The Project for
Capacity Development of Road and Bridge Technology
in the Republic of the Union of Myanmar (2016-2019)

CONSTRUCTION MANAGEMENT GUIDELINE FOR ROAD & BRIDGE

(1st Edition)

April 2019

Ministry of Construction, the Republic of the Union of Myanmar

Japan International Cooperation Agency

PREFACE

In the exercise of its primary mandate as the construction arm of the government, the Ministry of Construction endeavors to keep abreast with systematic quality control and the latest construction techniques, with the ultimate objective of being at par with the more advanced countries in ASEAN.

This quintessential goal cannot be achieved without having to adopt clear-cut, uniform, systematic and definitive procedures on Construction Supervision on Quality/Safety Control in the first place. It is a given prerequisite that Quality Infrastructure must be a direct result of good management and project implementation.

This manual, which was jointly prepared by the MOC Engineering Staff and the Experts assigned for the Project for Capacity Development of Road and Bridge Technology in the Republic of the Union of Myanmar (2016-2019) under the Japan International Cooperation Agency (JICA), serves an effective reference material to field engineers of road and bridge construction, instrumental in our pursuit of the aforementioned ambitious objective.

With this manual, the field engineers should become familiar with and knowledgeable of the overall process in Quality Control and Safety Control, thus making them more competent in constructing government projects that are in accordance with and in strict compliance to the specification/contract requirements of the project.

April 2019

U Han Zaw
Union Minister
Ministry of Construction,
the Republic of the Union of Myanmar

INTRODUCTION

BACKGROUND

The bridge construction technology has maintained in certain technological level since “Bridge Engineering Training Center (BETC) Project (1979-1985: JICA), however, new technology has not been transferred and bridge types that can be constructed in Myanmar are still limited. Besides, insufficient training for national engineers has hampered sustainable transfer of technology in bridge engineering. In this context, the Government of Myanmar requested “the Project for Capacity Development of Road and Bridge Technology” (hereinafter referred to as “the Project”) to the Government of Japan. Through series of discussion, Ministry of Construction (MOC) and JICA concluded the Record of Discussion (R/D) in January 2016 to implement the Project focusing on capacity development on construction supervision of bridges and concrete structures.

The Project was implemented for 3 years since 2016 in corroboration with MOC staff officer and JICA Experts aiming at improvement of quality as well as safety in construction of bridges and concrete structures. As the achievement of the Project, the Manuals on Quality and Safety Control for Bridge and Concrete Structure were developed in 2019 after several workshop and discussion.

REFERENCES

Following technical documents were referred as references.

1) Specification for Highway Bridges (2012, Japan Road Association, Japan)
2) Standard Specifications for Concrete Structures (2012, Japan Society of Civil Engineering)
3) Manual for Construction of Bridge Foundation (2015, Japan Road Association)
4) AASHTO LRFD Bridge Construction Specifications (3rd Edition, 2010)
5) The Guidance for the Management of Safety for Construction Works in Japanese ODA Projects (2014, JICA)
6) Manual for Construction Supervision of Concrete Works. (2016, NEXCO)
7) Manual for Construction Supervision of Road and Bridge Structures. (2016, NEXCO)
8) Construction Contract MDB Harmonized Edition (Version 3, 2010 Harmonized Red Book)

CONSTRUCTION MANAGEMENT GUIDELINE FOR ROAD AND BRIDGE

TABLE OF CONTENT

ABBREVIATIONS

AASHTO:	American Association of State Highway and Transportation Officials
AC	Asphalt Concrete
ADB	Asian Development Bank
ASTM	American Society for Testing and Materials
BDS	Bid Data Sheet
BOQ	Bills of Quantities
BRL	Bridge Research Laboratory
C/U	Construction Unit
CBR	The California Bearing Ratio
CESAL,	Cumulative Equivalent Single Axle Loads
CM	Construction Management
CMAA	Construction Management Association of America
CPM	Critical Path Method
D/D	Detailed Design
DDG	Deputy Director General
DG	Director General
DOB	Department of Bridge
DOH	Department of Highway
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESAL	Equivalent Single Axle Load
F/S	Feasibility Study
FIDIC	International Federation of Consulting Engineers
FFS	Fit for Service
GCC	General Conditions of Contract
GOM	Government of Myanmar
HMA	Hot Mix Asphalt
IAEB	Invitation for Apply Eligibility and to Bid
ITB	Instruction to Bidders
JICA	Japan International Cooperation Agency
MDB	Multilateral Development Bank
ME	Material Engineer
MOC	Ministry of Construction
NDT	Non-Destructive Testing
NGOs	Non-Governmental Organizations
PCC	Portland Cement Concrete

PD	Project Director
PE	Project Engineer
PERT	Project Evaluation Review Technique
PI	Public Information
PM	Project Manager
PMU	Project Monitoring Unit
QA	Quality Assurances
QC	Quality Control
QCP	Quality Control Program
R/O	Regional Office
RC	Reinforced Concrete
RE	Resident Engineer
ROW	Right-Of-Way
RRL	Road Research Laboratory
SCC	Special Conditions of Contract
WB	World Bank

CHAPTER 1 GENERAL

1.1 Definition of Construction Management

The Construction Management has been understood wide meaning as the way to manage the construction project from the beginning such as planning to the completion of the works to be performed by related entities. Construction Management Association of America (CMAA) has defined the Construction Management as "A professional service that applies effective management techniques to the planning, design, and construction of a project from inception to completion for the purpose of controlling time, cost and quality." On the other hand, considering current circumstance in road and bridge construction by MOC that Construction Unit under the MOC is performing a role of the construction work, special consideration in terms of improvement of Quality in Construction Work need to be given to the Guideline. Thus, the Construction Management Guideline in the Project shall be defined as "Operation Procedure of the activities to manage the Construction Project under MOC emphasized on Construction Supervision to enhance Quality Control and Safety Control to be improve under the Project."

1.2 Objectives of the Guideline

The objectives of this Construction Management Guideline are:

- To provide support to all personnel of the MOC with relevant and practical information and techniques to perform efficient construction management activities and accurate inspections for various construction works
- To secure the consistent and uniform documents, reports, procedures and quality of works
- To enhance the capacity and career development of the MOC personnel, especially for the position that is related to quality management, to be able to provide better services to the public

This Manual is intended to provide guidance to the project management and construction supervision personnel with clear understanding in solving various problems and issues encountered in the field. This Manual is not intended as a complete and all-inclusive text detailing every aspect of construction, but rather as an operational guidebook for basic and important road and bridge construction and inspection techniques. The Manual also provides some basic knowledge and information, on preconstruction activities among other stages of project implementation, guidance required for project management, construction supervision and quality assurance for basic capacity development of MOC employees.

