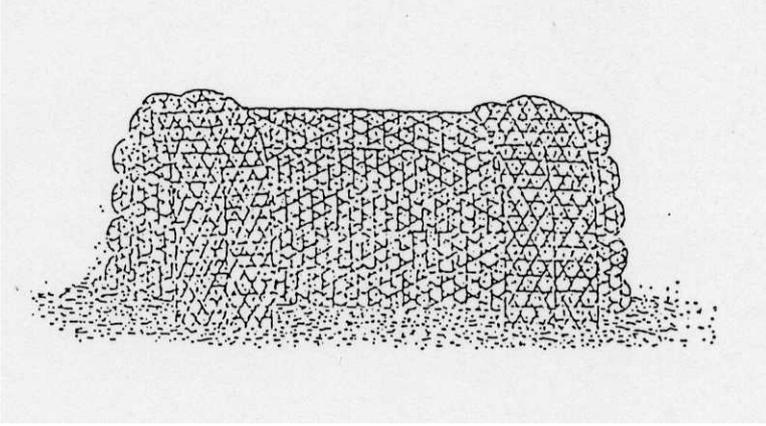
note 2: * mark denotes the survey sheet no.

Survey Sheet No. | 1

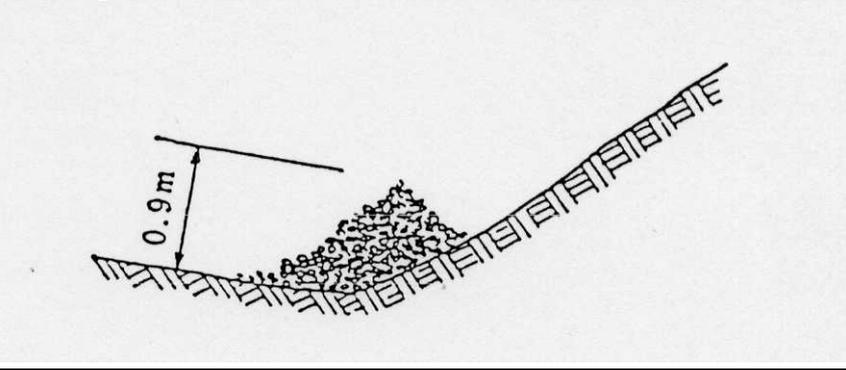
Construction: hillside	Method: Slope stabilization afforestation
Type: small check dams	Name: Armoured retention
Function: entrapment of sediment discharge.	
Structural characteristics and locality: very strong construction method among the construction methods at and before Edo era.	Considered as
Setting place and application conditions	Valley stream
Materials and construction methods: ($\phi = 12 - 15\text{cm}$, $25 - 30\text{cm}$) at the cross sectional direction and the row of trees of $\phi = 12 - 15\text{cm}$ are longitudinally placed on it in the way that the treetop is faced upstream. And are piled upto the height of 1.2 - 1.8m. The movement of the ties is controlled, using a long tree each at the right and the left ends.	- pine wood - ties of $\phi = 25 - 30\text{cm}$ are set up
Durability: 8 - 9 years	
Structural Image	
Points to give attention during the application of the type of construction: doesn't have long life due to the decay of the wood. constructed after 1877.	- It has not been - It
Effect on the ecosystems: spacing between the trees make highly porous structure, it can be the living place for the aquatic lives. - Impact to the scenery is also small in comparison to the concrete structures. disturbance across the flow direction, it disturbs the movement of the living beings.	- As the - Due to the

Survey Sheet No.	2
Construction: hillside	Method: Slope stabilization afforestation
Type: small check dams	Name: Embankment retention
Function: Entrapment of sediment discharge.	
Structural characteristics and locality: Continued to Meiji era with improvements and renaming as 'earth dams' following the Edo era.	
Setting place and application conditions: At the depression in the hillside or at the valley shaped place. Or setting at the valley stream at the places, usually having no water.	
Materials and construction methods: Constructed fully across the valley with the earth embankment of about 0.9 – 1.5m height and turfing is done on the surface.	
Durability:	Not durable
Structural Image	
Points to give attention during the application of the type of construction: No data.	
Effect on the ecosystems: existence of grass on the surface, plants can easily invade inside the whole dam. - Due to the grass, it can be thought to be more close to the surrounding view. - As the top surface is made of	

Survey Sheet No.	3
Construction: hillside	Method: Slope stabilization afforestation
Type: small check dams	Name: Embankment retention
Function: Entrapment of sediment discharge.	
Structural characteristics and locality: construction method than the embankment retention. stone masonry dam after improvement.	-Stronger Continued to the Meiji era as the
Setting place and application conditions: where retention is difficult with earth dams due to usual water flows. Again, set at the places where stones can be collected easily.	-Set at the places
Materials and construction methods: more than 30cm diameter, pebbles, gravels and clays diameter are placed across the stream at the location having low water depth and stone masonry of about 2m height is built on the stream by piling up the pebbles. The stone masonry is back filled by packing 0.9m thick gravels, which is further compacted mixing with clays.	-Pine logs of -Pine logs of more than 30cm
Durability: Differs with the material quality.	
Structural Image	
Points to give attention during the application of the type of construction: In order to increase the durability, sufficient care should be taken on the mixture of long and short as well as big and small sized stone materials and the good and bad quality of the stones.	
Effect on the ecosystems: at the stone masonry make a highly porous structure, it can be the easier place for the living of small aquatic lives. In addition, it is easy to grow the plants. the concrete structures. movement of the living beings.	- As the gaps - Impact to the scenery is also small in comparison to - Due to the disturbance across the flow direction, it disturbs the

Survey Sheet No.	4
Construction: hillside	Method: Slope stabilization afforestation
Type: small check dams	Name: stone box retention (gabion retention)
Function: Entrapment of sediment discharge.	
Structural characteristics and locality: boxes (0.6m diameter and 3.2m long) are knitted and stones are packed in it. It is fixed in position by the wooden posts.	
Setting place and application conditions: watershed having a lot of stone aggregates.	
Materials and construction methods: (bamboo) and 3.2m length are knitted by splitting the big bamboo and connected each other as shown in the figure, followed by packing of the stones in it and fixing by the wooden posts. Further, both ends are also wrapped and fixed with the gabion.	
Durability:	3 – 4 years.
Structural Image	
	
Points to give attention during the application of the type of construction: Stones are discharged out together with the water flow if the bamboos will be decayed.	
Effect on the ecosystems: between the stones make a highly porous structure, it can be the living place for small aquatic lives. - Impact to the scenery is also small in comparison to the concrete structures. disturbance along the flow direction, it disturbs the movement of the living beings.	

Survey Sheet No.	5
Construction: hillside	Method: Slope stabilization afforestation
Type: small check dams	Name: well weir retention
Function: Entrapment of sediment discharge.	
Structural characteristics and locality: -Pine woods are collected and piled up on the stream bed.	
Setting place and application conditions: -Set mainly on the streams.	
Materials and construction methods: -Pine logs (cross trunk of about 30cm diameter, longitudinal log of 15 – 18cm diameter with 2.4m length) -Pine log of slightly greater than 30cm diameter is burried as cross trunk and pine log of 15 – 18cm diameter and 2.4m length is lined up on them in longitudinal direction. Further, cross trunks are placed on them and piled up similarly. Kneaded clay is put at the back of it to make an embankment.	
Durability: 3 – 4 years.	
Structural Image	
Points to give attention during the application of the type of construction: - Does not have long life due to possible decay of the wood.	
Effect on the ecosystems: - As the gaps between the woods make a highly porous structure, it can be the living place for small aquatic lives. - Impact to the scenery is small in comparison to the concrete structures. - Due to the disturbance along the flow direction, it disturbs the movement of the living beings.	

Survey Sheet No.	6
Construction: hillside	Method: Slope stabilization afforestation
Type: earth retention works	Name: shoveled up embankment works
Function: Collapse of the land is prevented through the prevention of the flow of the soil deposited at the foot of the hill by filling that soil at suitable place in the form of embankment.	
Structural characteristics and locality: -Embankment is made at the foot of the hill by shoveling up the soil. That has been continued later by the improvement as earth dam.	
Setting place and application conditions: -Set at the foot of the eroded hillside.	
Materials and construction methods: -soil that has been fallen down and deposited at the foot of the hill. -Soils are shoveled up to the foot of the hill to make about 0.9m high embankment and let the grass grow over it naturally without grassing it.	
Durability: no data.	
Structural Image	
	
Points to give attention during the application of the type of construction: - There are a lot of discharge out cases or the breaking out cases rather than the growing of the grasses.	
Effect on the ecosystems: - As the work is just the collecting up of the deposited soil, there is no adverse impact to the ecosystem even after the breakage of the embankment. - As the animals can move on the embankment easily, there is no obstruction to the connection between slope and the foot of the hill.	

Survey Sheet No.	7
Construction: hillside	Method: Slope stabilization afforestation
Type: earth retention works	Name: opposite pine retention works
Function: Trapping and stopping of the soil collapsing from the uphill side.	
Structural characteristics and locality: -Coarse tree or brushwood is buried with soil and several such layers are piled up. Due to the the decay of the construction material, there are many examples of breakage and it has not been adopted since 1877.	
Setting place and application conditions: -Set up at the depressions in the hillsides or the foot of the hill.	
Materials and construction methods: -Pine brushwood, coarse pine trees of about 1m diameter, pine tree of 12 – 15cm diameter. Pine brushwood or the coarse pine tree of about 1m length is placed for the thickness of about 20cm on the soil covered pine tree of 12 – 15cm diameter, in the way that the top of the tree is pointing towards the hill. Soil is filled on it by making the offset of about 25cm and similar layers are piled up to make the thickness of about 0.9 – 1.2m. There are also the cases of continuation to longer lengths along the hillside.	
Durability: There are many examples of breakage due to the decay of the pine brushwood.	
Structural Image	
Points to give attention during the application of the type of construction: - There are many cases of the loss of effect due to the decay of the pine brushwoods.	
Effect on the ecosystems: - As the materials are plants or soil, there are no adverse effects to the ecosystems even after the breakage. - Although the structure is damaged due to the decay of the brushwood or the rough trees, the decayed brushwood will eventually be decomposed into inorganic substance and becomes the soil nutrition, which will thought to promote the growth of the plants that are grown afterwards.	

Survey Sheet No.	8
Construction: hillside	Method: Slope stabilization afforestation
Type: earth retention works	Name: Lined brushwood retention works
Function: Trapping of the soil movement.	
Structural characteristics and locality: on the hillside and coarse trees are laid inside it, which is then covered up with soil. Due to the cases of insufficient trapping of the soil, as a result of the decay of the brushwood, it has not been adopted after 1877.	
Setting place and application conditions: of the collapsing hill at 0.9 – 1.2m spacing.	
Materials and construction methods: the coarse tree. and 36 to 39 cm length is made at the hillside and trimmed branch of the coarse tree is laid upto the thickness of 6 – 9cm, which is then covered up by soil.	
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: There was no sufficient soil trapping due to the decay of the brushwood.	
Effect on the ecosystems: materials are plants or soil, there are no adverse effects to the ecosystems even after the breakage.	

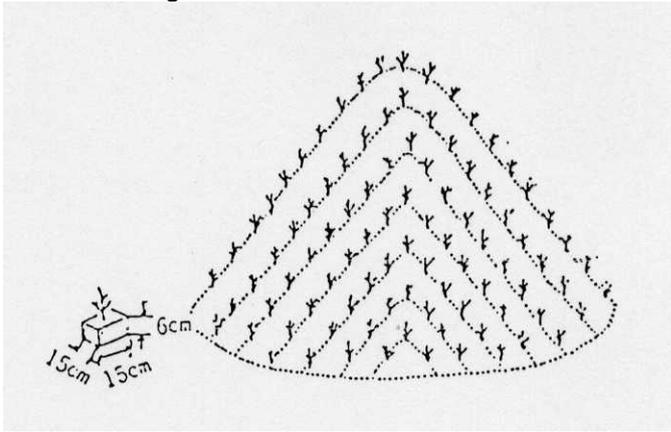
Survey Sheet No.	9
Construction: hillside	Method: Slope stabilization afforestation
Type: earth retention works	Name: Wooden post fence retention
Function: Preventing the flow of collapsed soil.	
Structural characteristics and locality: of small posts, splitted bamboos, brushwood and so on. This was improved afterwards and become bundled brushwood fence retention works, which was used until 24th year of Meiji. Afterwards, it was terminated, being substituted by the terracing works with seeding, which is comparatively cheaper for construction and highly effective.	
Setting place and application conditions: collapsing hill side which does not have steep slope.	
Materials and construction methods: posts, splitted bamboos, brushwood etc . Small posts are erected at the hillside of the bare hill and the fence is weaved for the height of about 50cm with splitted bamboos, brushwoods etc.	
Durability:	No data.
Structural Image	
Points to give attention during the application of the type of construction: the places where it is difficult to grow the plants, there are also the cases having no effects due to the decay of the posts, brushwoods etc.	
Effect on the ecosystems: materials are plants or soil, there are no adverse effects to the ecosystems even after the breakage. - Although it partly blocks the continuity of the longitudinal side of the hillside, as the place for this structure is not the main passing route of the living beings, there is no disturbance to the movement.	

