

Simple Guideline on Construction Planning and Construction Supervision

31 August 2022



*Japan International
Cooperation Agency*

***Project for Increasing Farmers
Households' Income through
Strengthening Domestic Rice
Production in Timor-Leste***

***Based on the experience of the works at Offtake
No.4 and No.5 under Small-scale Irrigation Canal
System Improvement***

Contents

1. Construction Planning
2. Quality Control, Earthwork
3. Quality Control, Stone Masonry
4. Quality Control, Concrete
5. Repair of Canal Slope
6. Safety Control

Construction Planning

General Procedure of Construction Planning

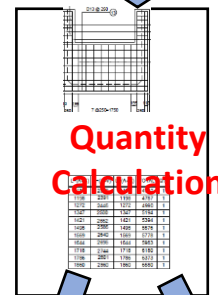
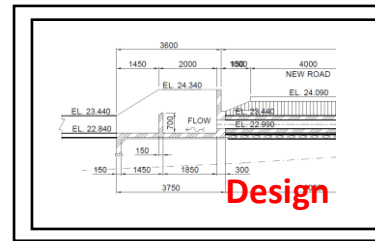
- Based on the design, quantity of each work item (price item) should be estimated, such as volume of concrete, stone masonry, reinforcement bar, excavation and embankment, etc. and required manpower, equipment and other related items.
- Then, based on each work quantity, total construction cost should be estimated, applying unit price (market price including cost for transportation)
- In addition, based on the required work quantity, required construction time should be estimated, applying standard production rate of each work item.

Cost Estimate

- There are two types of cost estimate. One is the tender/contractor cost and the other is cost for the direct managed works (by the government or by the WUA/Farmers).
- In this project, direct management construction is considered.

Construction Planning

- General workflow is briefly illustrated below.

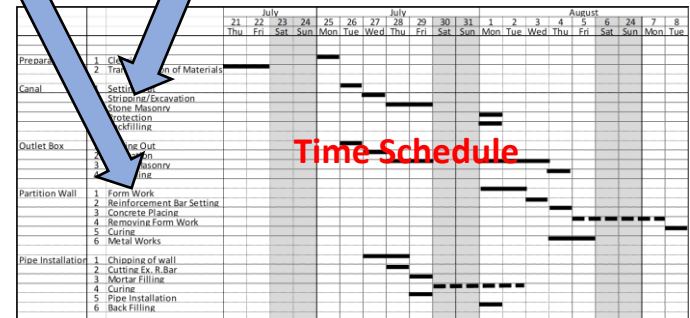


Unit Price

Standard
Production Rate

No.	Item	Quantity	Unit	Price	(in Rupees)
1	PVC Pipe 750 mm, 4m	100	m	232.00	
2	Concrete For concrete 1:2:4	80	m ³		
3	Sand (5mm) For stone masonry	80	m ³		
4	Sand (5mm) Cement Total in Bag (40kg)	132	bag		
5	Sand (5mm) For concrete 1:2:4	0.2	m ³	132.00	
6	Sand (5mm) For stone masonry	0.2	m ³		
7	Sand (5mm) For sand filling (PVC pipe)	0.2	m ³		
8	Sand (5mm) Say Sand Total in Unit (3 m)	0.2	m ³	90.00	
9	Gravel For concrete 1:2:4	0.2	m ³		
10	Gravel For Work stone masonry	0.2	m ³		
11	Gravel Boulder Total in Unit (3 m)	0.2	m ³		
12	Gravel Boulder Total in Unit (3 m)	0.2	m ³		
13	Reinforcement bar 12 mm	20.4	m	45.00	180.00
14	Reinforcement bar 8 mm	1	m	8.50	17.00
15	Reinforcement bar 8 mm	1	m	8.50	8.50
16	Form Work Form Work	4.1	m ²	4.00	16.40
17	Form Work Sub-total				286.40
18	Tool				
19	Shovel (Flat type)				50.00
20	Pick Axe				5.00
21	hoe				8.00
22	hammer				10.00
23	Shovel				30.00
24	Drill				60.00
25	Trowel				20.00
26	Trowel Pallet				20.00
27	Wheel Barrow				50.00
28	Bucket (Small)				20.00
29	Bucket (Big)				20.00
30	Vibrator				40.00
31	Machete				10.00
32	Galvan Mesh 2 x 1 x 1				50.00
33	Concrete anchor nail				8.00
34	Nail				2.50
35	Generator (rental)				1,000.00
36	Transportation (Track rent)				800.00
37	Sub-total				1,956.00
38	Labor				417.50
39	Skilled Worker 12h, 8 persons, 10 days	40	person-days		760.00
40	Unskilled Worker 2h, 10 persons, 12 days	120	person-days		1,080.00
41	Sub-total				1,840.00
42	Total				1,765.90
43	Material (in Rupees)				2,543.90
44	Miscellaneous				4,309.40
45	Grand Total				7,625.20

Cost Estimate



Time Schedule

Standard Production Rate

- A production rate is a set of requirements for standard labor, materials, machines, etc. required for each type of construction work.
- These production rates are used for the estimate of required materials, manpower, equipment, etc. and for estimate of the required work period.

1) Bush clearing for 100 square meter (manual)

Unskilled worker : 4.0 Man-day

2) Stripping of topsoil / Excavation for 1 cubic meter (manual)

Unskilled worker : 1.6 Man-day

3) Backfill for 1 cubic meter for 1 cubic meter (using excavated soil)

Unskilled worker : 1.7 Man-day

.

4) Stone masonry for 1 cubic meter (manual mixing)

Cement :	140 kg
Sand :	0.16 m ³
Stone :	1.1 m ³
Skilled worker :	0.4 Man-day
Unskilled worker :	1.2 Man-day

5) Concrete for 1 cubic meter (manual mixing)

Cement :	350 kg
Sand :	0.35 m ³
Gravel :	0.61 m ³
Skilled worker :	0.5 Man-day
Unskilled worker :	2.0 Man-day

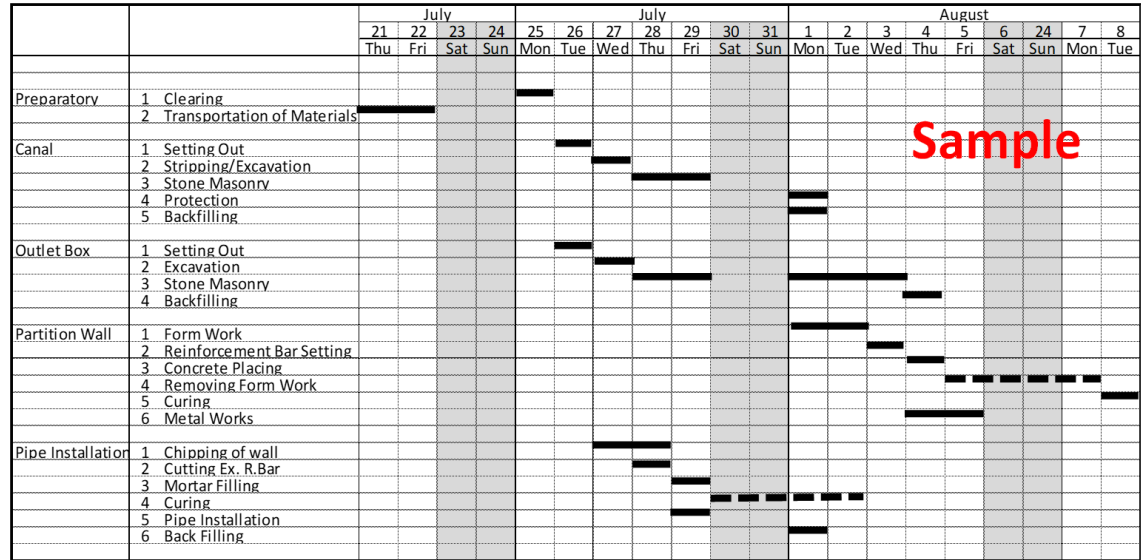
(These quantities are used for cost estimate and preparation of time schedule, including transportation loss and filed loss).

Construction Planning

Construction Time Schedule

(1) Schedule

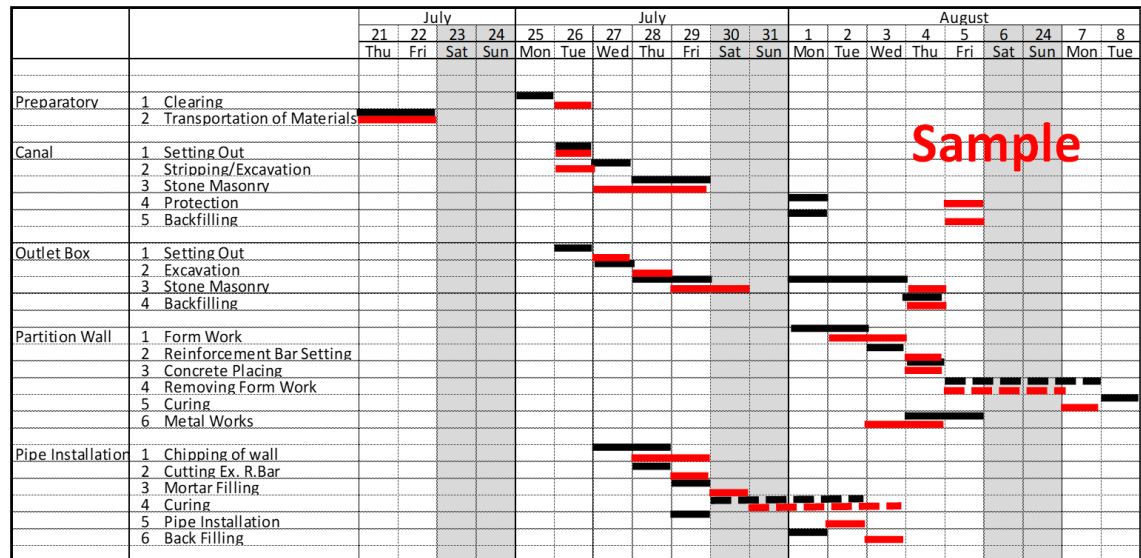
Prepared based on the work quantities and production rate.