1.3 Component of the Guideline

The Construction Management (CM) is consist of several time-oriented activities such as preconstruction activity, construction supervision, post-construction activities. Construction Work and its supervision is a part of the CM. In addition to the Quality Control and Safety Control during the construction, schedule and cost (financial) management as well as the Environmental Management

shall be the element of the Construction Supervision. The Guideline introduce the current MOC organization and its role and responsibility.

(a) Construction Management System and Organization
(b) Pre-Construction Activities
(c) Construction Supervision
(d) Field Inspection
(e) Quality Assurance
(f) Public Relations, Safety and Environmental Management
(g) Completion and Taking Over
(h) Defects Liability

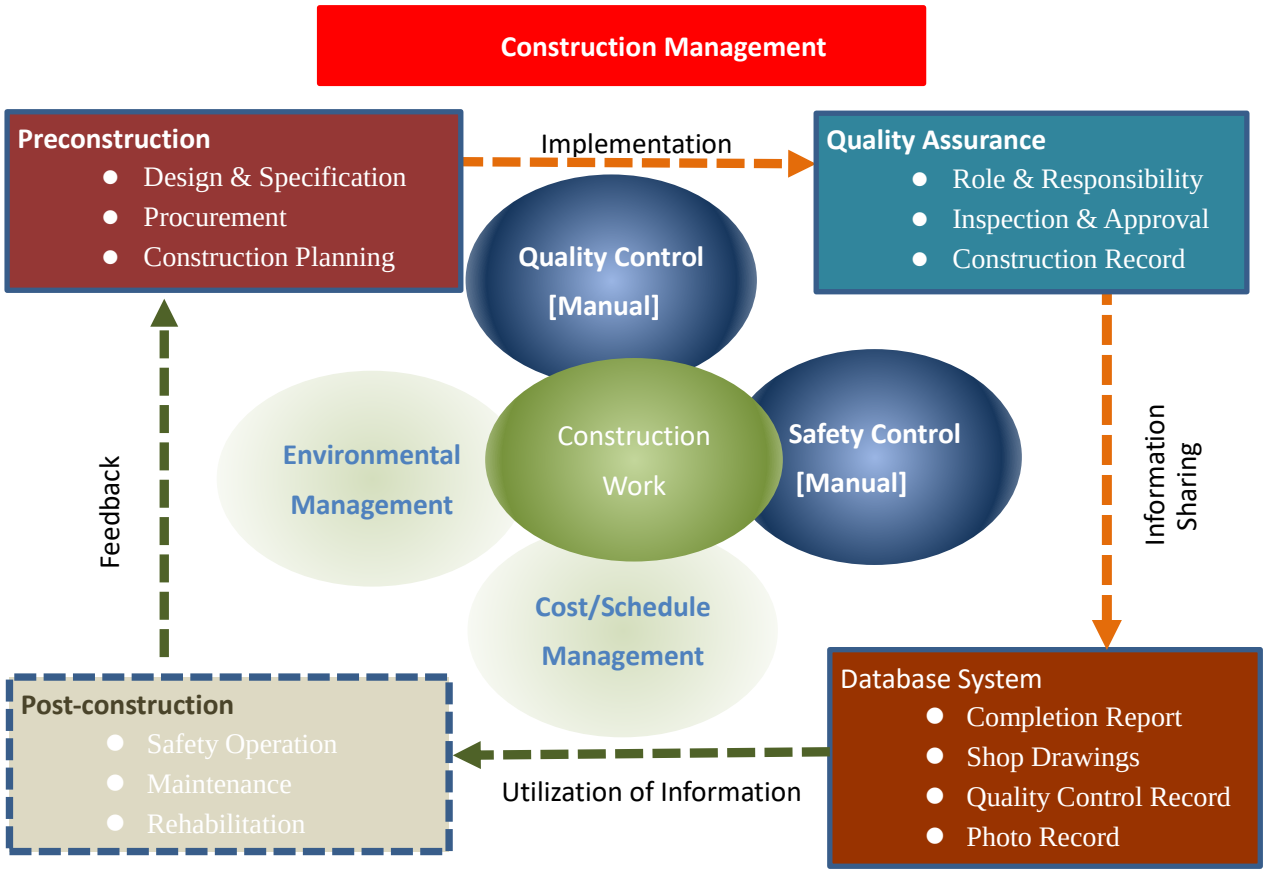
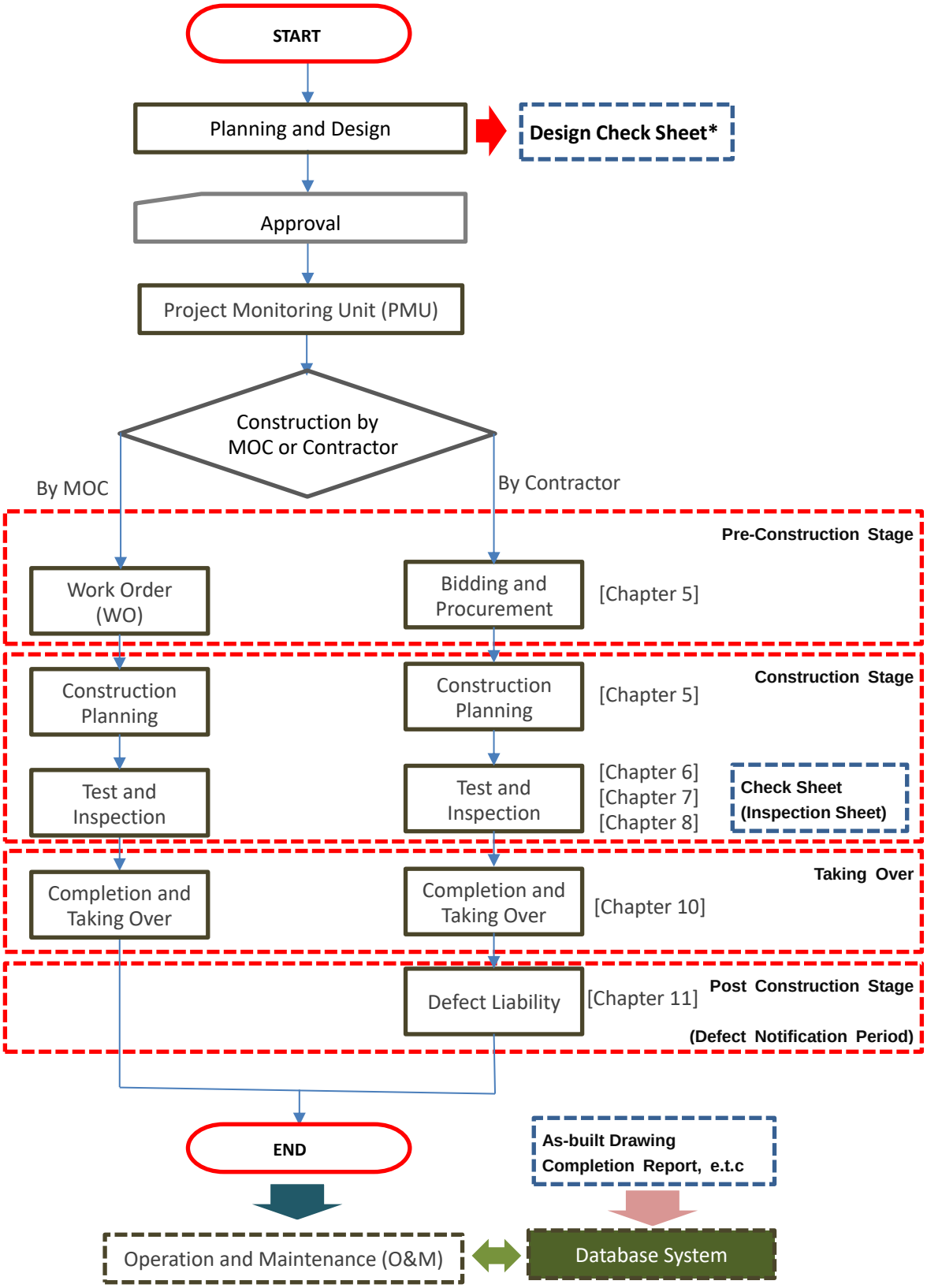