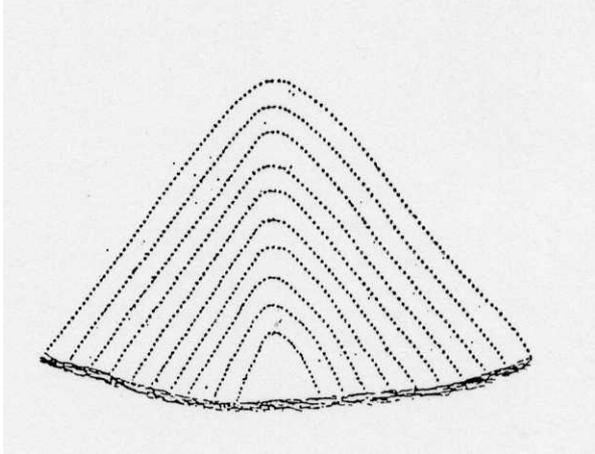
Survey Sheet No.	10
Construction: Hillside	Method: Slope stabilization afforestation
Type: Surface covering works	Name: Straw covering works (Thatched retention)
Function: Hill side is covered and protected from rain and snow fall and at the same time plant growth is promoted by controlling the soil erosion with the prevention of freezing.	
Structural characteristics and locality: Hill side is covered up by straw. Afterwards, it was modified and become bundled straw net work in 11 th year of Meiji era, which was constructed until the 28 th year of Meiji era.	
Setting place and application conditions: side of the slope.	
Materials and construction methods: split, straw . binding the tips. The binded side is placed at the upper side with the base downwards and hillside is covered up by expanding it in the shape of Japanese fan. Bamboo splits are used to fix it to the hill side.	
Durability: About 2 years.	
Structural Image	
Points to give attention during the application of the type of construction: Due to the decay of the straw, there seemed to have many failure places.	
Effect on the ecosystems: materials are plants or soil, there are no adverse effects to the ecosystems even after the breakage. -Becomes the hiding place for small animals and various kinds of insects during winter and rainfall.	

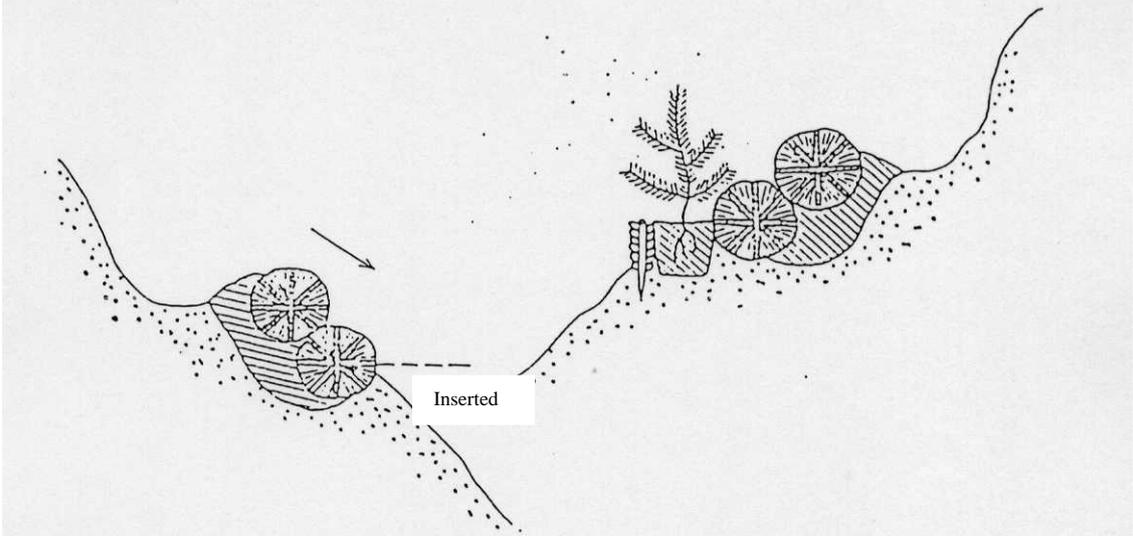
Survey Sheet No.	11
Construction: hillside	Method: Slope stabilization afforestation
Type: Plantation works	Name: Nursery plantation of various trees along contour
Function: recovered by transplanting the coarse trees that are grown at the surrounding area or the nursery of the pine tree to the hilly area having poor tree density and the barren land.	-Mountain potential is
Structural characteristics and locality: the trees well grown in the surrounding area are transplanted. Afterwards, improvement was done in the construction method by selecting the type of trees, and are still constructed at present as nursery tree planting works.	-The nursery of
Setting place and application conditions: tree growth is poor and the baren lands.	-Places where the
Materials and construction methods: various types of trees of pine or azalea . an average, six numbers of the nursery of azalea, pine trees, growing at surrounding area are transplanted in 1 Tsubo area.	-Nursary of -In
Durability: It seemed to have a lot of withering after the transplantation.	
Structural Image No data	
Points to give attention during the application of the type of construction: There are many cases of withering by shrinkage after transplantation due to the shortage of fertilizer.	-
Effect on the ecosystems:	- Not specially

Survey Sheet No.	12
Construction: hillside	Method: sideworks
Type: Plantation works	Name: grass plantation along the contour
Function: movement of the soil at the hillside and assures the afforestation.	-Controls the
Structural characteristics and locality: is done on the hill side. As a result of the collapse after few years of plantation due to the frost, it has not been constructed after 1877.	-Grass plantation
Setting place and application conditions: greenary is necessary at the hill side.	-Places where the
Materials and construction methods: -Trenches are dug at the hillside with the spacing of 76cm and grasses of 45cm length, 15cm width and 6cm thickness are lined up, which are then filled up by sand. Again, method of grass turving at the spacing of 0.9m to 1.2m is also available.	-Grass .
Durability: Few years.	
Structural Image	
Points to give attention during the application of the type of construction: There are many cases of loss of effect, as a result of the gradual collapse due to freezing etc.	
Effect on the ecosystems:	- Not specially

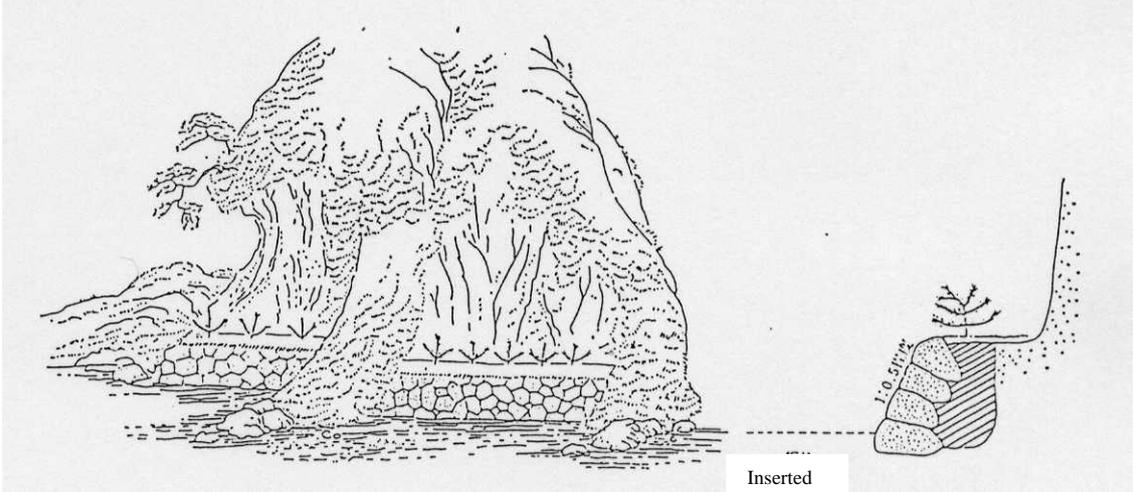
Survey Sheet No.	13
Construction: hillside	Method: sideworks
Type: Plantation works	Name: Scattered grass plantation along the contour
Function: afforestation.	-Assurance of
Structural characteristics and locality: simplified form of turfing, which includes spreading of the grass. It has not been constructed after 1877 due to the collapse by freezing after a few years of the plantation.	-This is the
Setting place and application conditions: where the slope of the collapsing hill is not steep.	-Set at the places
Materials and construction methods: grass stubs of 25cm size. About 6 different grass stubs of 25cm square is planted per Tsubo (3.3 m ²).	-Square
Durability: Few years.	
Structural Image	
Points to give attention during the application of the type of construction: There are many cases of collapses down due to freezing.	-
Effect on the ecosystems:	- Not specially

Survey Sheet No.	14
Construction: hillside	Method: sideworks
Type: Plantation works	Name: Scattered pine retention
Function: afforestation in the bare hill.	- assures the
Structural characteristics and locality: plantation in the hills.	-Pine tree
Setting place and application conditions:	-Bare hill etc.
Materials and construction methods: -Square trenches of 15cm side and 9cm depth are prepared at the spacing of 76cm along the hillside and naturally grown pines of about 45cm height is buried in the trench along with the root soil of 15cm square and 6cm thickness.	-Pine.
Durability:	Has long lasting effect if the pines can get matured.
Structural Image	
	
Points to give attention during the application of the type of construction: There are many cases of collapsing down due to freezing and melting.	-
Effect on the ecosystems:	- Not specially

Survey Sheet No.	15
Construction: hillside	Method: sideworks
Type: Plantation works	Name: Sowing retention
Function: comparatively wider afforestation.	- assures
Structural characteristics and locality: the tree seeds.	-Direct sowing of
Setting place and application conditions: the bank of the stream.	-From hill portion to
Materials and construction methods: (Thuja orientalis, Quercus dentate [daimyo (Japanese emperor) oak], pine, Juniperus rigida, wisteria, oak, nutmeg) . -Stripe is made with hoe from the part of the hill to the stream bank at the spacing of 60cm along the countour line and the seeds of the tree is shown there, which is then buried by the soil. Compacted straw bundles are placed separately on it.	-Tree seeds
Durability:	Long term effect is expected if it is germinated and grown up to the maturity.
Structural Image	
	
Points to give attention during the application of the type of construction:	-
There are many cases of failures due to washing out by freezing and melting.	
Effect on the ecosystems:	- Due to the
application of the imported seeds and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plant of the area.	

Survey Sheet No.	16
Construction: hillside	Method: slope stabilization afforestation
Type: Small check dams	Name: Sand bag retention work, Sandbag base retention works
Function: the hillside slope.	- Erosion control of
Structural characteristics and locality: with sand bags. Due to the decay of sand bags, it could not give long term effect and therefore was not constructed after 1880.	-Fixation of slope
Setting place and application conditions: depressions of the slopes where rain water accumulates and flows down.	-Set at the
Materials and construction methods: -Empty sand bags are filled up with soil and a pair of such bags are connected, followed by piling up of 2 or 3 sand bags. -Sand bag base retention work- In order to prevent the scouring of the water flowing part of the sand bag retention works, a simple fence is constructed with the brushwood.	-Sand bags .
Durability:	Can not preserve long term effect due to the decay of the sand bags.
Structural Image	
	
Points to give attention during the application of the type of construction:	
Function as temporary construction due to not so long term effect as a result of the sand bag decay. Besides, there are less examples of its construction at the steep bare lands of the hill slopes.	
Effect on the ecosystems:	- Mostly no
adverse effect to the ecosystems even after the breakage as the materials are plants and soil.	

Survey Sheet No.	17
Construction: hillside	Method: slope stabilization afforestation
Type: Small check dams	Name: Hillside stone masonry
Function: retention of discharging soil or prevention of erosion.	- Assurance of the
Structural characteristics and locality: by coarse stones. This type of construction was started from 1894 and was continued until 40 th year of Showa era after continuous improvements. Being strong, it is still showing the effect at present although it was the part of the construction during Meiji era.	-Fixation of hillside
Setting place and application conditions: depressions of the hillside where there are no water flows but have potential of water flow during rainfall. -Places with abundance of construction stones is desirable.	-Set at the
Materials and construction methods: coarse stones (surface dimension – 30cm and reverse dimension – 36cm) . -The width for the base of the trench is normally kept 1m and reverse slopped for the safety of the stone masonry. Offset of about 20cm is made at the base with more than 60cm width at the top. There are many dry stone masonaries with the side slope of 1:0.4 –0. 5 and slope height of 0.7 - 1m.	-Hard
Durability: Due to high durability, the same structures are still existing.	
Structural Image	
Points to give attention during the application of the type of construction: Large amount of hard construction stone is necessary.	-
Effect on the ecosystems: between the stones is the highly porous structure, it can bethe living place for small animals. -Impact to the ecosystems is also less compared to the concrete structure.	- As the space

Survey Sheet No.	18
Construction: hillside	Method: slope stabilization afforestation
Type: Small check dams	Name: Base stone masonry works
Function: hill which are potential to be scoured by the torrent .	- Fixation of the foot
Structural characteristics and locality: are piled up and plantation or the turfing works are done at the levelled parts of the slope.	-Long flat stones
Setting place and application conditions: construction methods are difficult due to vertical rise of the hillside.	-Places where other
Materials and construction methods: stones . are placed at high slope in the riverside and at lower slope in the hillside and piled up at the side slope of 1:0.5. Levelled place is prepared at that part, and is enhanced by the plantation or the turfing works.	-Long flat -Long flat stones
Durability: Has good durability.	
Structural Image	
	
Points to give attention during the application of the type of construction: Large amount of hard long stone becomes necessary.	-
Effect on the ecosystems: between the stones is the highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. application of the imported seeds and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plant of the area.	- As the space - Due to the