(2) Comparison

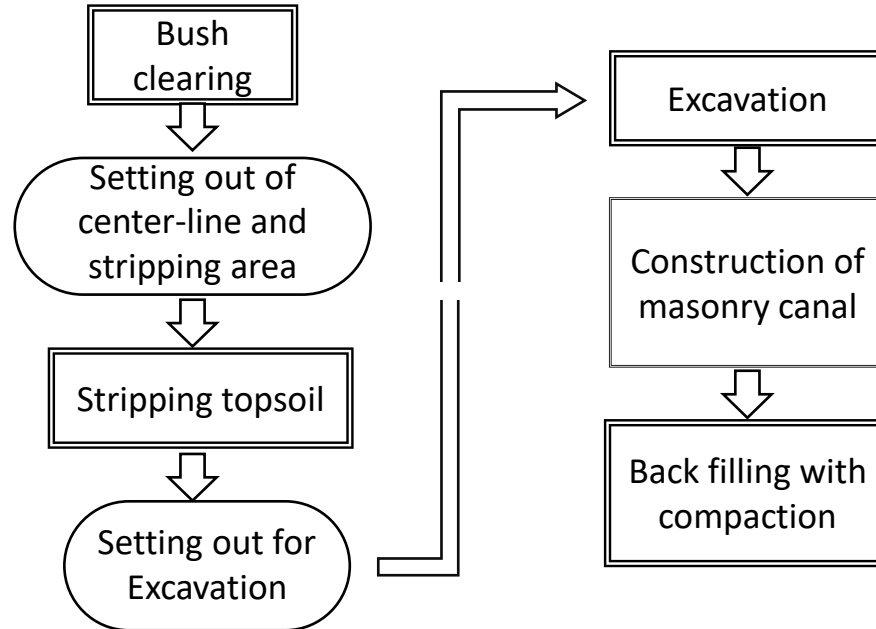
between Schedule
and Actual

— Schedule
— Actual



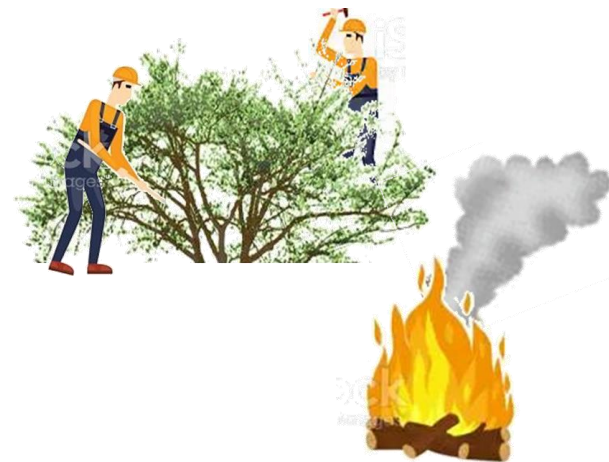
Earthwork

General Procedure of Earthwork



Bush Clearing

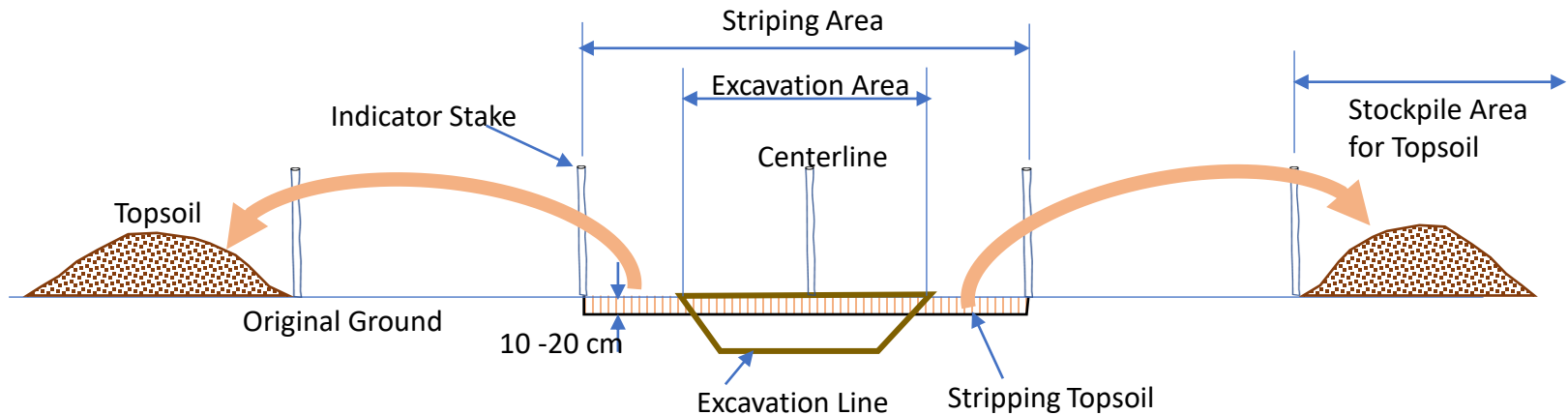
- This work shall consist of clearing and grubbing of the proposed land covered by bush and grass.
- After clearing, all the material to be burned shall be piled neatly and when in a suitable condition shall be thoroughly burnt.



Earthwork

Removal of Topsoil (Stripping)

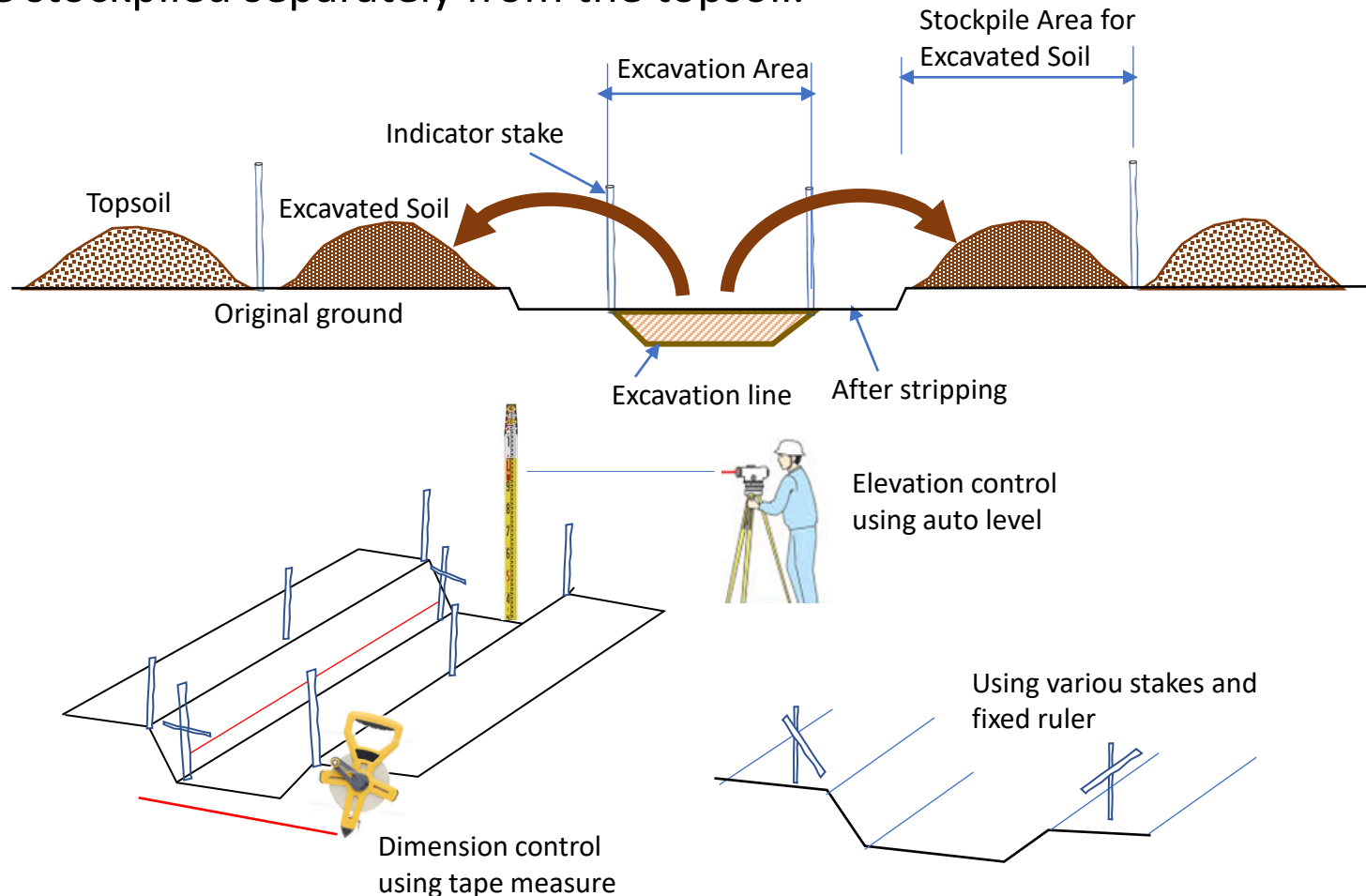
- All obstacles such as sod, tree roots and stumps, debris, organic soil and mud shall be removed, before excavation or embankment.
- The thickness of stripping shall be 10 ~ 20 cm as required at site.
- Topsoil and any unsuitable material produced in the removal of topsoil shall be stockpiled out of the working area.
- The area after removed the topsoil shall be leveled.