Figure 1.3-1 Component of the Construction Management

1.4 Flow-chart of Construction Management

Construction Management in MOC shall principally follow the Flowchart specified below in accordance with this Guideline.



*Note: Sample of Design Check List was developed as a reference shown in Appendix.

Figure 1.4-1 Flowchart of Construction Management in the Guideline

Table 1.4-1 Major Work Items on Construction Management and it Responsibility

		National Funded Project				International Funded Project with the Consultant	
		MOC Construction		Private Contractor			
		Preparation	Approval	Preparation	Approval	Preparation	Approval
Planning and Design Stage	Detailed Design (Design Check Sheet)	Director Design	DG	Director Design	DG	Director Design	DG
Pre-Construction Stage	Bid Document	-	-	Dir. Const.	DG	Consultant, Dir. Const.	DG
	Work Order	-	DG	-	-	-	-
	Commencement of Work	-	-	DG	-	The Engineer	-
Construction Stage	**Work Program (Construction Plan)**	PD	Chief Eng.	Contractor	Chief Eng.	Contractor	The Engineer
	Safety Program	PD	Chief Eng.	Contractor	Chief Eng.	Contractor	The Engineer
	Method Statement	PD	Chief Eng.	Contractor	PD	Contractor	The Engineer
	Daily Site Report	Assis. Dir.	PD	Contractor	Assistant Dir..	Contractor	RE
	Inspection Record	Assis. Dir.	PD	Contractor	PD	Contractor	The Engineer
	Monthly Progress Report	PD	Chief Eng.	PD	Chief. Eng.	Contractor	The Engineer
	Interim Payment Certificate	-	-	PD	Chief. Eng.	The Engineer	PMU
	Variation Order			PD	Chief. Eng.	The Engineer	PMU
Taking Over	**Report of Test on Completion (Final Inspection)**	PD	Chief Eng.	Contractor	PD	Contractor	The Engineer
	Taking Over Certificate		-	PD	-	The Engineer	(PMU)
	Completion Report and As-built Drawing	PD	Chief Eng.	Contractor	PD	Contractor	(PMU)
Defect Liability Period	Final Inspection	-	-	Contactor	PD	Contractor	The Engineer
	Performance Certificate (Letter of Acceptance)	-	-	Chief Eng.-	-	The Engineer	(PMU)

CHAPTER 2 OUTLINE OF THE GUIDELINE

2.1 Construction Management System

Efficient Construction Management System need to be developed to ensure the quality and safety in road and bridge construction work. The practical construction management system is introduced by this Guideline which is operational under the current organization. However, it shall be modified and amended in accordance with organization reforms as needed. In addition, construction project under international organization, it is recommended to establish the Project Management Unit to manage the project in corroboration with the Consultant selected by proper procurement process.