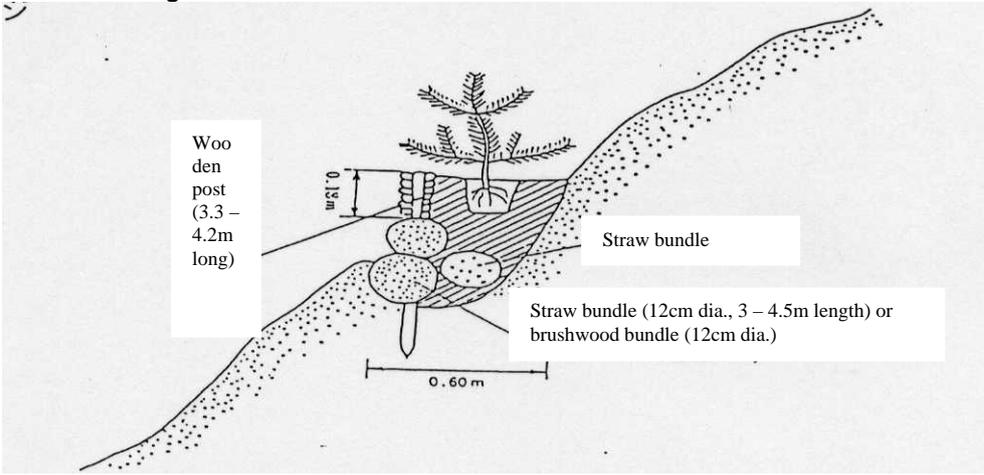
Survey Sheet No.	19
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side slope cutting works	Name: Slope cutting works
Function: slope is adjusted and stable slope is prepared by making the steep slope gentle . And the base for each type of hillside construction is prepared.	- Undulations of the
Structural characteristics and locality: construction methods which are still in use since its starting in 1909.	-One of the
Setting place and application conditions: where stability of the slope can not be kept due to steep slope or irregular undulations.	-Set at the places
Materials and construction methods: inclination of the slope cutting line is decided according to the surface condition, such as cutting and filling surfaces are not made steeper than about 1.5:1 (33°)– 1:1 (45°) and 1.5:1 (33°) respectively . (generally standardized as about 1.4:1 to 1.2:1 (35° – 40°) for the height more than 10m and 1.7:1 (30°) for the lower part). At first, the changing point for cutting and filling surface is fixed and the work is continued upwards from that point. -When the volume of the excavated soil is high, buried stone masonry works and buried brushwood fencing work, at the places where brushwoods are easily available, are set up at the filling surface in order to prevent the collapse of the filling soil. Again, for the assurance of the stability of the filling soil, hillside stone masonry works are set up at the base of the filling part.	-The
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: There are the cases of the collapses of the filling soil when the cutting volume is high.	-
Effect on the ecosystems: specially.	- Not

Survey Sheet No.	20
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side drainage channel works	Name: Channel sodding works, Channel stone lining works
Function: erosion due to the flow of spring and rain water along the hill slope.	- Prevention of the
Structural characteristics and locality: works Grass is packed on the water channel surface with the splitted posts. works Dry stones or wet stones are lined on the water channel.	-Channel sodding -Channel stone lining
Setting place and application conditions: fear of channel erosion by the water flow is high. abundancy of stone aggregates and there are the abundant places having high erosion potential of the flowing water.	-Places where the -Suitable at the places where there are
Materials and construction methods: stone aggregate. sodding works Grass of 18cm x 30cm size is packed by splitted posts, setting offset of 1 column each. -Channel stone lining worksAt the places where there are abundant stone aggregates or the high potential of erosion by the water flows, construction is done by using dry stone lining or wet stone lining in stead of grass.	-grass, -Channel
Durability: Channel sodding works are weak to erosion due to water flow. Channel stone lining works have good durability.	
Structural Image	
Points to give attention during the application of the type of construction: Construction of drainage channel works are less where promotion of tree growth by reserving water has higher priority than the worries of topographical erosion. (Example:Yodogawa River system, Setagawa watershed)	
Effect on the ecosystems: the promotion of plant growth around the construction area can be thought due to the disturbance to the water storage in the surface of the slope.	
	- Decrease in

Survey Sheet No.	21
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side drainage channel works	Name: Fascine drain works
Function: underground water and prevention of erosion due to underground water.	- Removal of
Structural characteristics and locality: structure based on culvert. Name differs in each region. Again, the materials of draining parts are improved according to the age.	-Drainage
Setting place and application conditions: (based on the example of construction in Setagawa watershed during 34 th year of Showa) the hill.	-Set on the impermeable layers of
Materials and construction methods: fascines, aggregates, soil. Fascines are placed inside the trapezoidal cross section of 34cm minimum width, 1.14m maximum width and 1m height and aggregates are uniformly spreaded on the fascines with the thickness of 10cm after driving the wooden posts at the spacing of 1m. Then, soil is filled back on it for the thickness of 40cm.	-pine posts, -
Durability:	Durability changes according to the materials of the water flow part.
Structural Image	
Points to give attention during the application of the type of construction: No data	
Effect on the ecosystems: thought that the promotion of the plant growth near the construction part is decreased due to the disturbance in the storage of water along the surface.	
- It can be	

Survey Sheet No.	22
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side stepped dam works	Name: Nursery tree plantation works
Function: hillside slope.	- Afforestation of the
Structural characteristics and locality: are made along the hill side slope and grasses are germinated by accumulating the grass seedling stubs along with rootgrass on it. The uppermost side is then planted with seedlings. However, it was renamed as nursery tree plantation using the cut grasses after 14 th year of Meiji era.	-Horizontal steps
Setting place and application conditions: Set on the bare mountains of hill side slope, having surface soil layer.	-
Materials and construction methods: root soil of grass seedlings -Horizontal steps of 39cm side are made along the hillside slopes and root soil of grass seedlings are piled upon the steps, keeping 15cm offset. Inner parts are back filled with soil and growth of the grasses from the seedlings are expected afterwards. However, it did not grow as per the expectation and seedlings were planted on the topmost surface only thereafter. Again, as the method of grass stubs plantation needs a lot of grass stubs, the grass stubs were patched up along the slope of 1:0.5 and innersides were backfilled with the soil.	-
Durability: No data.	-
Structural Image	
Points to give attention during the application of the type of construction: Due to the collection of deep grass stubs, the grass collected area could not be restored easily and the use of grass stubs were stopped.	
Effect on the ecosystems:	- There are almost no adverse effect to the ecosystems even after breakage, as the materials are soil or the plants .

Survey Sheet No.	23
Construction: hillsidet	Method: slope stabilization afforestation
Type: Hill side stepped dam works	Name: Nursery plantation works
Function: of hillside slopes, the collapsed soils are trapped and base for the plant growth is developed by increasing the water bearing potential.	
Structural characteristics and locality: consists of patching the grass on the stepped shape, it is very suitable method for the growth of plant seedlings. Therefore, it is continued upto the present by changing the type of plant and increase the numbers of plant types.	
Setting place and application conditions: -Set along the slope of bare mountain having surface soil layer.	
Materials and construction methods: grass, fertilizer straw -The slope is excavated for about 0.8 – 1.0m with horizontal or the reverse slope to conserve the moisture and is patched up by the grass, leaving 0.1 – 0.2m offset. The grass on the surface is made by piling up 2–3 numbers of patching grass with stepwise back filling and the work is proceeded by he compaction of patched grass surface sufficiently by the earth rammer and at the same time, compaction of the back fill materials. The patching work is done, generally, at the slope of 1:0.3 – 0.5 and surface slope height of 70cm. Again, straw fertilizers are placed suitably inside the backfill. - According to the steepness of the surface slope, it is suitable to construct at the spacing of 1.3 – 2.0m vertical height.	
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: There are several cases of using grass carpet, hard grasses, medium grasses, sky grasses etc. in place of grass patches to increase the strength. As the base of the places with weak soil surfaces are easy to be damaged, they are made stronger by using brushwoods below the grass carpet or inserting the brushwoods in between the grass patches.	
Effect on the ecosystems: materials are soil or plants, there are almost no adverse effects to the ecosystems even after damage.	

Survey Sheet No.	24
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side stepped dam works	Name: straw bundle (brushwood) fence retention works, fence retention dam
Function: retention works..... Prevention of soil collapse of the steep slope and promotion of the seedling growth by the conservation of the moisture at the hilly area. (Brushwood) bundled works is placed on the depression of the hillside and soil erosion prevention is increased.	
Structural characteristics and locality: are fixed on the ground by wooden posts and brushwood fences are weaved on the top of it. Although this construction method was applied from 1878 – 1895, it was replaced by the grass turfing works afterwards due to its high construction cost and poor effect in comparison to the grass turfing works.	
Setting place and application conditions: -Set at the places where soil collapse is expected due to the steep slope as well as freezing and thawing of the ground.	
Materials and construction methods: grass, fertilizer straw -Straw (brushwood) bundles.....12cm diameter and 4.5m long material, densely packed materials at the spacing of 45cm. Brushwood fence.....Highly durable material of about 3.3 – 4.2m length, original section of 2.1 – 2.4cm diameter. -Wooden posts.....Hard trees of about 0.6 – 1.2m length and 4.8 – 5.5cm original diameter. -Horizontal trenches of about 60cm width are excavated and steps are made according to the contour lines, where grass (brushwood) bundles are compacted and inserted ininside the ground with the wooden posts and in addition, the brushwood fences are weaved on the uppermost part. Most suitable spacing of the wooden posts and height of the fence are 36cm and 18cm respectively. The stepping works are constructed at the vertical height of 90cm each from the foot of the hill to the part of the mountain. -Fence retention dam.....Similar structure as the brushwood bundle retention works.	
Durability: No data.	
Structural Image 	
Points to give attention during the application of the type of construction: Use of brushwood bundle is stronger and has stronger controlling power against the movement of the soil and rock, compared to the straw bundle.	
Effects on the ecosystems: are soil or plants, there are almost no adverse effects to the ecosystems even after damage. - Due to the application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plant of the area. -As the decaying of the straw bundle makes the decayed soil, there will be the promotion of plant growth due to the decomposition of carbon dioxide gas, which is essential to the plants.	

Survey Sheet No.	25
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side stepped dam works	Name: stone masonry works
Function: collapse down of the soil, foundation works of each surface works to ease the steepness of the hillside slope, reinforced structural works for the prevention of erosion due to rainfall.	
Structural characteristics and locality: is made by the broken stones alongwith the back filling by soil. At 2 nd year of Showa, it was renamed as hillside stone masonry and gravels were started to be used as backfills. It was changed to PNC block construction method from 40 th year of Showa.	
Setting place and application conditions: -Set at the places where stone materials are abundant, easily erodible by rainfall, places having excessive undulations as well as the exposure of hard rocks.	
Materials and construction methods: Coarse broken stones (hard material of 30cm size facing and 36cm transverse dimension) -The basic width of the steps are fixed as 70cm and for the stability of the masonry as well as the conservation of the soil moisture, the beds are excavated with reverse slope. The foundation of the stone masonry is inserted inside the mountain place. The masonry is constructed with 0.7 – 1.0m height and 1:0.2 to 1:0.4 side slope after leaving at least 20cm offset. When the masonry is to be placed at step, top width should be more than 0.5 – 1.0m. More fertilizer straws are used at the upper part of the slope than the lower part and are generally spreaded 30 cm below the uppermost backfills.	
Durability: There are the cases of the collapse of the masonry when the stones are not fully compacted or the quantity of gravel is insufficient.	
Structural Image	
Points to give attention during the application of the type of construction: Although places with abundant stone aggregates is desirable for the construction, in actual practice, there are many cases of masonry building with the coarse broken stones or the stone from cultivation land, mixing with big and small stones.	
Effects on the ecosystems: - As the spacing between the stones make highly porous structure, it becomes the living place for small animals. - Impact to the scenery is less in comparison to the concrete structure.	

Survey Sheet No.	26
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side stepped dam works	Name: fencing works
Function: erosion of hillside surface and trapping of the collapsed soil.	-Prevention of the soil
Structural characteristics and locality: the substitution of stone masonry or the plantation works with the application of wooden posts, fencing brushwood etc. Constructed as sea shore protection works with the wood works along the hillside. In this case, wooden post fences are generally arranged in two lines and stones, gravels are filled up in between.	-Constructed as
Setting place and application conditions: -Set at the relatively soft place where wooden posts can be easily driven and the places where there is shortage of stone or grass materials but easy to get the brushwoods.	
Materials and construction methods: -Wooden posts, brushwoods (length 3.6 – 4.2m and diameter 1.8 – 2.4m) excavated for about 80cm inside width along the horizontal direction and wooden posts are driven there, leaving 30cm offset, followed by the weaving of brushwood fence upto the top of the posts. The innerside of the fence is filled up and well compacted by the spreading of willow branch, fertilizer straw, fertilizer coarse grass and backfilling of soil.	-The slope is
Durability:	Poor in durability due to the easy decay of the posts and fences.
Structural Image	
Points to give attention during the application of the type of construction: Although there are no limits for the tree species of the brushwood fence, it is desirable to select the hard materials with good germination.	
Effects on the ecosystems: - Although the posts and fences are decomposed easily and the durability of the structure is poor, the soil becomes rich in organic contents and fertility due to the decomposition and becomes the promoter for the plant growth. - Impact to the scenery is less in comparison to the concrete structure. - Due to the application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plant of the area.	