Earthwork

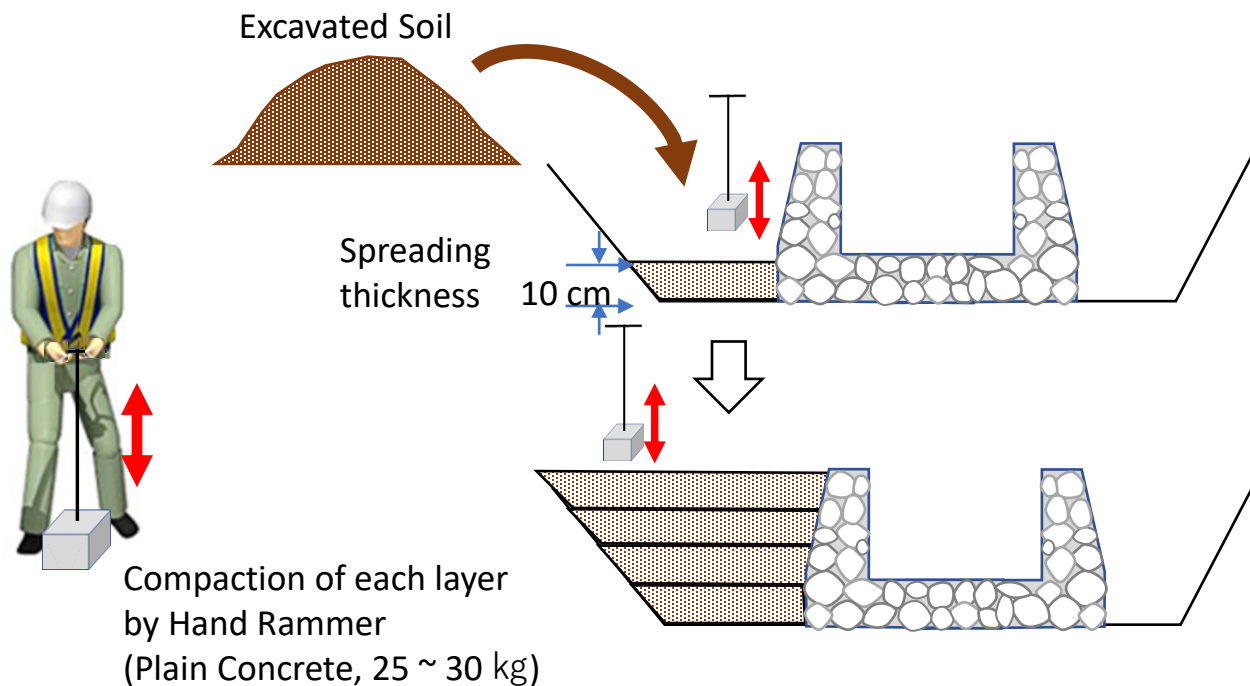
Excavation

- The excavated material can be used for backfill material, and stripping soil can not be used for backfilling and/or embankment, and therefore it shall be stockpiled separately from the topsoil.



Backfilling with Compaction

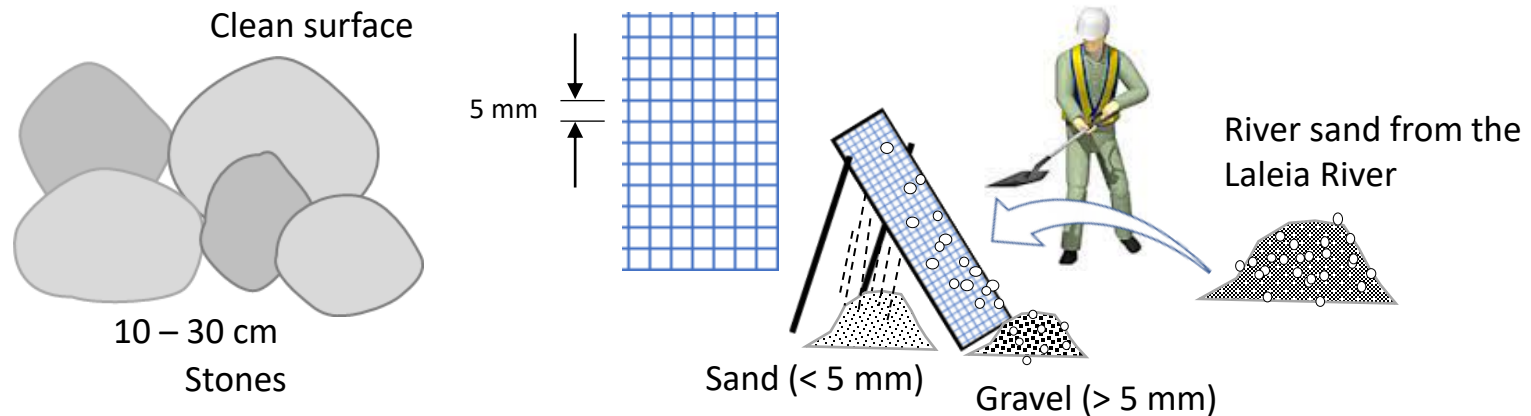
- Spreading thickness for compaction shall be less than 10 cm, however, this thickness depends on material and equipment to be used.
- Compaction of each layer shall be conducted sufficiently by hand rammer.



Stone Masonry

Materials

- ✓ Cement: Portland Cement
- ✓ Stone: Laleia River
- ✓ Sand: River Sand (Laleia River)
- ✓ Water : Buluto Main Canal (Laleia River)

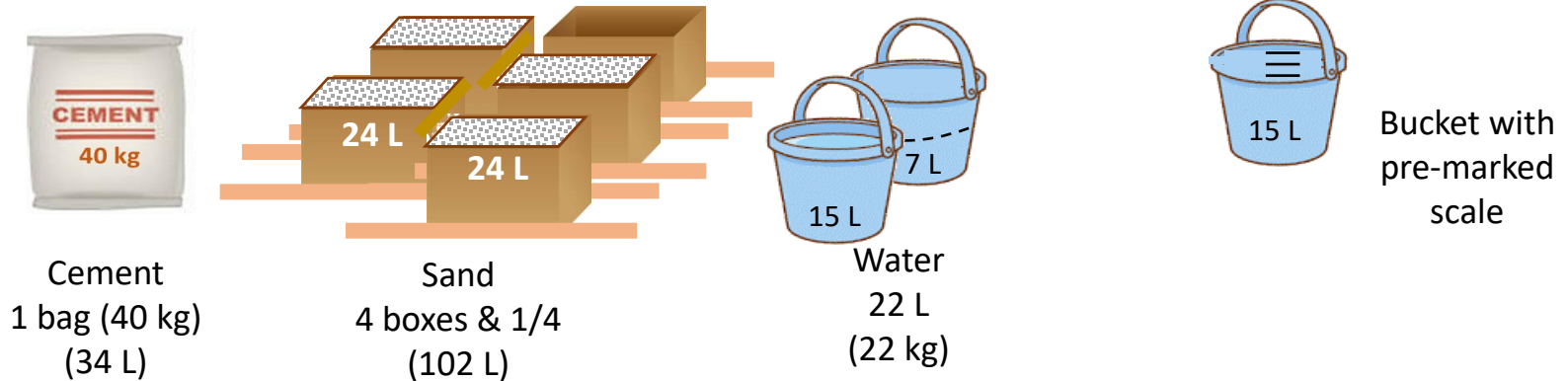


- ✓ The stone diameter should be between 10 – 30 cm per piece.
- ✓ Surface of stones to receive mortar should be cleaned of oil or clay or other contaminants.
- ✓ Sand should be sieved (maximum 5 mm).