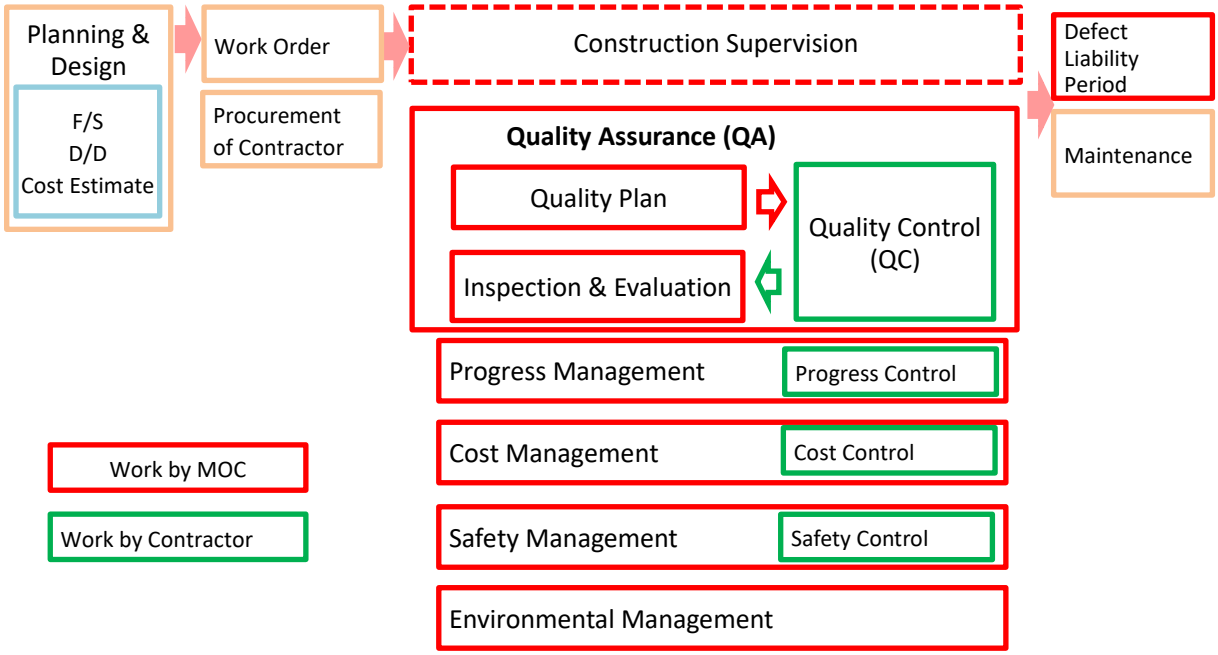


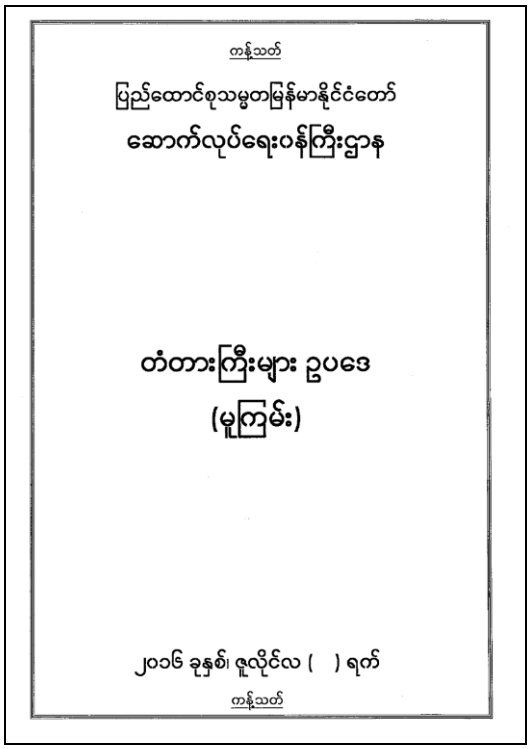
Figure 2.1-1 Construction Management System to be established in MOC

2.2 Existing Guidelines and Regulations

2.2.1 Existing Procurement and Implementation Guidelines

(1) Bridge Law 2017

Bridge Law was drafted in 2016 and currently under process of approval. The Law has consisted of following 9 chapters.


ကန့်သတ်

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်

ဆောက်လုပ်ရေးဝန်ကြီးဌာန

တံတားကြီးများ ဥပဒေ

(မူကြမ်း)

၂၀၁၆ ခုနှစ်၊ ဇူလိုင်လ ( ) ရက်

ကန့်သတ်

1. Definition
2. Purpose of Law
3. Duties & Authorities of Ministry
4. Duties & Authorities of Head of Department
5. Rules and Limitations
6. Construction and Maintenance Stations for Bridge
7. Exception
8. Prohibition
9. Crime and Punishment

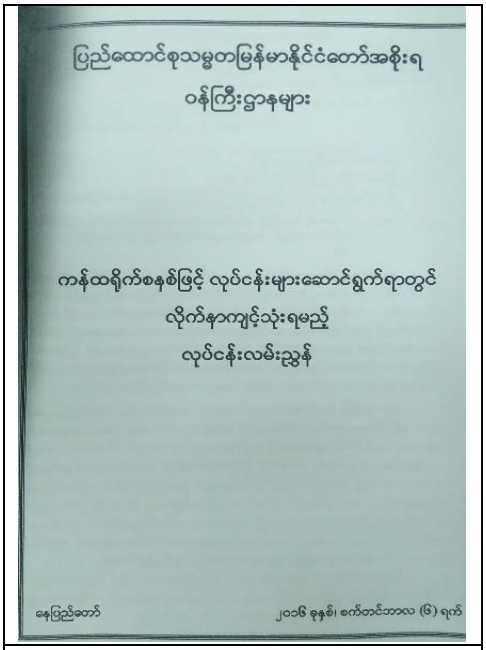
Role and responsibility of MOC and DOB have been stipulated in chapter 3 & 4 of the Law. These could be summarized as following table. This gudeline is developed to materialize more details works to be performed and be responsible by each section in DOB.

Table 2.2-1 Role and Responisbility stipulatedin in the Bridge Law

	MOC	DOB Head Office
Policy	• Formulation of the policy	• Proposal of long term and short-term project planning
Construction	• Coordination with international and other related entities for construction, maintenance, and develop specification. • Launching the Project • Supervising the construction work • Investigate the environmental, social impact by the construction	• Coordinate with regional and international organizations for technical and financial support • Execute the bridges construction. • Public announcement to notice the construction.
Operation	• Coordinate with the other related ministry and regional government for the safety and disciplinary of the use of bridge.	• Coordination with relevant organization for safety • Traffic Safety Control • Decision of tall fees • Specify the maximum load on bridge. • Specify the maximum speed in crossing bridge
Maintenance		• Execute the maintenance work. • Issue the require prohibitions

(2) Guideline for Works with Contractor (September 2016)

The MOC issued "Guideline for Works with Contractor in September 2016 to guide the proper procurement of private contractor through the bidding. Since quality inspection system is also proposed in this Guideline, this guideline shall be deemed as a part of the CM Guideline.


ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ
ဝန်ကြီးဌာနများ
ကန်ထရိုက်စနစ်ဖြင့် လုပ်ငန်းများဆောင်ရွက်ရာတွင်
လိုက်နာကျင့်သုံးရမည့်
လုပ်ငန်းလမ်းညွှန်
နေပြည်တော်
၂၀၁၆ ခုနှစ်၊ စက်တင်ဘာလ (၆) ရက်

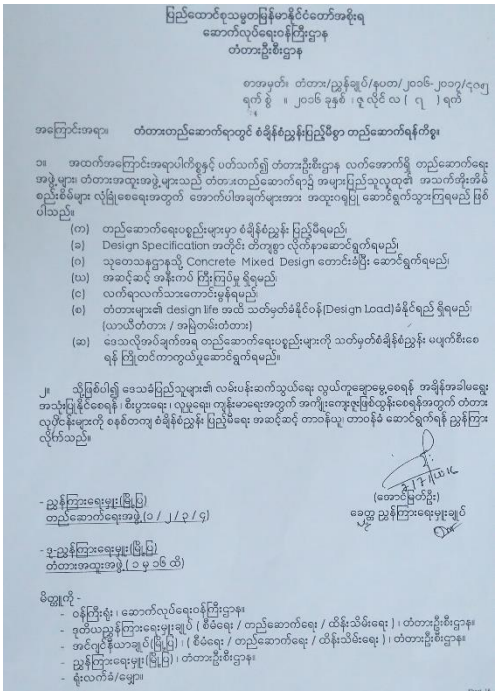
Guideline for Works with Contractor

Contents of Guideline for Works with Contractor

Major Item	Details
Bidding	Advertisement for Bid
	Bid Bond
	Bidding Procedure
	Bid Form
	Bid Evaluation
Quality Inspection for Contract Work	
Delay Damages	
Payment Method	
Penalty	

2.2.2 Existing Decrees issued by State Minister of MOC

(1) Department Order Bridge/ DG/ NPT/ 2016-2017/ 1508 (1st February 2017)


ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ
ဆောက်လုပ်ရေးဝန်ကြီးဌာန
တံတားဦးစီးဌာန

စာအမှတ်။ တံတား/ညွှန်ချုပ်/နယတ/၂၀၁၆-၂၀၁၇/၎၅၅
ရက်စွဲ ။ ၂၀၁၆ ခုနှစ် ၊ ဇူလိုင် လ (၎) ရက်

အကြောင်းအရာ။ တံတားတည်ဆောက်ရာတွင် စံချိန်စံညွှန်းပြည့်မီစွာ တည်ဆောက်ရန်ကိစ္စ။

၁။ အထက်အကြောင်းအရာပါကိစ္စနှင့် ပတ်သက်၍ တံတားဦးစီးဌာန လက်အောက်ရှိ တည်ဆောက်ရေးအဖွဲ့များ၊ တံတားအထူးအဖွဲ့များသည် တံတားတည်ဆောက်ရာ၌ အများပြည်သူလုပ်ထုံး၏ အသက်အိုးအိမ်စည်းစိမ်များ လုံခြုံစေရေးအတွက် အောက်ပါအချက်များအား အထူးဂရုပြု ဆောင်ရွက်သွားကြရမည် ဖြစ်ပါသည်။

(က) တည်ဆောက်ရေးပစ္စည်းများမှာ စံချိန်စံညွှန်း ပြည့်မီရမည်၊
(ခ) Design Specification အတိုင်း တိကျစွာ လိုက်နာဆောင်ရွက်ရမည်၊
(ဂ) သုတေသနဌာနသို့ Concrete Mixed Design တောင်းခံပြီး ဆောင်ရွက်ရမည်၊
(ဃ) အဆင့်ဆင့် အနီးကပ် ကြီးကြပ်မှု ရှိရမည်၊
(င) လက်ရာလက်သားကောင်းမွန်ရမည်၊
(စ) တံတားများ၏ design life အထိ သတ်မှတ်ခံနိုင်စွမ်း(Design Load)ခံနိုင်ရည် ရှိရမည်၊ (ယာယီတံတား / အမြဲတမ်းတံတား)
(ဆ) ဒေသလိုအပ်ချက်အရ တည်ဆောက်ရေးပစ္စည်းများကို သတ်မှတ်စံချိန်စံညွှန်း မယက်စီးစေရန် ကြိုတင်ကာကွယ်ပွဲဆောင်ရွက်ရမည်။

၂။ သို့ဖြစ်ပါ၍ ဒေသခံပြည်သူများ၏ လမ်းပန်းဆက်သွယ်ရေး လွယ်ကူချောမွေ့စေရန် အဓိန်အခါမရွေး အသုံးပြုနိုင်စေရန် ၊ စီးပွားရေး ၊ လူမှုရေး၊ ကျန်းမာရေးအတွက် အကျိုးကျေးဇူးဖြစ်ထွန်းစေရန်အတွက် တံတားလုပ်ငန်းများတို့ စနစ်တကျ စံချိန်စံညွှန်း ပြည့်မီရေး အဆင့်ဆင့် တာဝန်ယူ၊ တာဝန်ခံ ဆောင်ရွက်ရန် ညွှန်ကြားလိုက်သည်။

(အောင်မြတ်ဦး)
ခေတ္တ ညွှန်ကြားရေးမှူးချုပ်

- ညွှန်ကြားရေးမှူး(မြို့ပြ)
တည်ဆောက်ရေးအဖွဲ့(၀ / ၂ / ၃ / ၄)

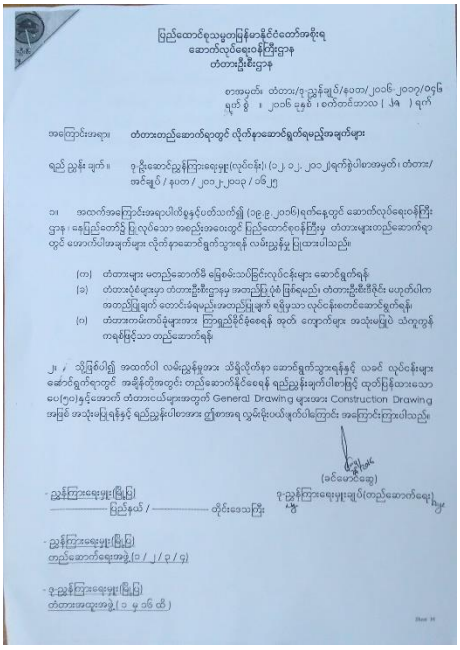
- ဒု-ညွှန်ကြားရေးမှူး(မြို့ပြ)
တံတားအထူးအဖွဲ့ (၁ မှ ၁၆ ထိ)

မိတ္တူကို -
- ဝန်ကြီးရုံး ၊ ဆောက်လုပ်ရေးဝန်ကြီးဌာန၊
- ဒုတိယညွှန်ကြားရေးမှူးချုပ် (စီမံရေး / တည်ဆောက်ရေး / ထိန်းသိမ်းရေး) ၊ တံတားဦးစီးဌာန၊
- အင်ဂျင်နီယာချုပ်(မြို့ပြ) ၊ (စီမံရေး / တည်ဆောက်ရေး / ထိန်းသိမ်းရေး) ၊ တံတားဦးစီးဌာန၊
- ညွှန်ကြားရေးမှူး(မြို့ပြ) ၊ တံတားဦးစီးဌာန၊
- ရုံးလက်ခံ/မျှော။

- To record delivery and received date of Steel Trusses and Plate Girders in Progress Chart
- To fix bridge boundary including 300 ft for each sides of bridge after construction, to perform Land Acquisition case by submitting relevant organizations and to send records to DOB.
- To perform load test for Steel Truss Bridge and FFS (Fit for Service) after getting approval letter from relevant designers and Head Office for other bridges when bridges have been constructed.
- To perform opening ceremony and permit public use after getting FSS.
- To list participation of local people, numbers of local workers, cost, usage of local materials (names of material, cost) in Bridge Project.