Survey Sheet No.	27
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side stepped dam works	Name: straw works
Function: growth of plant seedlings by making abundant land with the storage of moisture of the hillside slope.	-Promotion to the
Structural characteristics and locality: construction method of the straw bundle net works, which has the similar effect as that of straw bundle net works but one third construction cost.	-It is the improved
Setting place and application conditions: -Set at the soft location of the hillside slope or the bare land of the flat portion of the hill.	
Materials and construction methods: straw -Horizontal trench of 30cm width and 20cm depth is excavated on the slope and straw is distributed at the rate of 2kg in 1m length, which is then back filled by the thin soil layer followed by plantation. The trench is made at the spacing of 90cm. Straw is distributed in the trench in such a way that the base of the straw is kept at left and right sides, pointing the tip to the centre and two places at 15 – 20cm from right and left are tied by two ropes (if it is tied strongly, it is difficult to spread or preserve moisture).	
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: Huge quantity of straw is necessary.	
Effects on the ecosystems: the growth of the plants as a result of the decay of the straw bundle, which becomes the source of nutrition for the plant seedlings and the conservation of the infiltrated water.	
- It highly promotes	

Survey Sheet No.	28
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side stepped dam works	Name: Thatch works
Function: hillside slope, soil entrapment.	-Afforestation of the
Structural characteristics and locality: set on the bed of excavated trench and backfilled with the soil. It is very economical in comparison to the plantation works and is said to have very high effect.	-Thatch stump is
Setting place and application conditions: -Hillside or the foot of the hill.	
Materials and construction methods: Thatch stump (20cm diameter stump), thatch stem -Excavation of the bed on the slope is done and thatch stem is placed there at the spacing of 30cm, which is again placed on by 30cm cut thatch stems with the thickness of 3cm, followed by the backfilling with soil for about 15cm thickness. This work is repeated several times to have finished the construction work of the required height of the place. In the initial year, it is extended by about 1m and the stump is well grown to cover the whole slope in the following year.	
Durability:	Durability differs with the growth of the stump.
Structural Image	
Points to give attention during the application of the type of construction: This construction method is set from the time when the flow of the moisture in thatch is stopped in mid October to the time just before the germination in mid April. There is almost no germination except this period.	
Effects on the ecosystems: is done with the thatch from the location to the north of northern Tohoku region, it will worsen the existing environment for the habitat plant of the area and possibly, the thatch may not have the root.	
	- If the construction

Survey Sheet No.	29
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side stepped dam works	Name: Stripe works
Function: hillside slope, and the soil formation due to the fallen leaves which promotes the growth of the plant.	-Covering of the
Structural characteristics and locality: has been widened with the progress of the time and is brought to the present .	-The smaller width
Setting place and application conditions: -Hillside slope having soft ground (surface slope of about 1.5:1 (33°)) or the places having deep top soil and constructed in between the hillside works (plantation works) .	
Materials and construction methods: Thatch stump (30cm long and bound with 90cm rope), plant seedlings, fertilizer straw -The hillside slope is excavated horizontally for about 60cm width and 40cm wide and 30cm deep trench is excavated again from the trench bed, leaving 20cm offset. Thatch (silver grass etc.) at the rate of 1 – 1.7 bundles at 10m is planted across this trench. The fertilizer straw is placed at the rate of 0.8 – 2.5kg per meter at the bottom of the trench and backfilled by the thin soil layer. Then plantation is done there.	
Durability:	No data.
Structural Image	
Points to give attention during the application of the type of construction: This construction method is set from the time when the flow of the moisture in thatch is stopped in mid October to the time just before the germination in mid April. There is almost no germination except this period.	
Effects on the ecosystems: is done with the thactch from the location to the north of northern Tohoku region, it will worsen the existing environment for the habitat plant of the area and the possibly, the thatch may not have the root. - If the construction	

Survey Sheet No.	30
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side stepped dam works	Name: Brushwood set works
Function: of the hillside slope, foundation of the plantation work is made by trapping the collapsed soil.	-For the afforestation
Structural characteristics and locality: brushwood is fixed by the wooden posts and plantation is done at its upper part after placing the fertilizer straw and the backfill soil.	-Bundled
Setting place and application conditions: -Set at the relatively steep slope of the hillside.	
Materials and construction methods: -Bundled brushwood (the brushwood of more than 2.7m length, more than 2cm diameter are bound to make 30cm diameter bundle and bound with Fujijuru at the spacing of 60 – 90cm), wooden posts (60cm long, 3cm diameter), fertilizer straw. -During the slope surface cutting works, horizontal step cutting is done with the width of about 60cm and brushwood bundle is lined up horizontally in it after keeping the offset of 10cm. Coarse wooden posts are driven at the centre of the brushwood with the spacing of 20cm and fixed. The fertilizer straw is placed and compacted at the inner side, followed by the backfilling with the soil and plantation is done on it.	
Durability:	Poor durability due to easy decay of the wooden posts and the brushwood.
Structural Image	
Points to give attention during the application of the type of construction:	
Has high value than the stone masonry works.	
Effects on the ecosystems:	
- The decay of brushwood, wooden posts make the organic soil with high fertility, which promotes the growth of the plants. - Almost no adverse effect to the ecosystems even after damage as the materials are soil or plants. - Due to the application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plant of the area.	

Survey Sheet No.	31
Construction: hillside	Method: slope stabilization afforestation
Type: Hill side stepped dam works	Name: Straw stump netting works
Function: collapsed soil, keeping significant amount of rain water to the straw stump and providing abundant moisture in the hill.	-Trapping of the
Structural characteristics and locality: covered up with straw stumps and fixed with the bamboo split.	-The slope is
Setting place and application conditions: -Set at the bare red soil area where the slope is very porous as well as soft and plant growth is difficult due to the dry condition.	
Materials and construction methods: straw stump, bamboo split -The trench of 18cm width and 9cm depth is made with an rhombous shape, at 1.8m in longitudinal direction and 3.6m in lateral direction and straw stumps are placed there at 6 parts, which are then driven with bamboo splits at 60cm spacing for the stability of the straw stumps. The place where the straw stumps cross are tied up by the rope. -the size of the rhombus shape differs with the steepness of the slope and the slope of the straw stump is made less than 25°. (If it is made more than 25°, moisture can not pass through the rope and it will be hanged down).	
Durability: Poor durability due to decay.	
Structural Image	
<p>Long bamboo split (length: 55-58cm, width: 2.5-3cm)</p> <p>Short bamboo split (length: 45cm, width: 2.5-3cm)</p> <p>3.6 m</p> <p>0.6 m</p> <p>25°</p>	
Points to give attention during the application of the type of construction: There are many cases of failures by the decay and feathering before the plant intrusion at the steep slopes.	
Effects on the ecosystems: in the promotion of plant growth by making the mountain area wet due to the moisture content in the straw stump, which will be the fretilizer even after decay. the materials are soil or plants, there is almost no adverse effect to the ecosystems even after damage. - It will become the hiding place for the small animals and various kinds of insects during winter and rainfall.	
- As	

Survey Sheet No.	32
Construction: hillside	Method: slope stabilization afforestation
Type: Slope covering works	Name: Scattered straw
Function: erosion and promotion in the self growth of the grasses and trees.	-Prevention of soil
Structural characteristics and locality: along the slope.	-Straw is spread
Setting place and application conditions: -Set at the hillside slope which is severely damaged by the frost during the winter.	
Materials and construction methods: -Straw, cut grass (length- 30cm, width- 20cm, thickness- 5cm), silver grass. -Straw is placed along the slope and 2 cut grasses are piled up and pushed at the stem end of the straw. Again, trenches are excavated at the central part of the slope and the upper stem tip of the placed inside the trench, followed by the plantation of silver grass with compaction.	
Durability: Desirable durability is not attained due to decay.	
Structural Image No data	
Points to give attention during the application of the type of construction: Although the quantity of the straw for construction is small according to the surface area, due to the comparatively largen construction area, cost for used straw will be very high. Scattering straw does not have rapid effect and finishes with few year's construction.	
Effects on the ecosystems: role in the promotion of plant growth by providing fertilizer to the land through the decay. - As the materials are soil or plants, there is almost no adverse effect to the ecosystems even after damage. - It will become the hiding place for the small animals and various kinds of insects during winter and rainfall.	

Survey Sheet No.	33
Construction: hillside	Method: slope stabilization afforestation
Type: Slope covering works	Name: Brushwood laying works
Function: plantation works at the places where it is difficult to get grasses but brushwood are easily available . -Prevention of soil erosion of the slope at barren slope through the intermediate construction methods of plantation works and plotting works. works, used for the improvement of slope failure area.	-Substitution of -Slope covering
Structural characteristics and locality: with brushwood. At present, it has been improved and constructed as straw laying works.	-Slope is covered
Setting place and application conditions: -Places where it is difficult to get the grass but brushwood are easily available, barren lands, slope failure area.	
Materials and construction methods: brushwood (length: 3.6-4.2m), anchoring posts (similar to the size as brushwood), wooden posts. 50cm width is done along the slope and excavated soil is compacted well with the rammer and fertilizer straw is placed on it, followed by the covering with brushwood. Brushwood are fixed with anchoring posts at 1.4m spacing and wooden post of 55cm length and 4.5cm diameter is driven, which is then tied up with the anchoring posts by wire or the rope.	-Bed cutting of about
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: Young branches of the seedlings of the types of brushwood like willow, alder etc. are desirable. Better effect can be achieved by planting the silver grass or sowing the seeds of coarse trees or brushwoods in the open space.	
Effects on the ecosystems:	- Due to the application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plant of the area.

Survey Sheet No.	34
Construction: hillside	Method: sideworks
Type: Plantation works	Name: Seedling plantation
Function: discharge by providing the hillside afforestation through the plantation works after the construction methods like hillside stepping works . Protectinf from the direct sunlight at the slope suraces and prevention of drying out.	
Structural characteristics and locality: were used until middle of Meiji era. But due to the desertation effect to the plant collection mountains and increasing demand, use of artificial seedlings were started.	
Setting place and application conditions: -Places close to the hillside construction area or the dam area and mountain sides orginally having poor vegetation.	
Materials and construction methods: Seedlings of the type of the tree to be planted (although it has been changed with time, black pine, red colors are used at present). diameter and depth are excavated just before the plantation in order to prevent drying out. The seedling with thin rectangular root soil is put vertically in it and backfill is done better than the surrounding area to fill up the roots perfectly. Although the spacing of the plantation differs with the type of plant in each hillside works (about 30-40cm), the plantation by usual method leads easy drying of the land and high death rate of the plant. Therefore, relatively closed planting is better.	
Durability: No data.	
Structural Image (Main types of trees and grasses are as follows). <u>Coniferous trees:</u> black pine trees, red pine trees. <u>Broad leaf trees:</u> Himeyasyabusi, Oobayasyabusi, Yamahanno tree, Niseakasiya, willow, Nemune tree, <u>Herb types:</u> Silver grass, Itadori, Medoha tree, Yomo tree, Yamayomo tree, Kawarayomo tree, Komatsuna tree, chikara bush, oobako, toda bush, Yamaha tree, Kentatsuki 31F, Weeping love grass, Orchard grass.	
Points to give attention during the application of the type of construction: The period before the leaves dropping season, from the end of February to the early April is very suitable for planting. -Due to the shortage of manured part in bare mountain land, how to conserve the fertilizer for the hillside afforestation is very important.	
Effects on the ecosystems: application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plants of the area.	

Survey Sheet No.	35
Construction: hillside	Method: sideworks
Type: Plantation works	Name: Actual sowing
Function: afforestation by urging top soil formation through direct sowing of tree/grass seeds.	-Increase in
Structural characteristics and locality:	-No data.
Setting place and application conditions: -Soft ground on the hillside slope, or constructed on the steps of straw (brushwood) stub fencing works, plantation works, terracing works with seedlings, stone masonry works, etc (constructed on the flat portion created after each construction type).	
Materials and construction methods: Seeds of herb (strong in drying, root system, strong stems on the surface, very broad widening characteristics with low roots having long life and strong regeneration potential, growing in between autumn and spring). -Trenches of 25cm side and 13cm depth is made on the soft places of the hillside slope or on the steps of straw stub fencing works, terracing work with seedlings, stone masonry works etc. and grass/tree seeds are sown in the well mixed mixture of fertilizers, ashes and soil.	
Durability:	No data.
Structural Image	Nodata
Points to give attention during the application of the type of construction: Afterwards, the method of tree plantation on the hillside and covering up by the herbs in the inner space was developed (combination of terracing works with seedling and straw laying works)as mainstream method from ecological point of view and became fixed method thenafter. -The natural change from the herbs to tree is not certain and if the dense herb plantation is done to prevent surface erosion of the slope, natural invasion of the herbs is difficult. In addition, due to the continuous declination of artificial plants grown by various reasons, there is the fear of reversing into the original bare slope again .	
Effects on the ecosystems:	- Due to the application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plants of the area.

Survey Sheet No.	36
Construction: hillside	Method: slope stabilization afforestation
Type: Slope covering works	Name: Mixture sowing works on the slope
Function: of the slope.	-Surface afforestation
Structural characteristics and locality: mixture of seeds with the mixed soil sample. Constructed only on the bare mountain area of Kashima Peninsula in Okayama prefecture in 14 th year of Showa.	-Distribution of the
Setting place and application conditions: -Hillside slope where surface afforestation is necessary.	
Materials and construction methods: Seeds based on the herbs of rice or bean type, urea fertilizer, straw, brushwood. on the herbs of rice or bean type is mixed with urea fertilizer mixed soil and distributed for the thickness of 10cm (surface condition) or 20cm (stepping condition) and make germination by covering up with straw, brushwood etc	- -Seeds based
Durability: No data.	
Structural Image	No data
Points to give attention during the application of the type of construction:	-As a result of the difficulty to have the afforestation of the overall surface that was lost due to rainfall, it has not been constructed after the construction at the barren mountain area of Kasima Peninsula, in Okayama prefecture.
Effects on the ecosystems: application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plants of the area. adverse effect to the ecosystems even after breakage. - It becomes the hiding place for the small animals or various types of insects during winter or rainfall.	- Due to the - As the materials are plants or soil, there is almost no

Survey Sheet No.	37
Construction: hillside	Method: sideworks
Type: Protection works	Name: Supplementary plantation
Function: promoted by supplementary plantation at the existing construction area where growth of nursery plants is not good.	-Afforestation is
Structural characteristics and locality: present since 1967 as protection work B by increasing the type of supplementary plant.	- Still constructed at
Setting place and application conditions: -Places at the existing construction area having bad nursery plant growth.	
Materials and construction methods: Seedlings of <i>Alnus pendula</i> , <i>Yasyabushi</i> as well as black pine, acacia etc. are used. -Supplementary plantation was done at the places having bad plant growth. At the same time, 47kg of fertilizer or 25kg of fertilizer straw and 24kg of horse dung was used for 100 numbers of seedlings.	-
Durability: No data.	
Structural Image	Nodata
Points to give attention during the application of the type of construction: data .	No
Effects on the ecosystems: application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plants of the area.	- Due to the

Survey Sheet No.	38						
Construction: Torrent	Method: verticalwroks						
Type: Dam construction	Name: Sand retention						
Function: sediment flow and prevention of sediment movement.						-Trapping of	
Structural characteristics and locality: sabo works of the stream during the Edo era. Depending on the structural characteristics, it is divided into arch dam, armoured masonry type rock fill dam, stone dam of construction type as in castle etc. Constructions were done at 51 places in Shimofukuyama han of Hiroshima Prefecture from 1700 to the end of Edo era.						-Representative	
Setting place and application conditions: -Installed at the valleyside.							
Materials and construction methods: Broken stone, earthen dam, a part of which is made of clay and Sikkui. -Earthen dam is constructed and water flow part or downstream slope is made of stone masonry. Stone masonry of 17 th century was stone pitching whereas it became armoured masonry or jute masonry in 18 th century.							
Durability: There are still some structures in the similar condition as in the initial period.							
Structural Image							
(注) 粘土、シッコイを使用したものあり							
year	type	Dam type	Wate way	Stone	Plan shape	D/s slope	Masonry method
17 th century		earth		pebble		slipper	pitching
18 th century		rockfill		broken	arch		armoured
		stone		Broken/big	arch		jute
Structural characteristics of sand retention work at Shimofukuyama han of Hiroshima Prefecture							
Points to give attention during the application of the type of construction: data .						No	
Effects on the ecosystems: between the stones masonry is the highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.						- As the space - Due to the	