Stone Masonry

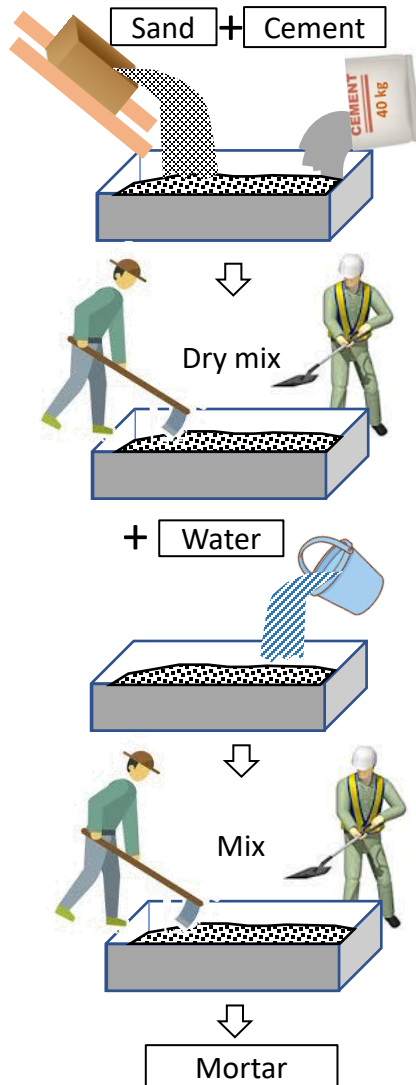
Mixture Composition of Mortar

- ✓ Ratio of cement : sand by volume: 1:3
- ✓ Water / Cement Ratio : $W/C = 0.55$ in weight



Stone Masonry

Mortar Hand Mixing



- ✓ Concrete should not be mixed on the ground.
- ✓ In mixing tub (box), sand is firstly spread, then the cement must be distributed on the sand.
- ✓ Sand and the cement should be perfectly dry-mixed to uniform color, then water should be added.
- ✓ Mixed material that stands longer than 1.0 hour should be wasted.

Stone Masonry

Placing Stones

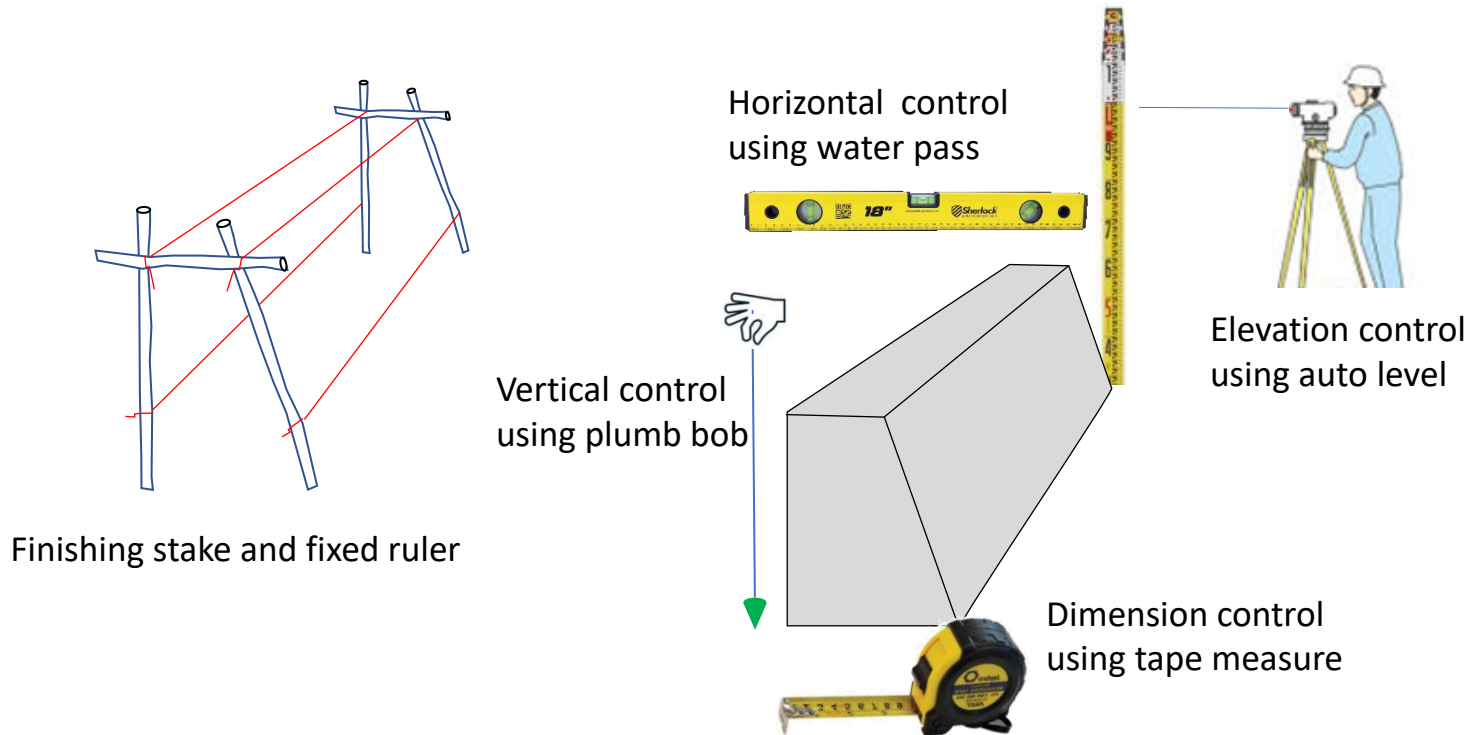


- ✓ Surface of stones should be thoroughly saturated before the mortar is applied.
- ✓ A bedding of fresh mortar should be placed at least 3 cm thick on the prepared foundation which is in a sufficiently dry condition without any standing water and muddy condition
- ✓ The masonry stone should be placed by hand in such a manner that each stone is completely surrounded by mortar and that the mortar completely fills the joints.

Stone Masonry

Quality Control of Finished Shape

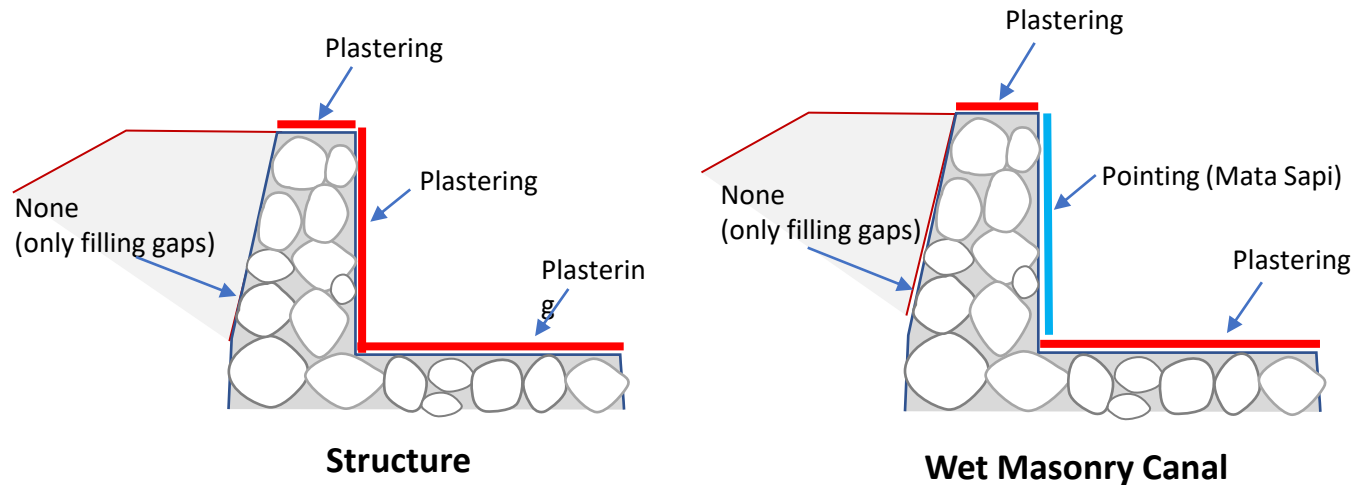
- ✓ The following tools can be used for the quality control for the finished shape of the stone masonry works.



Stone Masonry

Plastering

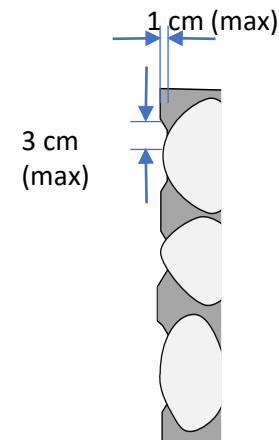
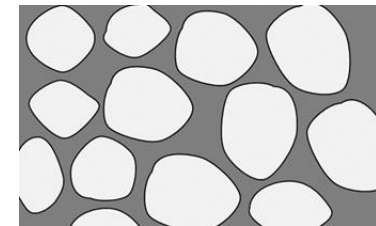
- ✓ The top and sides of stone masonry canals and structures should be finished as below by cement mortar.
- ✓ Before plastering, mortar in the joints of the stone masonry should first be removed to a depth of 3 cm. The joint and top portion should then be cleaned thoroughly with a wire brush of all loose materials and plastered with such a cement mortar.