(2) Department Order Bridge/DDG/NPT/2016-2017/046 (28th September,2016)

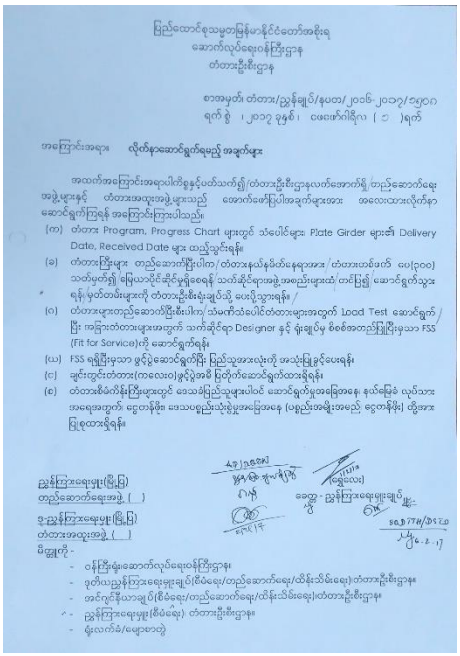
Following were instructed by DDG to prohibit using of already published drawings for bridges more than 50 ft.



- Perform soil tests before bridge construction
- All bridge drawings must be approved drawings from Department of Bridge. Even if design was not from Bridge Department, it needs to get approval from Bridge department. Start the construction works only after getting approval from Bridge department.
- Use reinforced concrete abutment of bridges instead of brick and rock abutment to get long-lasting bridges

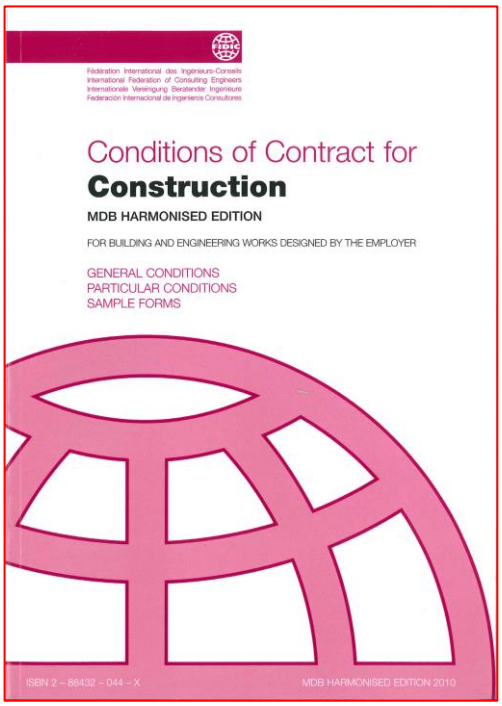
(3) Department Order Bridge/DG/ NPT/ 2016-2017/ 405 (7th July ,2016)

Following instruction was made to all Construction Units to construct the bridge in accordance with standard to improve the quality.



- To use the materials qualified by the standard specification.
- To design and construct in accordance with Design Specification exactly.
- To carry out the work based on Concrete Mixed Design approved by Research Department.
- To supervise the construction work by step.
- To keep good appearance.
- To ensure the Design Load up to design life. (Temporary/ Permanent Bridge)
- To follow the specified standards for the construction materials according to regional requirements.

2.3 International Practice



The Construction Contract of International Federation of Consulting Engineers (FIDIC), so called "Red Book", has been adopted as standard contract documents for building and engineering works designed by the employer or by his representative (the Engineer [1]) for international contracts. The Federation produced the Harmonized Edition for the Multilateral Development Banks (MDB), including Word Bank and Asian Development Bank, in 1999 of which the latest edition (version) is that released in June 2010. This MDB Harmonized Edition, so called "Pink Book", also includes sample forms for Contract Data, Securities, Bonds, Guarantees and Dispute Board agreements. In general, this harmonized document follows earlier FIDIC risk sharing principles for the type of contract for which they were prepared. In most cases, the amendments which have been made to produce the MDB Harmonized Edition of the FIDIC General Conditions of Contract for Construction are those arising from the requirements of the MDB. Construction Management Activity introduced in this Guideline as the "International Practice" is presented in accordance with this Pink Book.

2.4 Scope of the Guideline

The Guideline is developed to provide guidelines of Operation Procedure for Construction Management by introducing following contents.

- Definition of the roles and responsibilities of each entities on Quality and Safety Control for road and bridge construction
- Introduction of the operation procedure on Quality and Safety Control to be performed by MOC and related organization.
- Workflow to materialize above procedures and responsible entities from the beginning of the Construction work up to handing over of the construction record to Maintenance Section in MOC.

[1] The Engineer is appointed from the Consultant (in usually), in case of the international project with FIDIC condition. In case of the project financed by MOC, Project Director (PD) is responsible for same authority.

CHAPTER 3 CONSTRUCTION MANAGEMENT SYSTEM AND ORGANIZATION

3.1 Role and Responsibility of Entities

3.1.1 Project Implementation by MOC Head Office

The MOC is mandated to undertake (a) the planning of infrastructure, such as roads and bridges, and other public works, and (b) the design, construction, and maintenance of national roads and bridges, and other infrastructure projects. The MOC functions as the engineering and construction arm of the Government and responsible for the planning, design, construction and maintenance of infrastructure, especially the national highways in accordance with national development objectives. Figure 3.1-1 and Figure 3.1-2 shows the organizational chart of MOC Head Office as of April 2017.