Survey Sheet No.	39
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: Earthen dam
Function during rainfall, prevention of stream bed degradation.	
Structural characteristics and locality:	-Some earthen dams, which were constructed at comparatively gentle stream bed are still existing.
Setting place and application conditions: -Set at the small rivulets or the hillside depressions having comparatively gentle flow and generally do not have water flows nor there is the possibility of sudden increase in water flows.	
Materials and construction methods: clay, grass turf -Foundation or the connecting parts of both left and right sides were compacted by using clay. Then, 20-25cm thick clay is filled and compacted on it. A number of such layers were made upto the desired height. Central part of the dam is made horizontal and left and right sides are made slightly higher than it in trapezoidal shape (to prevent the erosion of both left and right stream banks and protection of the earthen dam from damage). Downstream slope and top surface of lowest water level is constructed with the turfing work in order to control the scouring of soil. And, slope at the upstream and downstream sides are made 10% to 15% whereas brushwood works and the reinforcement with the materials suitable for that area are done to protect the apron from scouring. Width of the top surface is generally made three fourth of the dam height.	
Durability:	Ordinary effects are expected, but long lasting effects are not expected.
Structural Image	
Points to give attention during the application of the type of construction: As the damage of the earthen dam causes the discontinuity of the structure connecting left and right sides as well as foundation, strong compaction of the central part is very important. Again, at the places having severe disasters, short term effects can be obtained, but long term effects are not expected.	
Effects on the ecosystems:	- As the surface is soil and grass, it is easy for the plants to invade into the dam body. - Impact to the ecosystems is also less compared to the concrete structure. - Due to the disruption in the continuity at the flow direction, it disturbs the movement of the living beings.

Survey Sheet No.	40
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: Stone dam
Function: done across the stream, stream bed slope is decreased which causes the prevention of side slope collapses by fixing the foot of the hill at both banks along with the prevention of river bed scouring in the longitudinal direction. This results in the adjustment of the trapping of sediment flow.	
Structural characteristics and locality: stone masonry dam, wet stone masonry dam and compond stone masonry dam, based on the availability of binding materials.	
Setting place and application conditions: -At the places, where both banks are at narrow and compressed part as well as both banks having strong foundation and wide area is available for sedimentation at the upstream.	
Materials and construction methods: Dry stone masonry dam: mainly stones are used. Bigger stones are desirable as far as possible. Tall heights are not possible. -Wet stone masonry dam: Constructed by fixing stones by mortars. Generally used when the height is more than 4.5m. -Compound stone masonry dam: Major parts are made of dry stone masonry. Crown of the dam and side slope of the water way are fixed with mortar. -Locations having sedimentation area at the upstream are selected and construction is done exactly perpendicular to the flow direction in such a way that the water flowing from the crown will not pass to the banks. -Priority is given to the use of pebble layers at the construction places. 'Base compaction pile for stone dam' made of stone dam with the downstreamside made of raw trees (pine trees) and downstream foundation driven with raw piles (pine) which was stabilized by pile fencing, was constructed as reinforcement works against stream bed variation.	
Durability: Has comparatively long lasting effects and a large number of such dams are still existing.	
Structural Image	
Points to give attention during the application of the type of construction: As all types of masonry i.e. dry stone, wet stone and compound masonry have their merits and demerits, it is necessary to investigate the suitable topography or installment condition for each type. Besides, stones should be of good quality and as big as possible to increase the strength.	
Effects on the ecosystems: between the stones masonry is the highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	
- As the space - Due to the	

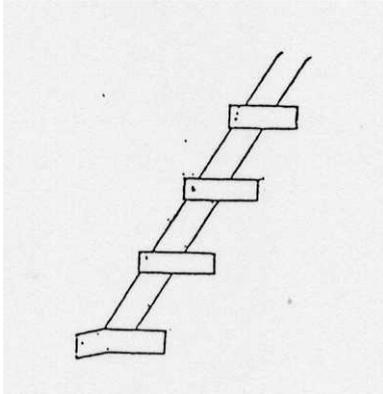
Survey Sheet No.	41
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: Soil concrete dam
Function: bed gradient, prevention of erosion, fixation of the foot of the hill and prevention of slope failure, entrapment of the flowing sediments and pebbles, decrease in water current.	-Easing of stream
Structural characteristics and locality: used at the foundation part and strong stones are used at the crown part of the dam.	-Soil concrete is
Setting place and application conditions: -Set at the torrent.	
Materials and construction methods: Soil concrete, big sized stones. stone masonry is made using soil concrete at the foundation and strong big sized stones at the crown part of the dam.	- -Wet
Durability: It has longer durability compared to the earthen dam.	
Structural Image	No data
Points to give attention during the application of the type of construction: Danger of damage due to the flowing big stones or woods is high if the flat stones are not used at the crown of the dam. Again, if dam is made of soil concrete, surface will be slippery and water velocity is not decreased. This will cause the danger of scouring.	-
Effects on the ecosystems: between the stones masonry is the highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	- As the space - Due to the

Survey Sheet No.	42
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: wooden dam, brushwood dam
Function: bed gradient, prevention of erosion, compaction of the foot of the hill and prevention of slope failure, entrapment of the flowing sediments and pebbles.	-Easing of stream
Structural characteristics and locality: the small streams having less stone aggregates and there is no influence to the entire dam even though a part of the dam is damaged. rough trees with branches and leaves as the filler material.	- Very effective at - Brushwood dam is similar to the wooden dam but it uses
Setting place and application conditions: -Set at the small stream where stone aggregates are less available.	
Materials and construction methods: wood (pine wood etc) -Unit wall dam: Woods such as wooden logs or wood with angular surface at one or two faces are placed closely or at a spacing of 15cm and piled up. In case of dense placing, it is supported by wooden posts whereas in case of having spac, it is supported by filler materials. stone box dam: Two wall plates are connected with transverse wood and stone is filled up in it. Crown of the dam is made by blocks or flatstones.	-Compound wall dam or
Durability:	Durable effect is not expected due to the decay of the wood.
Structural Image	
Points to give attention during the application of the type of construction:	
Wood that has been cut down in autumn or winter i.e. other than the tree fluid dropping season is used. Again, the dam is either directly constructed on the bed rock or constructed on the foundation made of brushwood or sediment. It is necessary to reinforce the apron as in the stone dam. While filling the stone box with stone, big stones are placed at sides, top and bottom and smaller stones are filled up inside them.	
Effects on the ecosystems: between the stones masonry is the highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	- As the space - Due to the

Survey Sheet No.	43
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: Brushwood work dam
Function: collapse of both banks, maintenance of pebbled stream bed.	-Prevention of the
Structural characteristics and locality: bundled brushwoods, brushwoods etc. Similar type of construction was done from Kyubaku to Maiji era.	- It is a dam made of
Setting place and application conditions: -Set at the places having less stream bed gradient and comparatively shortage of stones and aggregates.	
Materials and construction methods: bundled brushwood, brushwood, clay spread and compacted on the fixed foundation, after excavating the bed. 2 numbers of bundled brushwood are arranged on it and brushwood, pointing towards upstream, is placed on them for a thickness of 15cm. Then, 1.2m long wooden piles are driven at the spacing of 40cm. Top 15cm of the pile is made like a fence using fencing brushwood and stone pitching is done inside the fence after spreading the clay. This part functions as apron. One bundled brushwood is put on the brushwood leaving the apron part and brushwood of about 15cm thickness is placed on it. This is driven with 1.2m long wooden pile and top of the pile is made like fence by using brushwood. Then, kneaded clay mortar is inserted into the spacing of the brushwood. 3 to 4 such layers are piled up and topmost layer is made like the apron by making a fence at the top of the pile. Stone pitching is done after spreading of clay inside the fence.	- -About 15cm clay is
Durability: About 8 – 9 years.	
Structural Image	
Points to give attention during the application of the type of construction: order to compact the apron part, mattress works are sometimes made. necessary due to the decay of wood after 8 – 9 years.	- In - Repairment is
Effects on the ecosystems: ecosystems is also less compared to the concrete structure. continuity at the flow direction, it disturbs the movement of the living beings.	- Impact to the - Due to the disruption in the

Survey Sheet No.	44
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: Stone low dam
Function: stream bed erosion; sedimentation of pebbles. Easing the stream bed gradient; erosion control of the foot of the hill. Protection of bank protection works, drainage channel works and dam works.	-Prevention of the
Structural characteristics and locality: to stone dam and has less than 2m height.	- Structurally similar
Setting place and application conditions: -Set at the steep gradient and narrow streams as well as deeply cut streams.	
Materials and construction methods: Foundation is made sufficiently deep and both sides of the top surface of the dam are inserted sufficiently deep into the hillsides. Shape is either straight line or curved. The shape of the downstream slope and crown of the dam is constructed similar to that of stone dam. Dry stone masonry is made using big stones.	-
Durability: Similar durability is expected as that of stone dams.	
Structural Image	No data
Points to give attention during the application of the type of construction: the big stones, existing on the stream bed, is used as foundation, low and durable dams can be made easily.	- If
Effects on the ecosystems: between the stones masonry is the highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	- As the space - Due to the

Survey Sheet No.	45
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: Valley sedimentation stone masonry works
Function: sediment flow.	-Prevention of
Structural characteristics and locality: to the stone dam and has less than 2m height.	- Structurally similar
Setting place and application conditions: -In the stream.	
Materials and construction methods: Bed excavation is sufficiently done and construction of the dam side is done repeatedly according to the water flow condition. In the example of Okayama Prefecture, as shown in figure, more than 45cm offset was kept for surface stone.	
Durability: Similar durability is expected as that of stone dams.	
Structural Image	
Points to give attention during the application of the type of construction: Construction of the dam sides is done repeatedly according to the water flow condition.	-
Effects on the ecosystems: between the stones masonry is the highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure.	- As the space - Due to the
disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	

Survey Sheet No.	46
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: Valley sedimentation turfing works
Function: sediment flow at small valley.	-Prevention of
Structural characteristics and locality: laid.	- Grass carpet is
Setting place and application conditions: -Constructed by connecting straight below the terracing work with seeding.	
Materials and construction methods: Land is excavated and leveled and bed excavation is done in reverse slope up to the strong place for the foundation. About 15cm strong side is left and remaining part is laid with grass carpet. From the small opening of the grass carpet, 6cm offset is made and sediments are filled inside, which is sufficiently compacted by the wooden rammer to make stronger grass. Then, the grass is supported from outside by piles and top surface is finished with top layer grass at the slope of 73° . Top surface of lower step is at the same level as that of the bottom surface of the upper step.	
Durability:	No data.
Structural Image	
	
Points to give attention during the application of the type of construction: Sufficient compaction is necessary according to the construction height.	
Effects on the ecosystems: plant or sediment, there is no adverse effect to the eco system even after damage. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	
	- As the material is - Due to the

Survey Sheet No.	47
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: Wooden low dam
Function: stream bed erosion; sedimentation of pebbles. Easing the stream bed gradient; erosion control of the foot of the hill. Protection of bank protection works, drainage channel works and dam works.	-Prevention of the
Structural characteristics and locality: to the wooden dam and has less than 2m height.	- Structurally similar
Setting place and application conditions: - In the stream.	
Materials and construction methods: Stone box low dam: Structurally similar to stone box dam. dam: made of flat wood/ raw tree with leaves and branches (similar to brushwood dam) - Isssel type low dam or log wood low dam: Low dam made of usually thicker log woods, the shape of which is as shown in the figure.	- Brushwood low -
Durability: Long lasting effects are not expected due to the decay of the wood.	
Structural Image	
Points to give attention during the application of the type of construction: No data.	-
Effects on the ecosystems: between the woods is a highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	- As the space - Due to the

Survey Sheet No.	48
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: Knitted fence low dam
Function: stream bed erosion; sedimentation of pebbles. Easing the stream bed gradient; erosion control of the foot of the hill. Protection of shore protection works or drainage channel works and dam works.	- Prevention of the
Structural characteristics and locality: work made of brushwood.	- Knitted fencing
Setting place and application conditions: - Suitable at the short term scouring stream having possible growth of willow but have less wood.	
Materials and construction methods: First level knitted fence work: It is a 20-30m long and less than 1.5m high compound fence dam with bundled brushwood apron works. Piles are deeply driven into the land, perpendicular to the flow direction and knited fence is made with the branches of willow. - Second level knitted fence work: It is a unit knitted fence, generally having the height of 0.5-0.6m. Short piles are driven into the land at a spacing of 33cm .	-
Durability: No data.	
Structural Image	
<p>The image contains three technical drawings of a knitted fence low dam. The 'Front view' shows a perspective of the dam structure with a height of 1.0m and a length of 2.0m. The 'Side view' shows a cross-section of the dam with a height of 0.12m and a width of 0.10m. The 'Plan' view shows the top-down layout of the dam structure.</p>	
Points to give attention during the application of the type of construction: Knitted fence is not suitable at the stream having high sediment volume.	
Effects on the ecosystems: ecosystems is also less compared to the concrete structure. continuity at the flow direction, it disturbs the movement of the living beings.	- Impact to the - Due to the disruption in the