Stone Masonry

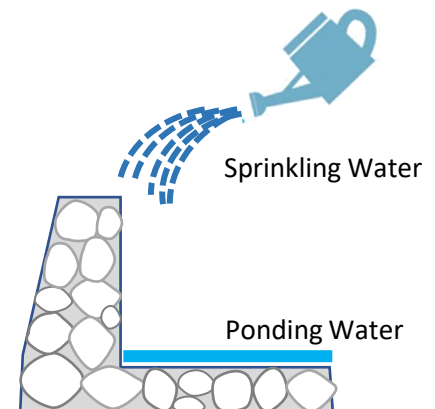
Pointing (Mata Sapi)

- ✓ The width of joints in facing stone should not exceed 3 centimeters.
- ✓ Joints on the face of all stone masonry exposed to view should be neatly finished.
- ✓ The joint should be cleaned thoroughly with a wire brush of all loose materials and filled with cement mortar with mortar.
- ✓ The surface of the face stone shall be cleaned of all mortar upon completion of the pointing operation.



Curing

- ✓ All newly placed mortar should be cured, and curing shall begin immediately after placing and be continued for 3-5 days.
- ✓ This method should include supplying additional water by ponding or sprinkling water onto the masonry surfaces.



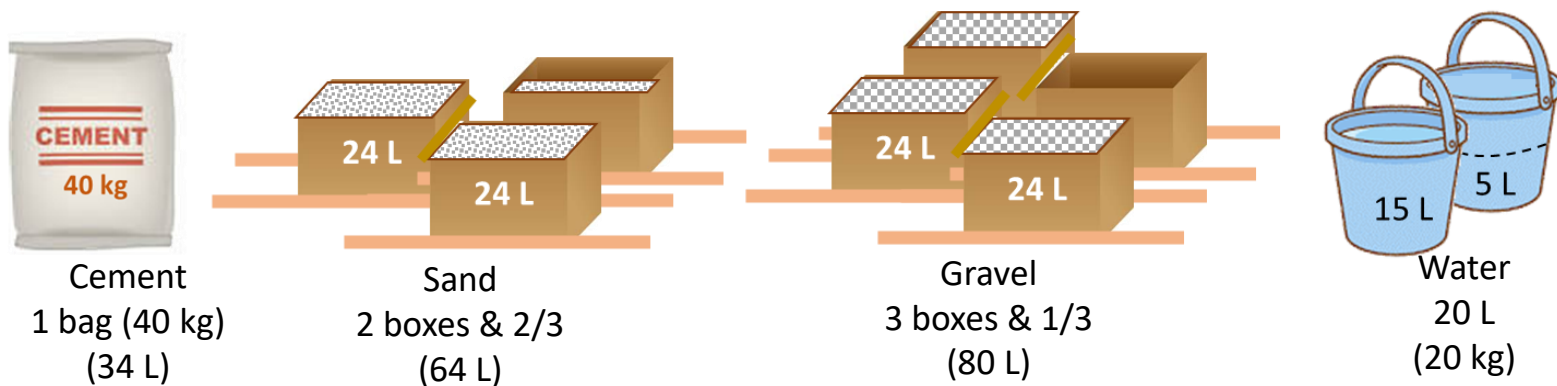
Concrete

Materials

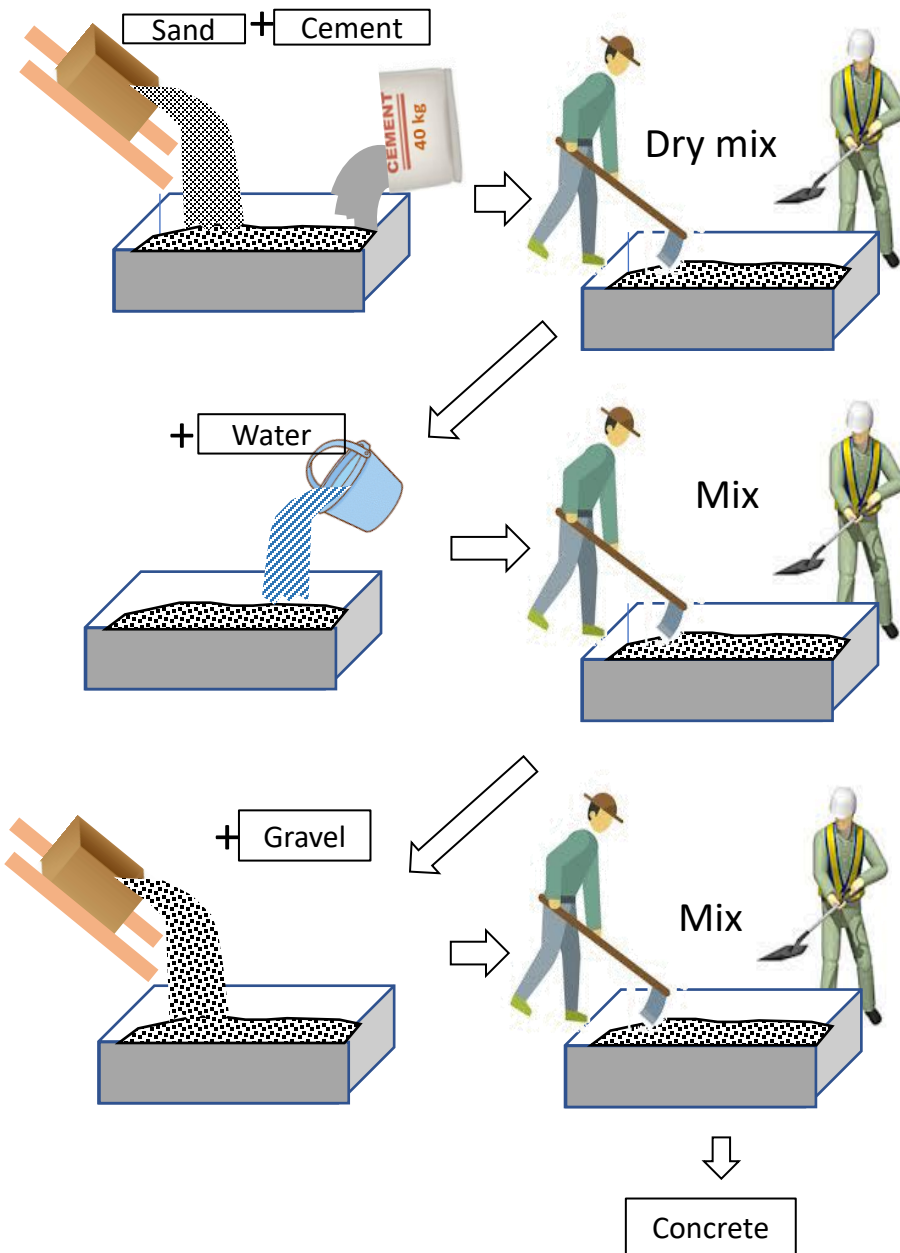
- Cement: Portland Cement
- Sand: River Sand (Laleia River)
- Gravel: Stockpiled at Buluto Headworks
(Surplus of Headworks Rehabilitation)
- Water : Buluto Main Canal (Laleia River)

Mixture Composition

- Ratio of cement : sand : gravel (20mm) by volume: 1 : 1.9 : 2.4
- Water / Cement Ratio : $W/C = 0.50$ in weight



Concrete



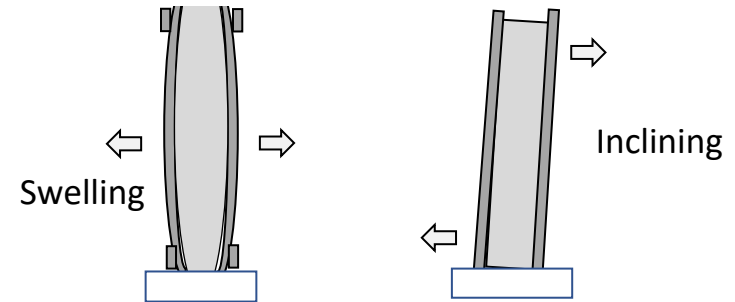
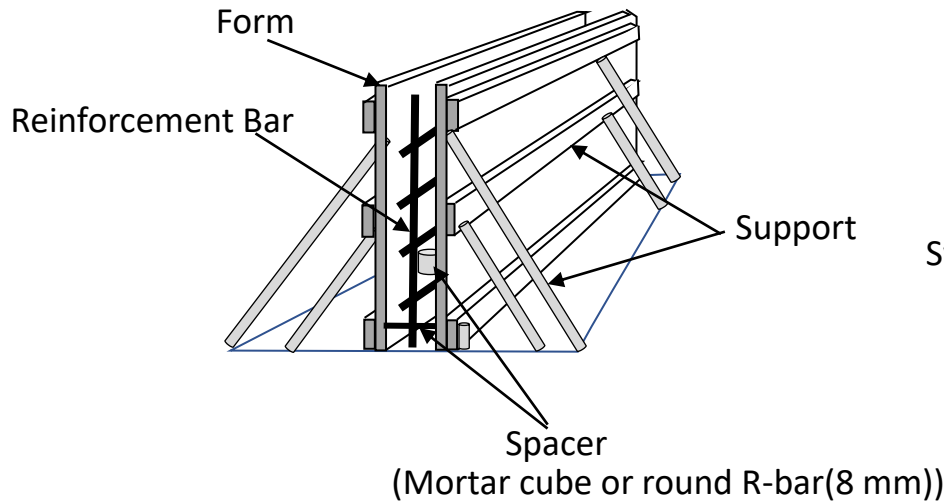
Concrete Hand Mixing

- In mixing boxes, sand is firstly spread/distributed, then the cement must be distributed on the sand.
- Sand as well as the cement perfectly should be mixed, then water addition to make mortar layers,
- Then the gravel is spread on the surface and all is combined in such a way to perfection and all of gravels are closed with the mortar.