The Department and Offices which are directly administrating and implementing projects as representative of the MOC or which are providing major support services for the project implementation are as follows:

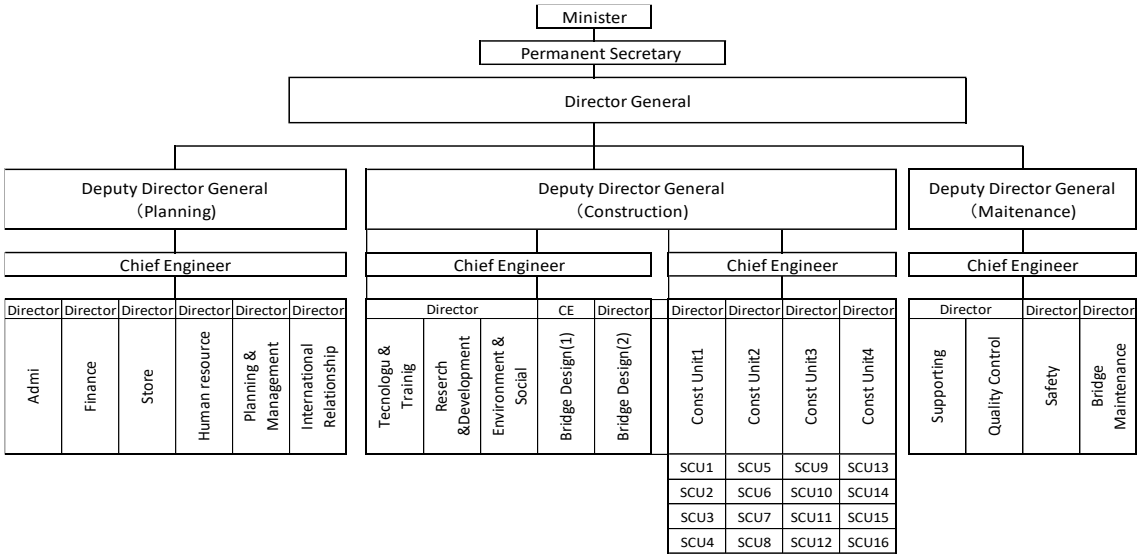


Figure 3.1-1 Organization Chart of DOB

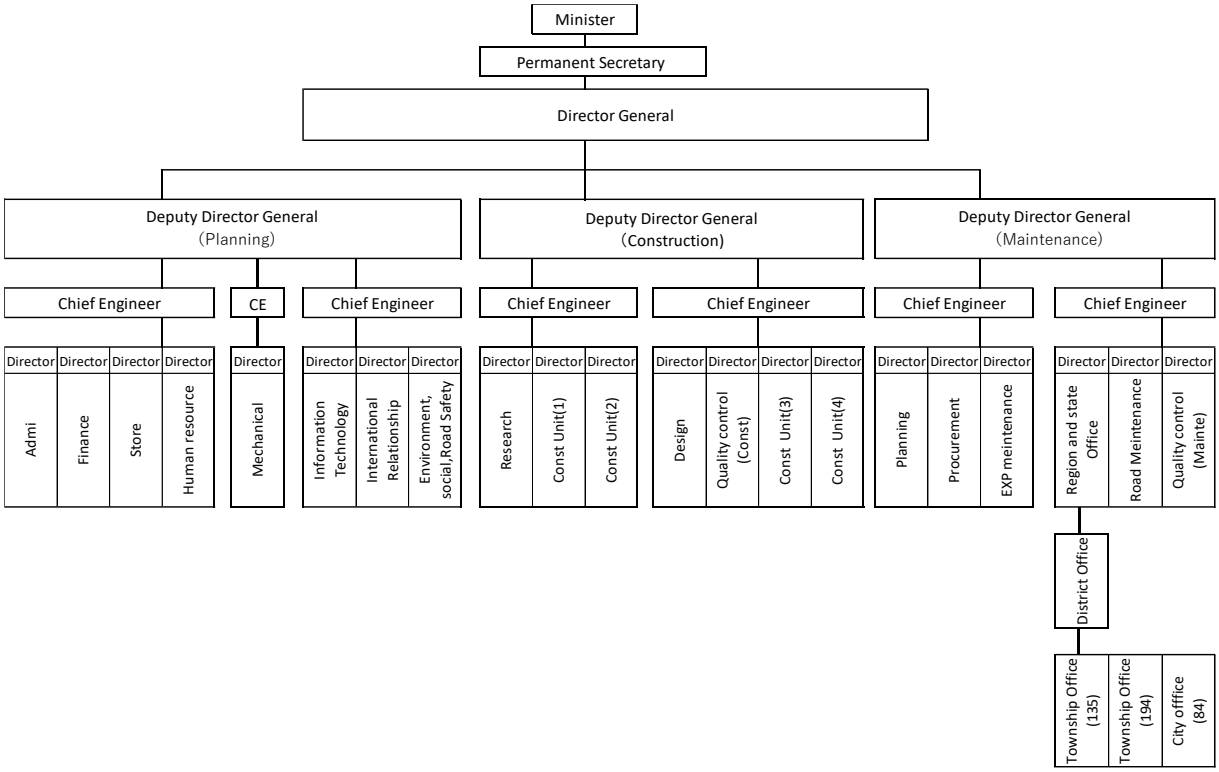


Figure 3.1-2 Organization Chart of DOH

3.1.2 Institutional Function in DOB

(1) Construction Unit under DOB (No.1~No.4)

Construction Unit 1-4 that is headed by the Director of DOB is mainly in charge of largescale bridge.

(2) Special Construction Unit under DOB (No.1~No.16)

Special Construction Unit 1-16 that is headed by Deputy Director of DOB are mainly in charge of small or middle scale bridges at each state/region.

Table 3.1-1 Bridge Construction Unit and its Location

No	Name	Township	State/Division
1	**Construction Unit 1**	**Mandalay**	**Mandalay Division**
	1. Bridge construction (1)	Myitkyina	Kachin state
	2. Bridge construction (2)	Monywa	Sagaing division
	3. Bridge construction (3)	Pakokku	Magwe division
	4. Bridge construction (4)	Mandalay	Mandalay Division
2	**Construction Unit 2**	**Nyaung Oo**	**Mandalay Division**
	1. Bridge construction (5)	Seikphyu	Magwey division
	2. Bridge construction (6)	Naypyitaw	Mandalay Division
	3. Bridge construction (7)	Kyauktaw	Rakhine state
	4. Bridge construction (8)	Ann	Rakhine state

3	**Construction Unit 3**	**Yangon**	**Yangon Division**
	1. Bridge construction (9)	Bago	Bago division
	2. Bridge construction (10)	Hlegu	Bago division
	3. Bridge construction (11)	Yangon	Yangon Division
	4. Bridge construction (12)	Shwe Nyaung	Shan state
4	**Construction Unit 4**	**Yangon**	**Yangon Division**
	1. Bridge construction (13)	Myeik	Tanintharyi division
	2. Bridge construction (14)	Mawlamyine	Mon state
	3. Bridge construction (15)	Pyapon	Ayeyarwaddy division
	4. Bridge construction (16)	Bokalay	Ayeyarwaddy division

(3) Quality Control Section (DOB)

Quality Control Section (DOB) has been developed under DOB. The QCS consist of two (2) major division such as Soil, Concrete, and their staff would visit the site for inspection and sapling the materials.