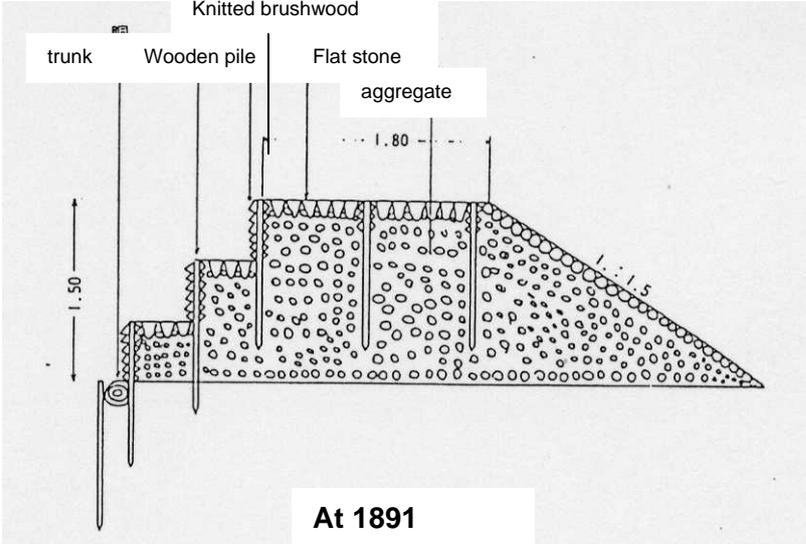
Survey Sheet No.	49
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: Bundled brushwood low dam
Function: stream bed erosion; sedimentation of pebbles. Easing the stream bed gradient; erosion control of the foot of the hill. Protection of shore protection works, drainage channel works and dam works.	- Prevention of the
Structural characteristics and locality: made of brushwood.	- Transverse works
Setting place and application conditions: -Set at narrow and water cut streams.	
Materials and construction methods: First level bundled brushwood works: Piles are driven only at the front slope and 3 numbers of usual bundled brushwood (made of the branches of willow) is placed at the back. Both sides of the bundled brushwood are inserted into the hillsides. Hight is generally made of 1m although there are the cases of making 1.5m hight by piling 5 numbers of bundled brushwood. - Second level knitted fence works: It is similar to the first level upto the insertion of brushwood into the hillside, but the major differences are – (1) Usually 1,2 numbers of bundled brushwood are used, (2) Usually willow wood is used for piles, (3) Piles are inserted directly into the bundled brushwood rather than putting in the front of it.	-
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: No data.	
Effects on the ecosystems: ecosystems is also less compared to the concrete structure. continuity at the flow direction, it disturbs the movement of the living beings.	- Impact to the - Due to the disruption in the

Survey Sheet No.	50
Construction: Torrent	Method: verticalwroks
Type: Dam construction	Name: Gabion low dam
Function: stream bed erosion; sedimentation of pebbles. Easing the stream bed gradient; erosion control of the foot of the hill.	- Prevention of the
Structural characteristics and locality: bamboo gabion, willow gabion, GI wire gabion are found when used as low dam. Willow gabions are less decaying than bamboo gabions but are not as durable as GI wire gabions.	- Three types i.e.
Setting place and application conditions: - At the streams, having bed width less than 9m.	
Materials and construction methods: bamboo gabion, willow gabion, GI wire gabion, wooden piles gabion: 8 gauge or 10 gauge GI wire is used. Mesh size is made 6-12cm and diameter of the box is made 30-90cm. Length of the box varies with the width of the stream, but is generally kept less than 9m. This gabion is transported to the installation site and filled up with stones. 2-3 numbers of wooden posts (6cm diameter/side and 1.5 – 1.8m long) is driven at the spacing of 1.8m lengthwise to support it.	- In case of GI wire
Durability: Durability differs with the materials of gabion box.	
Structural Image	No data
Points to give attention during the application of the type of construction:	
Number of gabion layers depends on whether it is to prevent the bed erosion or it is to increase the river bed.	
Effects on the ecosystems: between the stones is a highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	- As the space - Due to the

Survey Sheet No.	51
Construction: Torrent	Method: longitudinalwroks
Type: Flow channel works	Name: Stone bank protection work
Function: mountain side.	- Conservation of
Structural characteristics and locality: by changing the stone materials into block or concrete.	- Still used at present
Setting place and application conditions: - Set at the places where hillsides are hit by the water current and the possibility of collapse is increased. Construction is done after leaving a small distance from the foot of the hill.	
Materials and construction methods done after leaving small offset at hillside and surface facing the stream side is covered up with stones.	-Pebble filling is
Durability: No data	
Structural Image	
Points to give attention during the application of the type of construction: No data.	
Effects on the ecosystems: between the stones is a highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	- As the space - Due to the

Survey Sheet No.	52
Construction: Torrent	Method: longitudinal wroks
Type: Flow channel works	Name: Stone bank protection work
Function: collapse of foot of the hill.	- Prevention of the
Structural characteristics and locality:	
Setting place and application conditions: streams having relatively gentle bed slope.	
Materials and construction methods bundled brushwood, brushwood, clay, small stones - Eaxavation is done with 1.8m width and 0.9-1.3m depth from stream bed surface and clay is spreaded for the thickness of 15cm. 2 bundles of bundled brushwood are placed horizontally on it longitudinally at the spacing of 80cm. Brushwood is placed on it for the thickness of 15cm, pointing the tips towards the flow direction. Bundled brushwood are driven with 1.2m long wooden piles. Top of the piles are knitted with the fencing brushwood and stone pitching is done with small stones in between the fences. This becomes the foundation of the structure. Earthen dam is made on it with clays. That slope and the 1:0.6 sloped track of the width equal to horse feet is finished by stone pitching with small stones.	
Durability:	No data
Structural Image	
Points to give attention during the application of the type of construction: As cost is cheaper compared to the stone bank protection works although effect is similar, it was widely used in the starting of Meiji era. However, it was not constructed afterwards due to the damage of the structure caused by the decay of the construction materials.	
Effects on the ecosystems: between the woods is a highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure.	

Survey Sheet No.	53
Construction: Torrent	Method: longitudinal wroks
Type: Flow channel works	Name: Stone work bed compactio work
Function: stream bed erosion; easing of stream bed gradient.	- Prevention of the
Structural characteristics and locality: height and is still construted after substituting the material with concrete.	- It is stone dam of low
Setting place and application conditions:	- No data.
Materials and construction methods stone, in some cases trunk of tree, wooden pile - Foundation and both side connections are made strong in order to protect from damage. Water flowing parts are made of stone masonry or stone pitching. Vertical parts of both sides are made so high that water flow does not exceed that level even during high flood. - When bed rock is deep, trunk of the tree (fresh pine tree log of diameter more than 20cm) is set at the pebble layer of bed rock and retaining wooden pile (60cm long and diameter of more than 6cm) is driven. It is considered as foundation for the construction of bed compaction works on it.	
Durability:	No data
Structural Image	
Points to give attention during the application of the type of construction: data	No
Effects on the ecosystems: between the stones is a highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	- As the space - Due to the

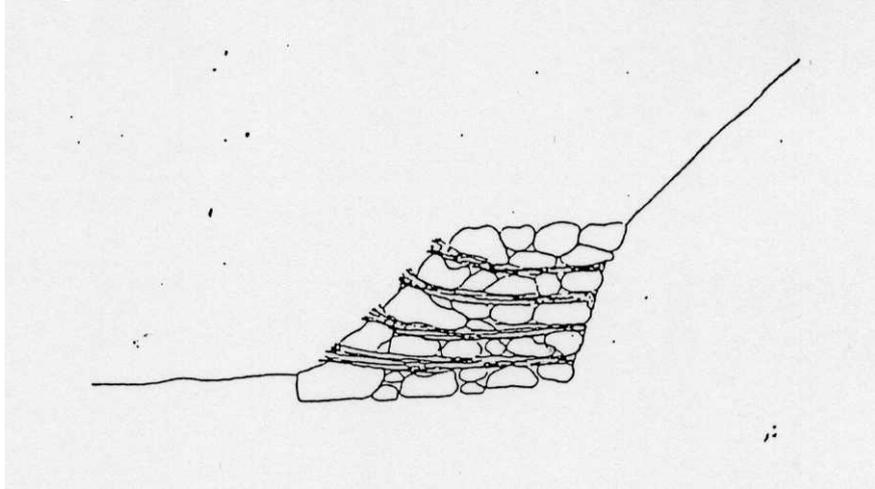
Survey Sheet No.	54
Construction: Torrent	Method: longitudinal wroks
Type: Flow channel works	Name: Brushwood work bed compaction work
Function: stream bed degradation.	- Prevention of
Structural characteristics and locality:	- No data.
Setting place and application conditions: the places having relatively less stone availability and gentle stream bed.	- Installed at
Materials and construction methods brushwood, wooden piles, pine wood logs, stones, flat surfaced stone. brushwoods are laid on the stream bed and brushwoods are lined up on it at the sides. Then 4 wooden piles (about 1.2m long) are driven for fencing. Clay is filled up inside it. A number of such steps are piled up and topmost layers are finished up with stone pitching.	- Knitted - Bundled
Durability: No data	
Structural Image 	
Points to give attention during the application of the type of construction: As repairing works may be necessary after a few years due to the decay of the materials, it is not so popular.	
Effects on the ecosystems: - Impact to the ecosystems is also less compared to the concrete structure. - Disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	
	- As the space - Due to the

Survey Sheet No.	55
Construction: Torrent	Method: longitudinal works
Type: Bank protection works	Name: Stone pitching bank protection work
Function: - Protection of the foot of the dam, the stream bank; maintenance of engineering objects placed at the hillside of both banks.	
Structural characteristics and locality: on stone.	- Bank protection based
Setting place and application conditions: the places having possibility of the erosion of stream bank or the sides of the dam by the force of water.	- Installed at
Materials and construction methods - As it is necessary to make the foundation strong, construction is done on the piled formation or foundation base made of soil concrete. Transverse works are done with similar principle as in stone dam. -Dressed stone pitching works: Dressed stone pitching is done at the slope of 10 – 20% and aggregates are placed inside. -Broken stone pitching works: Broken stones having flat surface is selected and processed to fit with surrounding situation before doing stone pitching works at the side slope towards stream side.	dressed stones, broken stones, wooden posts
Durability: Stability changes with the decay of wooden posts.	
Structural Image	
Points to give attention during the application of the type of construction: data	No
Effects on the ecosystems: - Impact to the ecosystems is also less compared to the concrete structure.	- Part of the space between the stones is a highly porous structure, it can be the living place for small animals.

Survey Sheet No.	56
Construction: Torrent	Method: longitudinal wroks
Type: Bank protection works	Name: Stone box bank protection work
Function: Protection of the foot of the dam, the stream bank; maintenance of engineering objects placed at the hillside of both banks.	- Protection of the
Structural characteristics and locality:	- Wooden box.
Setting place and application conditions: the places having possibility of erosion of stream bank or the sides of the dam by the force of water.	- Installed at
Materials and construction methods method is similar to that of the stone box dam. driven piles are to be connected, piles are driven at the water side and wall boards are set in such a way that it will not be pushed out by the pressure of the filler stone.	- Construction When stone boxes and
Durability: Stability changes with the decay of wooden posts.	
Structural Image	
Points to give attention during the application of the type of construction: Flat broken stones are selected and processed to fit with the surrounding situation.	-
Effects on the ecosystems: between the stones is a highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	- As the space - Due to the

Survey Sheet No.	57
Construction: Torrent	Method: longitudinal wroks
Type: Bank protection works	Name: Stone wall bank protection work
Function: the foot of the dam, the stream bank; maintenance of engineering objects placed at the hillside of both banks.	- Protection of the
Structural characteristics and locality: types such as stone wall made of dressed stone masonry, stone wall made of dry pyramid stone masonry etc.	-There are different
Setting place and application conditions: the places having possibility of erosion of stream bank or the sides of the dam by the force of water and in case when gentle slope can't be made for bank protection works.	- Installed at
Materials and construction methods construct foundation or not ; whether to make foundation with strong materials or not, is decided based on the ground characteristics and height of the wall. Generally, it is necessary to make foundation works with stronger materials in case of higher stone walls. Broken stone pieces, gravel blinders etc. are compacted at the spacing of the pyramid stones. Wet stone masonry made of stone wall is made when the height is more than 2m.	- Whether to
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: data.	No
Effects on the ecosystems: between the stones is a highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure. disruption in the continuity at the flow direction, it disturbs the movement of the living beings.	- As the space - Due to the

Survey Sheet No.	58
Construction: Torrent	Method: longitudinal wroks
Type: Bank protection works	Name: Turfing works
Function: foot of the dam, the stream bank; maintenance of engineering objects placed at the hillside of both banks.	- Protection of the
Structural characteristics and locality: types such as turfing works, Tatami turfing works, lined turfing work etc.	- There are different
Setting place and application conditions: at the upper high water surface of the stone pitching works, bank protection fencing works; parts above the normal water level.	- Constructed
Materials and construction methods Entire surface is covered with field grass or mountain grass and joints are fixed by bamboo splits. -Tatami turfing works (Terracing with turfs): Turfs of 18cm width is piled up making cut end at the surface and joints are fixed with bamboo splits. It is constructed at relatively steeper slopes where turfing is not possible as well as at the places where materials are abundant. - Lined turfing works: It is made of placing 18cm wide turfs at each 30m slope height. When materials are not sufficient, it is constructed at the places where possibilities of erosion by flowing water is less.	-Turfing work:
Durability: No data.	
Structural Image	No data
Points to give attention during the application of the type of construction: data.	No
Effects on the ecosystems: the bank protection works is turf rather than stone, growth of the plants is easy. - Impact to the ecosystems is also less compared to the concrete structure.	- As the slope of