Concrete

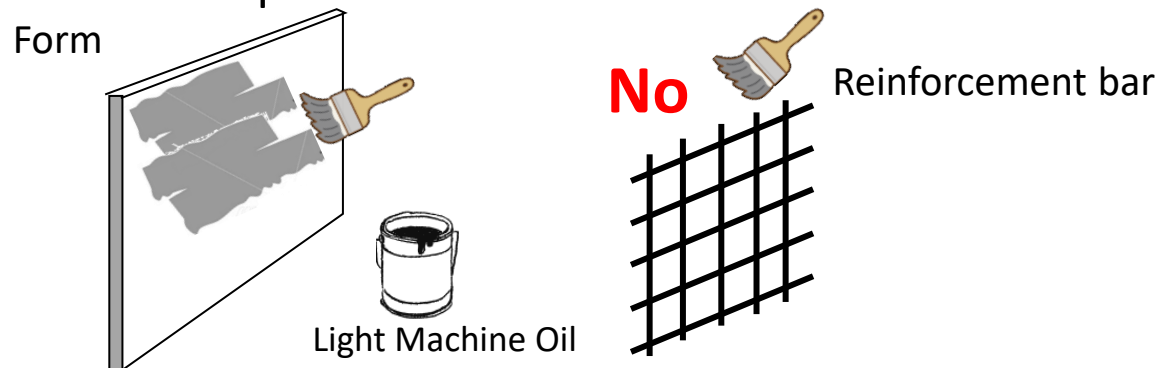
Form Work

- The form should be sufficient tight and properly braced.



Deflection, if supports are not sufficient.

- The light oil should be painted on the inside surface of the form to make the removal of the forms easily.
- ✓ Such oil should not be painted on the reinforcement bar.



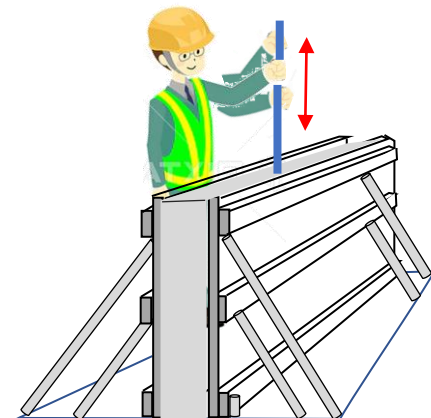
Concrete

Reinforcement Bar Placing

- Reinforcement bar should be fastened together properly.
- Reinforcement bar should be free from mud, oil, grease and/or other contaminant.
- All embedded material should be properly placed.

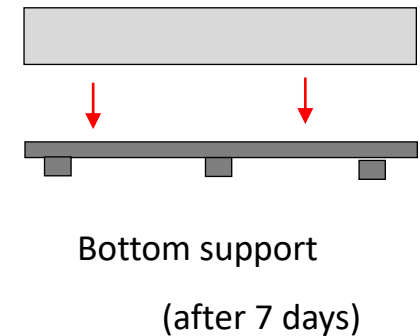
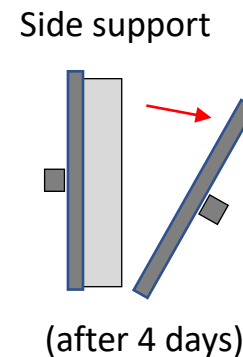
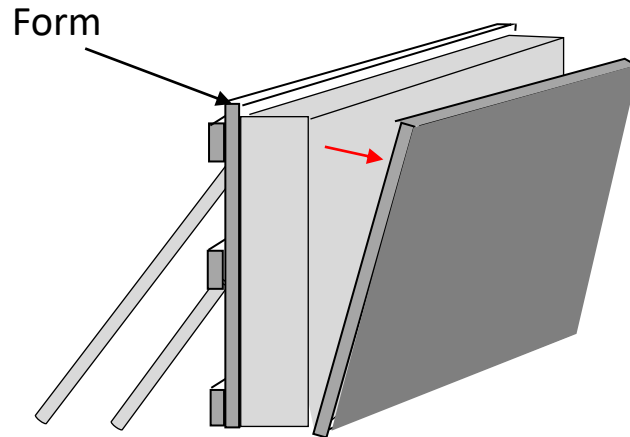
Concrete Placing

- The concrete should be placed immediately after mixing.
- When placing concrete, care must be taken to ensure that the reinforcement bars and forms do not move from their positions.
- The placed concrete should not move laterally within the formwork.
- If concrete vibrator is not available or difficult to use because of the narrow space, the placed concrete should be sufficiently compacted by the tamping rod (stick).



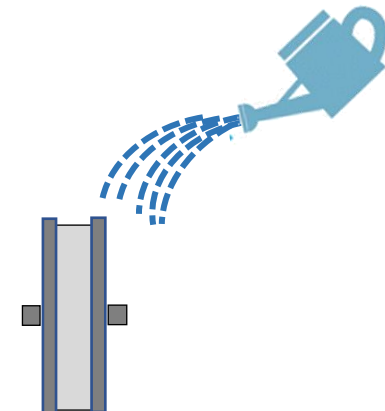
Removal of form

- The form should not be removed at least for 4 days for side support and 7 days for bottom support after a concrete placement.



Curing

- Curing should be continued to 3 - 4 days after placement of the concrete.
- This method should include supplying additional water by ponding or sprinkling water onto the concrete surfaces.
- In case of water sprinkling, it should be done at least 3 times a day (morning, noon, and evening).

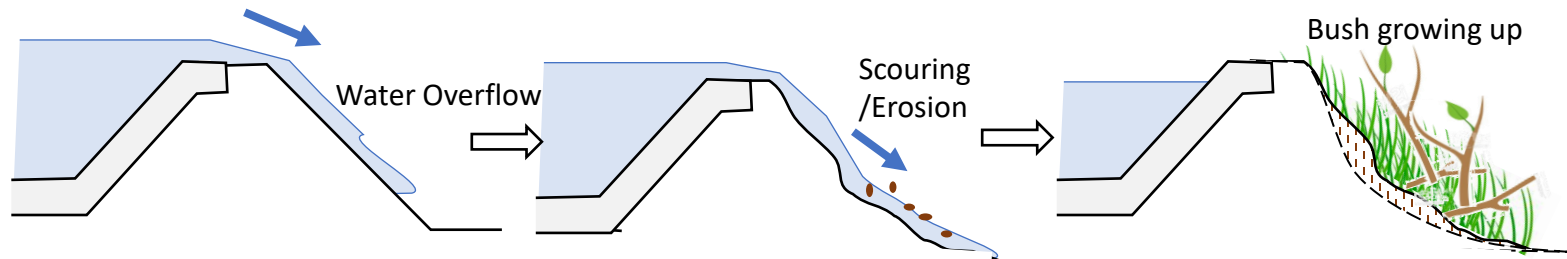


Repair of Canal Slope

General

- In this work, it is required to investigate the slope collapse sections that frequently occur on the slope outside the canals, and to carry out a verification survey of repairs among them.
- It is assumed that slope collapse is mainly due to overflow from the canals.

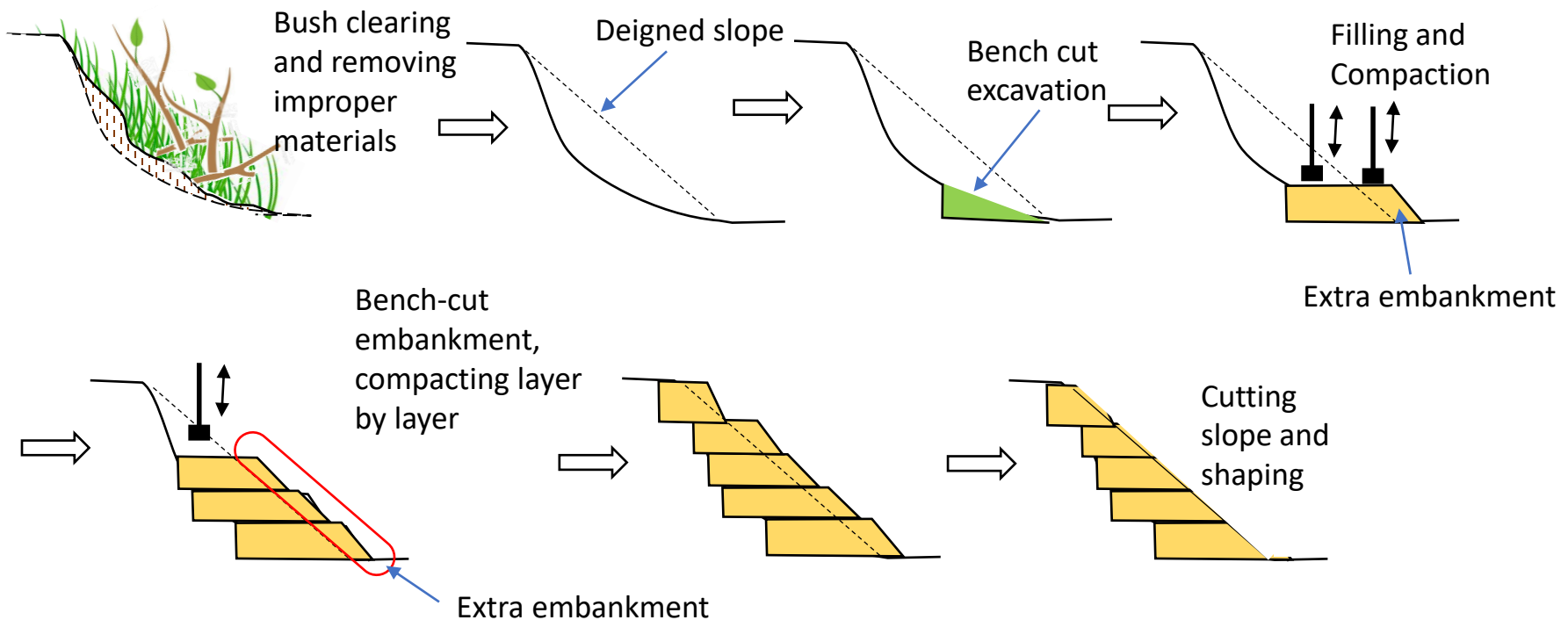
Growth of Erosion/Scouring



Repair of Canal Slope

Repairing Method (General)

- General repairing method includes 1) removal of any vegetation, inappropriate soils, collapsed, loosely eroded soils, 2) selection and transportation of appropriate embankment materials, 3) embankment with proper compaction, and 4) shaping of surface.

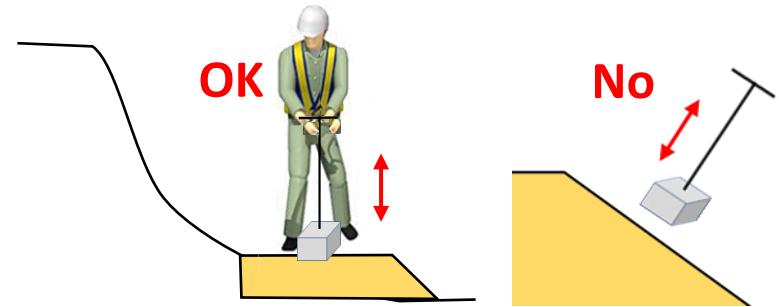


Repair of Canal Slope

Points to be Noted

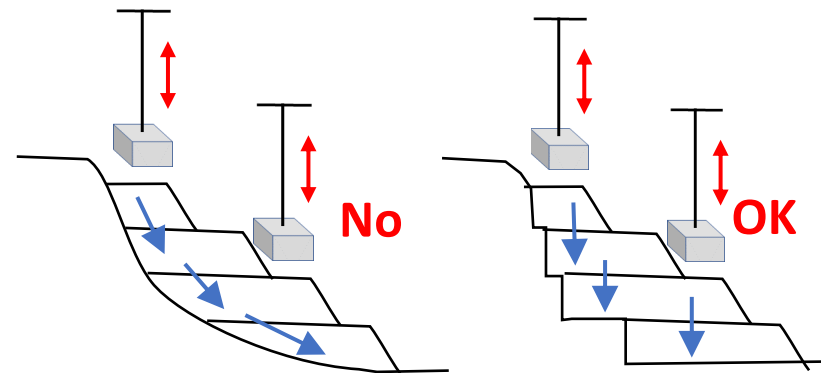
➤ Vertical Compaction

Compaction with a concrete hand rammer should be done vertically on each horizontal soil layer with some 10 cm in thickness after the spreading. Oblique compaction is not only dangerous but also ineffective.



➤ Bench cut

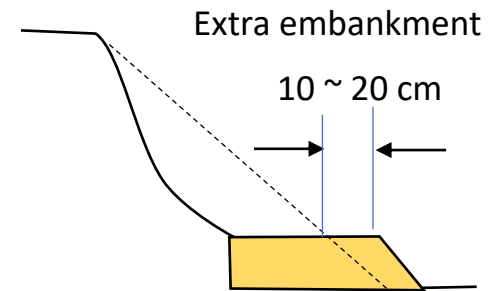
Bench cut of the existing slope should be executed to avoid the newly filled embankment moving down along the existing slope at every strike by the hand rammer. One step height is to be 10 ~ 20cm.



Repair of Canal Slope

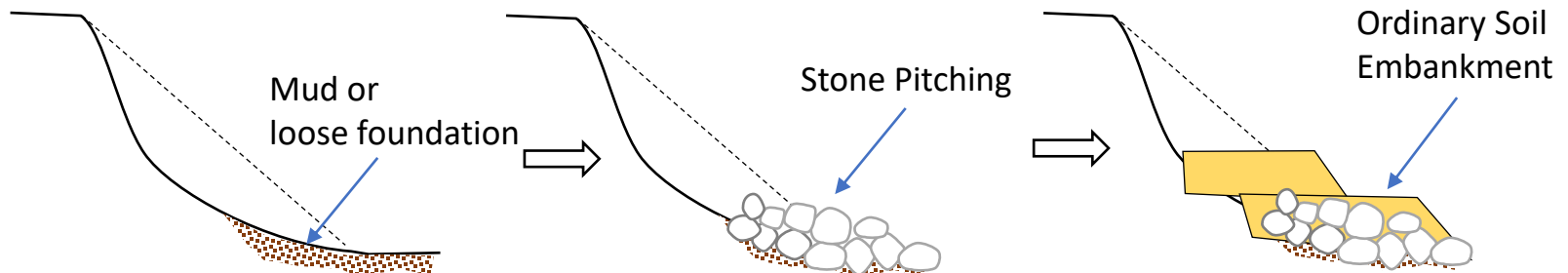
Extra Embankment

- Spreading and compaction width should be 10 ~ 20 cm wider than the designed one (extra embankment, considering difficulty of slope compaction).



Stone Pitching

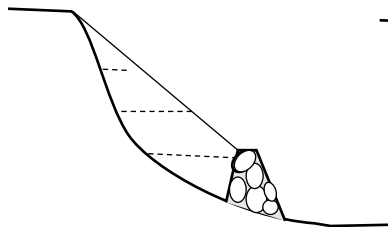
- Placing stones on the bottom is also an effective method. especially in wet or loose soils



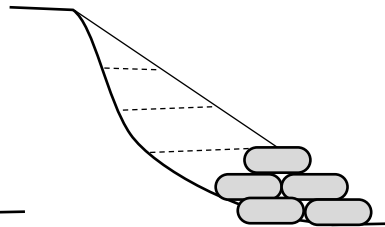
Repair of Canal Slope

Reinforcement of the Toe

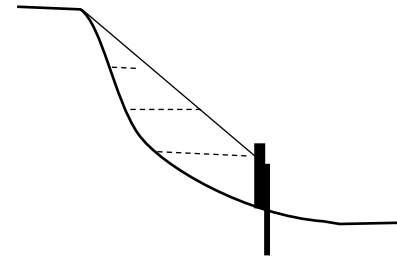
- Reinforcement of the toe of slope should be considered as needed (retaining embankment, wooden stakes, sandbags, wood, or masonry retaining walls, etc.)