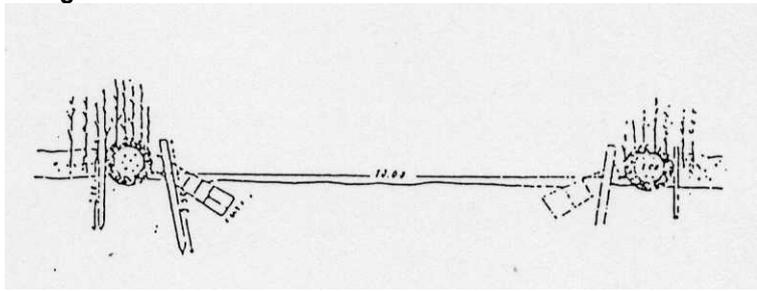
Survey Sheet No.	59
Construction: Torrent	Method: longitudinal works
Type: Bank protection works	Name: Alternate layer of stone and brushwood works
Function: the foot of the dam, the stream bank; maintenance of engineering objects placed at the hillside of both banks.	- Protection of the
Structural characteristics and locality: along with the stabiliation by stone masonry.	- Uses brushwood
Setting place and application conditions: the places having side slope of about 10% or at the gentle slope.	- Installed at
Materials and construction methods excavated with the suitable depth and masonry is made by putting soiled tree branch or willow branch in between the course stones. Mixed soil is filled in between the stones afterwards and the structure will be strong after willow roots will covered up the surface. However, if foundation is shallow, there is the possibility of collapse before the structure is covered by the roots.	- Foundation is
Durability: No data.	
Structural Image	
	
Points to give attention during the application of the type of construction: data.	No
Effects on the ecosystems: between the stones and brushwood is a highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure.	- As the space

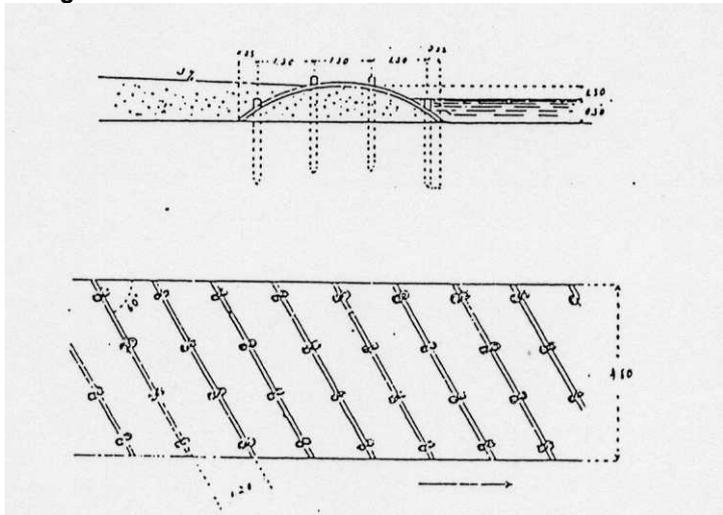
Survey Sheet No.	60
Construction: Torrent	Method: longitudinal wroks
Type: Bank protection works	Name: Bank protection knitted fence works, bamboo fence works
Function: the foot of the dam, the stream bank; maintenance of engineering objects placed at the hillside of both banks.	- Protection of the
Structural characteristics and locality: fence is covered with turfing and prevented from the erosion due to water flow and rainfall.	- Upper part from the
Setting place and application conditions: the small streams having gentle slope and less sediment volume.	- Installed at
Materials and construction methods: 1.2m length is driven at the spacing of 60-90cm. This is knitted with green willow brushwood. Suitable type of the wood, which does not decay until the germination and root spreading of the willow, should be selected. - Bamboo fencing works: It is similar construction method as knitted fencing work, but uses bamboo in place of green willow brushwood. Bamboo, used, should be unseasoned having elasticity.	- Pile of about
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: data.	No
Effects on the ecosystems: between the brushwood is a highly porous structure, it can be the living place for small animals. - Due to the application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plant of the area. compared to the concrete structure.	- As the space - Impact to the ecosystems is also less

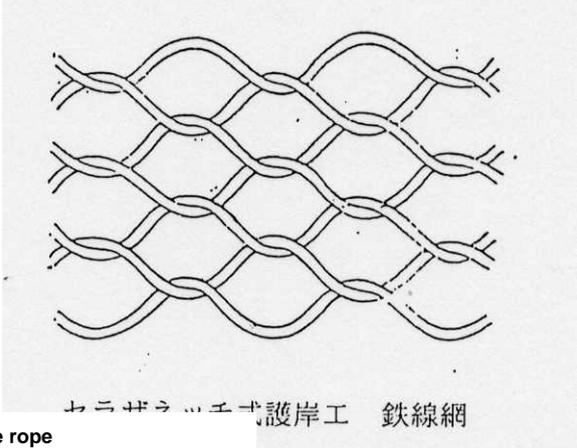
Survey Sheet No.	61
Construction: Torrent	Method: longitudinal wroks
Type: Bank protection works	Name: Pile arrangement works
Function: foot of the dam, stream bank; maintenance of engineering objects placed at the hillside of both banks.	- Protection of the
Structural characteristics and locality: square timber is desirable, logs are also used to reduce the cost.	- Although use of
Setting place and application conditions: the small streams having gentle slope and less sediment volume.	- Installed at
Materials and construction methods (square timber or wood log) are driven very closely. Cedar bark or brushwood is used to reduce the space and prevent soil transportation. Generally height is made 1.2 – 1.8m. If more than 1.8m height is to be made, wooden piles are driven in front of the fence at the spacing of 0.9-1.8m and each piles are connected with transverse connecting wood, placed 30cm down from the top, which is then connected to piles with bolt or 10 gauge GI wire.	- Wooden piles
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: data.	No
Effects on the ecosystems: ecosystems is also less compared to the concrete structure. continuity at the flow direction, it disturbs the movement of the living beings.	- Impact to the - Due to the disruption in the

Survey Sheet No.	62
Construction: Torrent	Method: longitudinal wroks
Type: Bank protection works	Name: Patching works
Function: the the places where dams or bank area are potential to be eroded by water force. having piping (It was first constructed in Austria)	- Protection of the foot of the dam, the stream bank; maintenance of engineering objects placed at the hillside of both banks. - Installed at the the places
Structural characteristics and locality: such as 'patching work without piles', which is generally set at the rocky stream beds and 'floor patching work ', which is strong and can be constructed at the places having pebbles.	- It has different types
Setting place and application conditions: the the places where dams or bank area are potential to be eroded by water force. having piping (It was first constructed in Austria)	- Installed at the the places
Materials and construction methods work: floor is constructed with no spacings (in order to prevent wash out of connection of patch work due to scouring of the base). Stopper wood at both sides of the patching is driven at least 75cm below the patching. If it is too short, tearing of the patching is possible due to thermal expansion of stopper woods.	- Floor patching
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: data.	No
Effects on the ecosystems: ecosystems is also less compared to the concrete structure. continuity at the flow direction, it disturbs the movement of the living beings.	- Impact to the - Due to the disruption in the

Survey Sheet No.	63
Construction: Torrent	Method: longitudinal wroks
Type: Bank protection works	Name: Stone throwing works
Function: stream bank and stream bed from erosion and damage, prevention of damage to the existing bank protection works, foundation is made of stone pitching.	- Protection of the
Structural characteristics and locality: using stone.	- Construction method
Setting place and application conditions: the the places where dams or bank area are potential to be eroded by water force. Installed at the dam part which has direct hit by water force.	- Installed at
Materials and construction methods thrown at the part, which has direct hit by water force to keep the natural gradient of the stream or protection of the existing bank protection work from damage by laying the stones on its front side or using it as the foundation of stone pitching.	- Stones are
Durability: No data.	
Structural Image	No data
Points to give attention during the application of the type of construction: Stone throwing work keeps the stability of the structure repeatedly by launching down along with the river bed erosion.	-
Effects on the ecosystems: between the stones is highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure.	- As the space

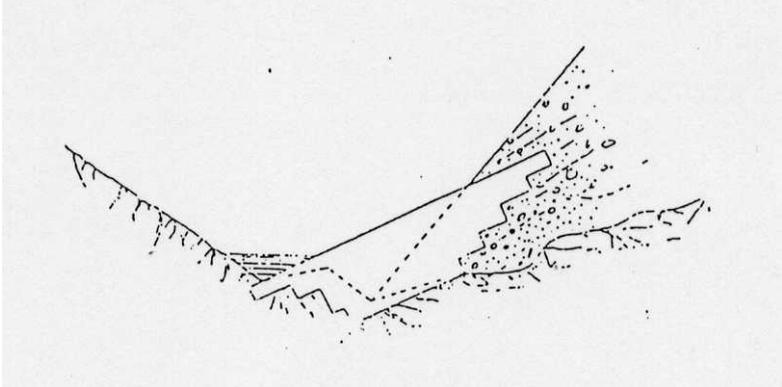
Survey Sheet No.	64
Construction: Torrent	Method: longitudinal works
Type: Bank protection works	Name: Bundled brushwood work (packed brushwood work)
Function: foot of the dam; stream bank; maintenance of engineering objects placed at the hillside of both banks; construction of stream bank at the flat flooding area; prevention of stream bank erosion during the maintenance of dam or flood control works.	- Protection of the
Structural characteristics and locality: brushwood works have been used to make the stream bank in flat flooding area.	- Many bundled
Setting place and application conditions: make stream bank along the field channel of hilly area or the flat flooding area, it is installed at the gentle sloped and more than 9m wide stream having sediment stones of more than 6cm size.	- If it is used to
Materials and construction methods: brushwood mattress is made by using high germination type brushwood. Hight of the brushwood layer is made 18cm and gravel is inserted at the central part with about 60cm diameter. The whole structure is tied up with iron wire. Piles are driven at the bank in order to control the deep shinking of bundled brushwood mattress at the water flow part.	- Bundled
Durability: No data.	
Structural Image	
	
Points to give attention during the application of the type of construction: There are the cases of disaster due to the change in flow course due to the damage of bundled brushwood mattress at the narrow streams. Besides, if the bundled brushwood work is made of the brushwood having no germination power, other tree branches, having germination power is inserted in it.	
Effects on the ecosystems: - Due to the application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plant of the area. - Impact to the ecosystems is also less compared to the concrete structure.	
- As the space	

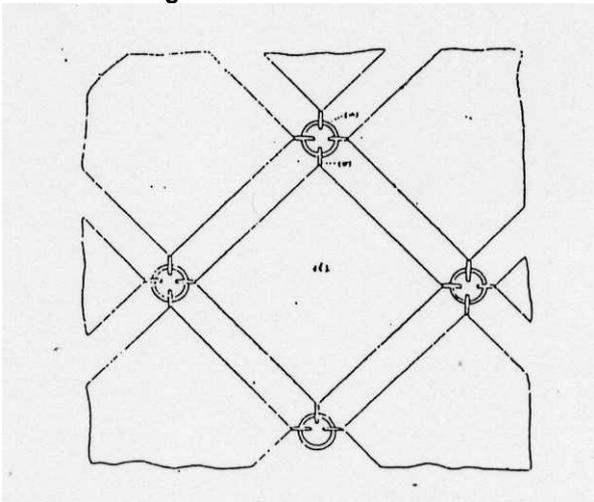
Survey Sheet No.	65
Construction: Torrent	Method: longitudinal works
Type: Bank protection works	Name: J-ring type bank protection works
Function: is made optionally.	- Future stream bank
Structural characteristics and locality: piles driven into the soil is densely filled up with brushwood and they are fixed with lateral wood. - First applied as repairment of river works at Galizien state of Austria.	- Space between the
Setting place and application conditions: the location of stream banks or stream banks, planned for construction. streams having river bed gradient less than 1/100.	- Costructed at - Costructed at the
Materials and construction methods brushwood. 1.2m. 2 piles are driven for the depth more than 1m. Then, at its back, piles are driven at multiple lines through out the width of the dam at the spacing of 1.3m. Location of the piles along the direction of flow is as shown in the figure. - Brushwoods are filled up in the space between the piles as compactly as possible. In order to fixthe piles or the brushwood, lateral wooden post is connected with the piles in such a way that both sides are touched with the land.	1.5m long and 8cm ϕ pile, brushwood, lateral posts for the fixation of pile or - Piles are driven at the spacing of
Durability: Become comparatively stronger due to the filling up of soil or pebbles at the spacing of brushwood after the post construction floods.	
Structural Image	
	
Points to give attention during the application of the type of construction: Huge quantity of brushwood is necessary. Besides, it is not suitable at the places where pile driving is difficult. - Maintenance against erosion is difficult at the streams having highly angular sediment stones. - In order to activate the brushwood, it is necessary to construct at the streams, usually having required water flow for the germination of the root.	
Effects on the ecosystems: between the brushwood is a highly porous structure, it can be the living place for small animals. - Due to the application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plant of the area. - Impact to the ecosystems is also less compared to the concrete structure.	

Survey Sheet No.	66
Construction: Torrent	Method: longitudinal wroks
Type: Bank protection works	Name: Metallic bank protection works (dell, rabbit, sera the net type)
Function: protection works, water supply, low dam works.	- Used for bank
Structural characteristics and locality: bank protection work is made of metal.	- Entire or part of the
Setting place and application conditions: the places where stream banks or sides of the dam are scoured by water force.	- Installed at
Materials and construction methods piles are made and iron wires are knitted between them. wires are laid on the stream banks and they are plastered by soil concrete to protect it from rusting. - Sera the net type: Banks are fixed with GI ropes. In case of steep places at mountain torrents, it is connected with small piles to protect the breakage of iron wire from hitting by big stones.	- Dell type: Iron - Rabbit type: Ropes made of iron
Durability:	Depending on the prevention of corrision of metals, it is possible to use for long term.
	
Struct	Sera the net type bank protection works iron wire rope
Points to give attention during the application of the type of construction:	
GI wire ropes have been used for various purposes.	
Effects on the ecosystems:	
- As the space between the metal pile is a highly porous structure as in the spacing of stones, it can be the living place for small animals. It provides wasy movement of the living beings too except at the piled location.	

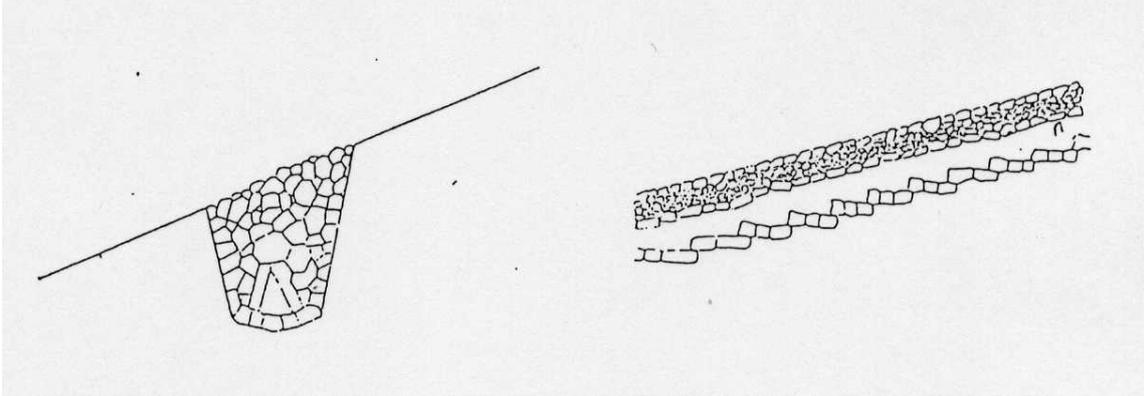
Survey Sheet No.	67
Construction: Torrent	Method: longitudinal wroks
Type: Bank protection works	Name: Gabion (iron wire gabion, bamboo gabion, brushwood gabion)
Function: water supply. or prevention of scouring.	- Bank covering work, - Blocking of the dam side collapsing places
Structural characteristics and locality: iron wire (0.3-0.6mm dia), bamboo, brushwood etc and stones are filled up inside.	- gabions are made of
Setting place and application conditions: surface of bank protection works, stream bed, scouring parts etc. there are no possibilities of the movements of gabions due to water flow or ground slope.	- Slope - At the places where
Materials and construction methods bamboo, brushwood, stone.	- Iron wire, - Gabion boxes are made as per desire with iron wire etc. and stones are filled inside. Those boxes are set by suitably connetcting and fixing each boxes.
Durability: Durability differs with structural material of the gabion boxes.	
Structural Image	
Points to give attention during the application of the type of construction: Prevention of the movement of the gabion should be confirmed . - Corrosion of the iron wire should be prevented in case of iron wire gabion.	-
Effects on the ecosystems: between the stones is a highly porous structure, it can be the living place for small animals. - Impact to the ecosystems is also less compared to the concrete structure.	- As the space

Survey Sheet No.	68
Construction: Torrent	Method: longitudinal wroks
Type: Bank protection works	Name: Wolf type hanging brushwood layer
Function: bank, repairing of the river works.	- Protection of stream
Structural characteristics and locality: are hanged from stream to the bank. river works of Bayern kingdom.	- Bundled brushwoods - It was used in the maintenance of Isar
Setting place and application conditions: suitable at the field streams having gentle gradient and flow of big stones.	- It is not
Materials and construction methods 25cm diameter are driven at the spacing of 2.5m and depth of 3-6m, parallel to the reparation line and 3m towards the stream from future construction line. Thicker end of bundled brushwood is binded by a stick and this stick is fixed to the piles by iron wires at the height of low water level. The other side is fixed to the stream. According to the strength of the flowing water, 2 or 3 lines of bundled brushwoods are fixed.	- Piles of 10-
Durability: No data	
Structural Image	
Points to give attention during the application of the type of construction: is not suitable at the field streams having low gradient and flow of large stones and therefore is applied at the places other than such places.	- It
Effects on the ecosystems: between the brushwood is a highly porous structure, it can be the living place for small animals. - Due to the application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plant of the area. compared to the concrete structure.	- As the space - Impact to the ecosystems is also less

Survey Sheet No.	69
Construction: Torrent	Method: longitudinal works
Type: Bank protection works	Name: De monse water cut off
Function: from dangerous bank to the strong bank.	- Used to guide water
Structural characteristics and locality: stone dam.	- It is special form of
Setting place and application conditions: weak part of the stream bank.	- Installed at
Materials and construction methods place in between 2 cutoffs is stone pitched. And front part of the cutoff is protected by big stones. Water cut off is made of dry stone masonry wall. Or it can be easily made by making foundation of the big stones, existing on the river bed.	- Collapsed
Durability: No data	
Structural Image	
	
Points to give attention during the application of the type of construction: No data.	-
Effects on the ecosystems:	- Not specially.

Survey Sheet No.	70
Construction: Torrent	Method: longitudinal works
Type: Bank protection works	Name: Kitamura type soil concrete mattress work
Function: of stream bed.	- Assures the stability
Structural characteristics and locality: mainly made of soil concrete . Kitamura Tagataro. Construction is possible from steep to gentle flow.	- It is a mattress work - It is a construction type developed by
Setting place and application conditions: stream bed and it is possible to construct for the stability of the stream bed.	- Installed at
Materials and construction methods concrete, iron stirrup around all corners of soil concrete blocks of 1m side (thickness depends on situation) and 4 blocks are connected through these stirrups to make the mattress of necessary size.	- Soil -Iron stirrups are connected
Durability: Increase in durability is expected compared to the combination of brushwood mattress, gabion works and other types of constructions.	
Structural Image	
	
Points to give attention during the application of the type of construction: Levelling of the bed is done before launching the soil concrete blocks on the bed.	- In order to increase the durability, wooden posts are driven at the spacing between soil concrete blocks and iron stirrups and broken stones, boulders, other types of stones, gravels etc are filled up in the spacing between the soil concrete blocks.
Effects on the ecosystems: levelling of the stream bed, living space and breeding place for fishes will be damaged.	- Due to the

Survey Sheet No.	71
Construction: Torrent	Method: longitudinal wroks
Type: Drainage channel (subsurface)	Name: Stone sub surface drainage works
Function: water, prevention of soil erosion due to ground water.	- Drainage of ground
Structural characteristics and locality:	- No data.
Setting place and application conditions:	- No data.
Materials and construction methods stones of 0.2m thickness are placed inside the trapezoidal sub surface drainage of 1.0-1.25m depth, 0.8m upper width and 0.3m lower width. A layer of grass, straw, moss etc are placed on it and soil is spreaded on this layer. Soil should not be dropped in the space between stones, during the placing. Lowerside of the sub surface drainage is made in stepped form. Length of this part depends on the topographic condition.	- Small
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: angular broken bolders will be used, spacing between the stone will be more and will be easier for water flow than in case of boulder filling. The main dimerit of stone sub surface drainage is that it can not be constructed at the place having no stones. Besides, it frequently chocked, which decreases the drainage efficiency.	- If
Effects on the ecosystems:	- Not specially.

Survey Sheet No.	72
Construction: Torrent	Method: longitudinal works
Type: Drainage channel (sub surface)	Name: Stone sub surface drainage works with water channel
Function: water, prevention of soil erosion due to ground water.	- Drainage of ground
Structural characteristics and locality: water by leaving hollow space inside the stone sub surface drainage.	- Increasing the flow of
Setting place and application conditions:	- No data.
Materials and construction methods or rectangular water channel is made inside the stone sub surface drainage, using blocks of flat rock or bricks and stone is filled up on it. Lowerside of the sub surface drainage is made in stepped form. Length of this part depends on the topographic condition.	- Triangular
Durability: No data.	
Structural Image	
	
Points to give attention during the application of the type of construction: Lowerside of the closed sub surface drainage is made in stepped form, the length of which depends on the topographic condition.	
Effects on the ecosystems:	- Not specially.

Survey Sheet No.	73
Construction: Torrent	Method: longitudinal works
Type: Drainage channel (sub surface)	Name: Brushwood sub surface drainage works
Function: water, prevention of soil erosion due to ground water.	- Drainage of ground
Structural characteristics and locality: chocking of the water channel, bundled brushwood is placed at the bottpm of the stone.	- In order to prevent the
Setting place and application conditions: the mountain area having brushwood but do not have stones.	- Installed at
Materials and construction methods logs are placed inside the sub surface drainage in crossing fashion and brushwood is placed on it. In another method of construction, 3 numbers of bundled brushwood are placed at the bottom and wood or grass is placed on it.	- Wooden
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: No data.	
Effects on the ecosystems:	- Not specially.

Survey Sheet No.	74
Construction: Torrent	Method: longitudinal wroks
Type: Drainage channel (sub surface)	Name: Earthen/ earthen pipe subsurface drainage works
Function: water, prevention of soil erosion due to ground water.	- Drainage of ground
Structural characteristics and locality: in case of earthen pipe subsurface drainage works.	- Unglazed pipe is used
Setting place and application conditions: subsurface drainage: installed at the places having clayey soil.	- Earthen
Materials and construction methods subsurface drainage: A deep trench is excavated and the trench is covered on top by grass lid. subsurface drainage: Unglazed earthen pipe of 4-16cm internal diameter is used to make the subsurface drainage.	- Earthen - Earthen pipe
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: Long term efficiency is not expected due to fast chocking of the earthen subsurface drainage. Besides, earthen pipe subsurface drainage has high drainage capacity but can not be used in mountain area.	
Effects on the ecosystems:	- Not specially.

Survey Sheet No.	75
Construction: Torrent	Method: longitudinal wroks
Type: Drainage channel (open)	Name: Flag stone water channel
Function: water is drained quickly. For example, in case of valley area with gentle slope, damage due to flood disaster is reduced by quick drainage of the rain water.	- Large quantity of
Structural characteristics and locality: of flat stones.	- Water channel made
Setting place and application conditions: the stream bed or the downstream slope of the dam. stream bed from steep to gentle slope.	- Installed at - Can be installed at the
Materials and construction methods wood, brushwood. the stone is placed along the flow direction of the river bed and is fixed by either pile or brushwood or embankment depending on the stream bed condition. upstream to downstream. In case of steep stream bed, construction is done from downstream to upstream. Maximum sized stones are used at the flowing part and both side connections.	- Stone, - Londger side of - In case of gentle stream bed, construction is done from
Durability: No data.	
Structural Image	
Points to give attention during the application of the type of construction: In case of steep channel gradient, flag stone laying is done by leaving some spaces. Usually, dry stone masonry work is done, but thick stone wall or stone wall with wet stone masonry is made in case of steep slope, big water discharge, big volume of stone and so on. Besides, in case of steep water channel, wet stone masonry water channel is made and lower end is supported with flag stone cut off.	- In
Effects on the ecosystems: improvement works in river bed, places for the living and breeding of fishes will be broken.	- Due to the

Survey Sheet No.	76
Construction: Torrent	Method: longitudinal wroks
Type: Drainage channel (open)	Name: Turfing water channel, flat block water channel
Function: quantity of water is to be drained quickly by the construction of water channel.	- Installed when large
Structural characteristics and locality: of turfing or flat blocks.	- Water channel made
Setting place and application conditions: channel: Installed at the stream having small gradient and thin sediment discharge. - Flat block water channel: Installed at the places having no sediment flow unless there is the collapse of hillside due to deep water cutting.	- Turfing water
Materials and construction methods water channel: Turfing is done at the bed of the water channel. - Flat block water channel: narrow and shallow water channel is made of flat blocks.	- Turfing
Durability: No data.	
Structural Image	No data
Points to give attention during the application of the type of construction: No data.	-
Effects on the ecosystems: improvement works in river bed, places for the living and breeding of fishes will be broken.	- Due to the

Survey Sheet No.	77
Construction: Torrent	Method: longitudinal wroks
Type: Drainage channel (open)	Name: Brushwood covering work
Function: hillside with dip gullies is to be covered very fast.	- Used when barren
Structural characteristics and locality: water channel is done by covering the slope surface with brushwood.	- Maintenance of the
Setting place and application conditions: hillside.	- Barren
Materials and construction methods dip gully is covered up with 1m thck tree branches or filler materials. Thicker part of the tree branches or filler materials is inserted into the ground and upper part of those materials is laid at upstream of the stream. Wooden post is placed on it and it is fixed with wooden pile or big stones. Construction is done from downstream to upstream. Dry stone dam or wooden dam is made at several places of the brushwood covering works.	- Bed of the
Durability: No data.	
Structural Image	No data
Points to give attention during the application of the type of construction: Young pine trees, the leaves of which do not fall for long time, is better as covering material. Besides, due to suitability of germination of fallen seeds because of the organic soil formed from decayed fallen leaves, Hanki etc. are also applied.	-
Effects on the ecosystems: application of the imported types of plants and the plants grown at other places, there is the possibility of worsening the existing environment for the habitat plant of the area.	- Due to the

Survey Sheet No.	78
Construction: Torrent	Method: longitudinal wroks
Type: Dam work	Name: Dam (Wet stone masonry dam or boulder concrete dam)
Function: bed gradient, control of scouring, fixation of foot of the hill and prevention of collapse, sedimentation adjustment of flowing pebbles.	- Decrease of stream
Structural characteristics and locality: boulder concrete etc. is used in the dam.	- Mortar, concrete,
Setting place and application conditions: compressed banks of narrow stream having strong bed rock at both banks and place having sedimentation space at upstream. - If the foundation is soft, secondary dam or apron is constructed. Scouring of the stream bed is protected by the installing thrown stone works at the front part.	- Installed at
Materials and construction methods stone, mortar, concrete, boulder concrete 1:0.2 slope at the downstream slope and 1:0.4 slope at the upstream slope. This is fixed with top surface mortar and backfilling concrete. Central part is connected with boulder concrete. Both upstream and downstream slopes of the secondary dam is made of 1:0.2 slope. Structure of the secondary dam is made similar to the main dam. In case of Tenjin river dam no. 1, main dam has height of 13m, top surface width of 2.8m and length of 74m.	- broken - Stone masonry is made with
Durability:	Highly durable compared to the dams explained above.
Structural Image (Attached with structural map and photographs) メージ〔構造図および写真等の添付〕:	
Points to give attention during the application of the type of construction:	-
Large scale construction can be done compared to the dams explained above.	
Effects on the ecosystems: ecosystems is also less compared to the concrete structure. continuity at the flow direction, it disturbs the movement of the living beings.	- Impact to the - Due to the disruption in the