Reinforcement
with masonry
blocks



Reinforcement
with sandbags

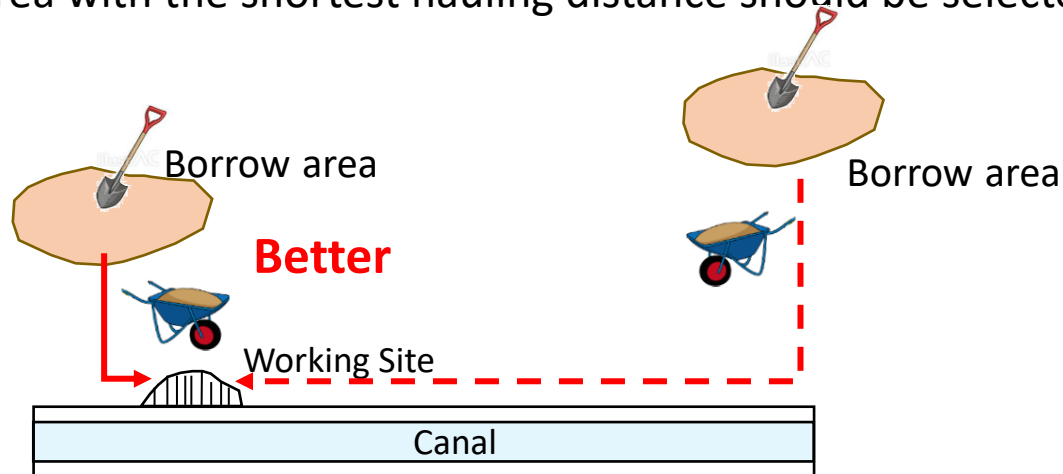


Reinforced with
wooden stakes or piles

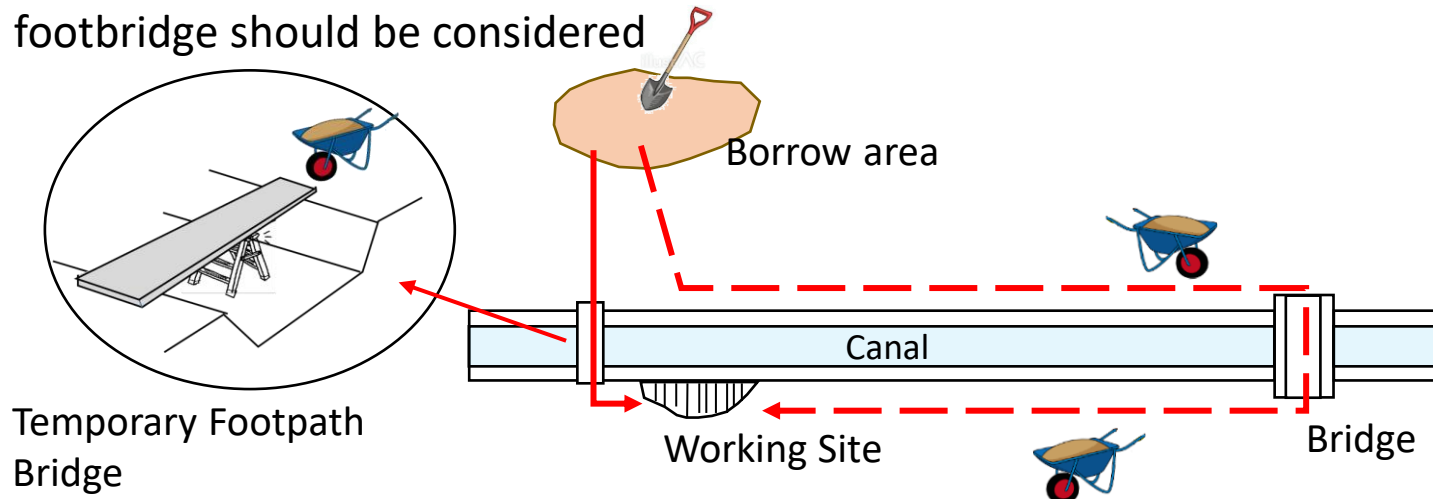
Repair of Canal Slope

Selection and Transportation of Appropriate Embankment Materials

- The borrow area with the shortest hauling distance should be selected.



- In case that the best borrow area is located across the canal, a temporary footbridge should be considered



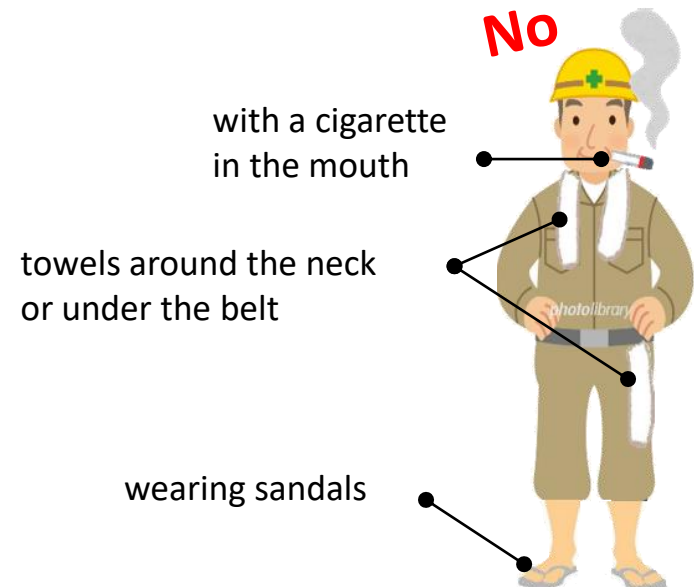
Safety Control

General

- Safety control for construction works is a crucial issued and all the concerned persons should tackle for safety management in order to minimize the construction accidents.
- The repairing and construction of irrigation facilities in Buluto Irrigation Scheme are quite small scale, mainly consisting of manual works without using heavy equipment.

Working Clothes

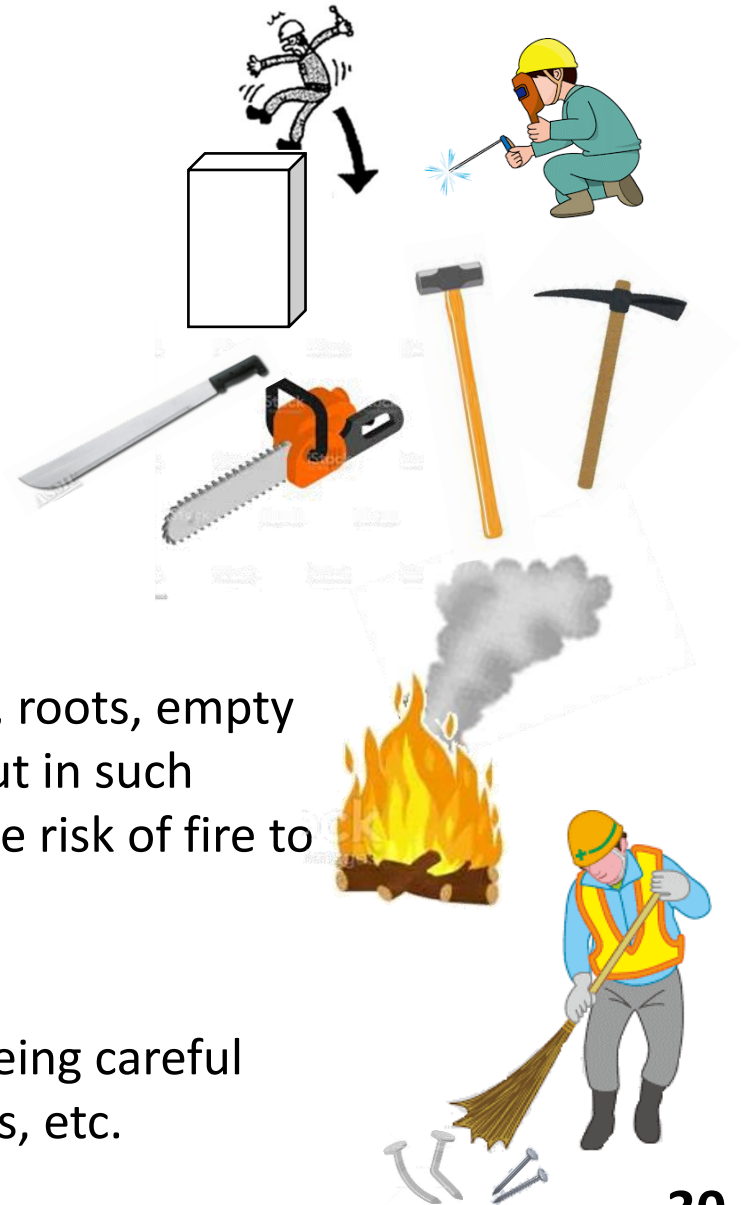
- The working clothing and protective gears of the workers should be confirmed.



Safety Control

High Risk Works

- The following work requires special attention not to hurt oneself or others.
 - ✓ Working at high place
 - ✓ Welding
 - ✓ Using machete, chainsaw, hammer, pickaxe, etc.



Burning Operations

- Burning operations (for cut-down trees, roots, empty cement bags, etc.) should be carried out in such locations and manner as to minimize the risk of fire to surrounding areas or property.

Site Cleaning

- The site should be kept clean always, being careful especially with nails, wires, broken glass, etc.

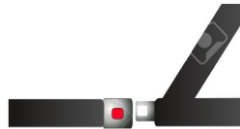
Safety Control

Traffic and Transportation

- Strictly follow traffic laws/rules, when driving on public roads



Speed limit



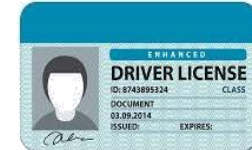
Seat belt



Traffic rules



No mobile phone while driving

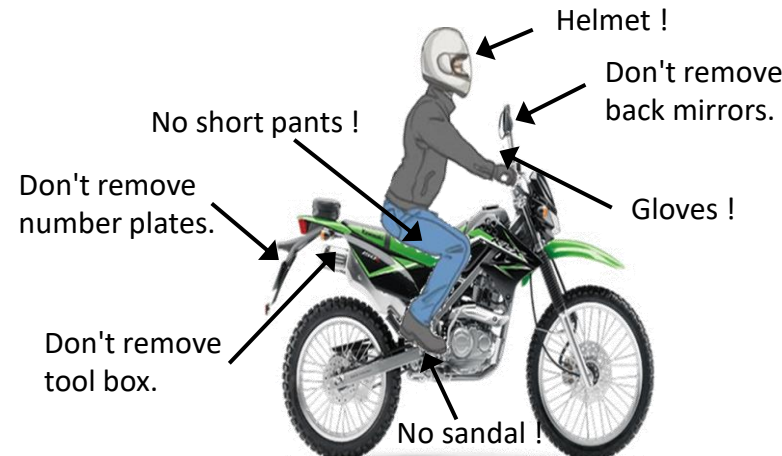


Driver's license

- Workers should sit down on the loading platform so they will not fall.

- Tie the load securely with rope so it will not move.

- Safety for motor bike riding.



Safety Control

When Heavy Equipment is Working

- A flagman should be stationed and perform the operation in accordance with his guidance, when using construction equipment.
- Keep out barrier should be put and appropriate measures should be taken to restrict unauthorized access during the equipment work.



Flagman



Signboard



detour