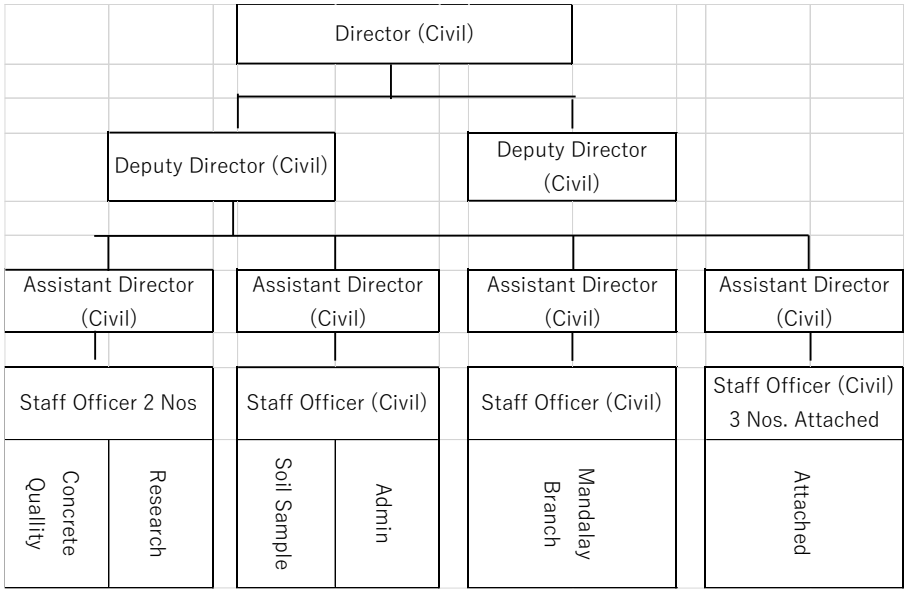


Figure 3.1-3 Organization Chart of BRL

Following major functions are undertaken by the BRL as quality control for bridge construction.

1) Soil Extraction of Soil sample and soil test
2) Testing of aggregates, sand, cement, steel, bentonite
3) Concrete mix design
4) Concrete quality control
5) Measurement of Load Test, Cable Force Tension
6) Non-Destructive Testing (NDT)

3.1.3 Institutional Function in DOH

(1) Regional Office (District Office)

The office is responsible for construction (limited distance only), maintenance, and upgrading of roads and bridges (under 180 feet or 54.9 m) within the district. Districts are normally headed by Executive Engineers. The office has to execute the following works:

- Road and Bridge Inventory;
- Road Condition Survey;
- Traffic Survey;
- Cost Estimate for Maintenance;
- Cost Estimate for Upgrading;
- Prepare Work Program;
- Request Funds from Headquarters through Superintending Engineer; and
- Request RRDS to investigate and design the major roads.

(2) Road Construction Special Unit (RCSU) (No.1~No.24)

The RCSU is responsible for new construction works as well as maintenance and upgrading of major roads. If District Office does not have enough facility and capable personal, RCSU is usually assigned for the road works. The RCSU is normally headed by Deputy Superintending Engineer. Their duties are:

- Request RRDS to strengthen and design the new roads;
- Prepare cost estimate and construction materials in accordance with the new road design;
- Request the budget for the new road construction as well as maintenance and upgrading of major roads; and
- Construct the new roads in accordance with the design and specifications.

Note: RCSU is under the control of MOC for road construction, maintenance, and upgrading, and the District Office is under the control of the Regional Government from the fiscal year 2012-2013.

Table 3.1-2 Road Construction Unit and its Location

No.	Name	Township	State/ Division
1	**Construction Unit 1**		
	Road Special Unit (1)	Puta-O	Kachin State
	Road Special Unit (2)	Myitkyina	Kachin State
	Road Special Unit (3)	Keng Tung	Shan State
	Road Special Unit (4)	Shwe Nyaung	Shan State
	Road Special Unit (5)	Loilem	Shan State
	Road Special Unit (6)	Lashio	Shan State
2	**Construction Unit 2**		
	Road Special Unit (7)	Kalewa	Sagaing Division
	Road Special Unit (8)	Paungbyin	Sagaing Division
	Road Special Unit (9)	Meiktila	Mandalay Division
	Road Special Unit (10)	Hakha	Chin State
	Road Special Unit (11)	Minbu	Magwe Division
	Road Special Unit (12)	Gangaw	Magwe Division
3	**Construction Unit 3**		
	Road Special Unit (13)	Pyinmana	Mandalay Division
	Road Special Unit (14)	Yangon	Yangon Division
	Road Special Unit (15)	Taungoo	Bago Division
	Road Special Unit (16)	Ann	Rakhine State
	Road Special Unit (17)	Sittwe	Rakhine State
	Road Special Unit (18)	Toungup	Rakhine State
4	**Construction Unit 4**		
	Road Special Unit (19)	Mawlamyine	Mon State
	Road Special Unit (20)	Yay Kyi	Ayeyarwady Division
	Road Special Unit (21)	Nyaung Tone	Ayeyarwady Division
	Road Special Unit (22)	Hpa-an	Kayin State
	Road Special Unit (23)	Dawei	Tanintharyi Division
	Road Special Unit (24)	Myeik	Tanintharyi Division

(3) Road Research and Development Section (RRDS)

RRDS is in charge of pavement design and mix design of asphalt pavement and concrete. RRDS has no inspector to visit the construction site. Followings are the major function of RRDS.

1. Material Testing and Mix Design (for structure design and quality control)

2. Roads and Airfield Structure Design,

3. Specifying Specifications,

4. Quality Control Testing During Construction,

5. Road Failures Investigation and Road Strengthening Design

6. Giving Lectures concerning with roads at Central Training Center.

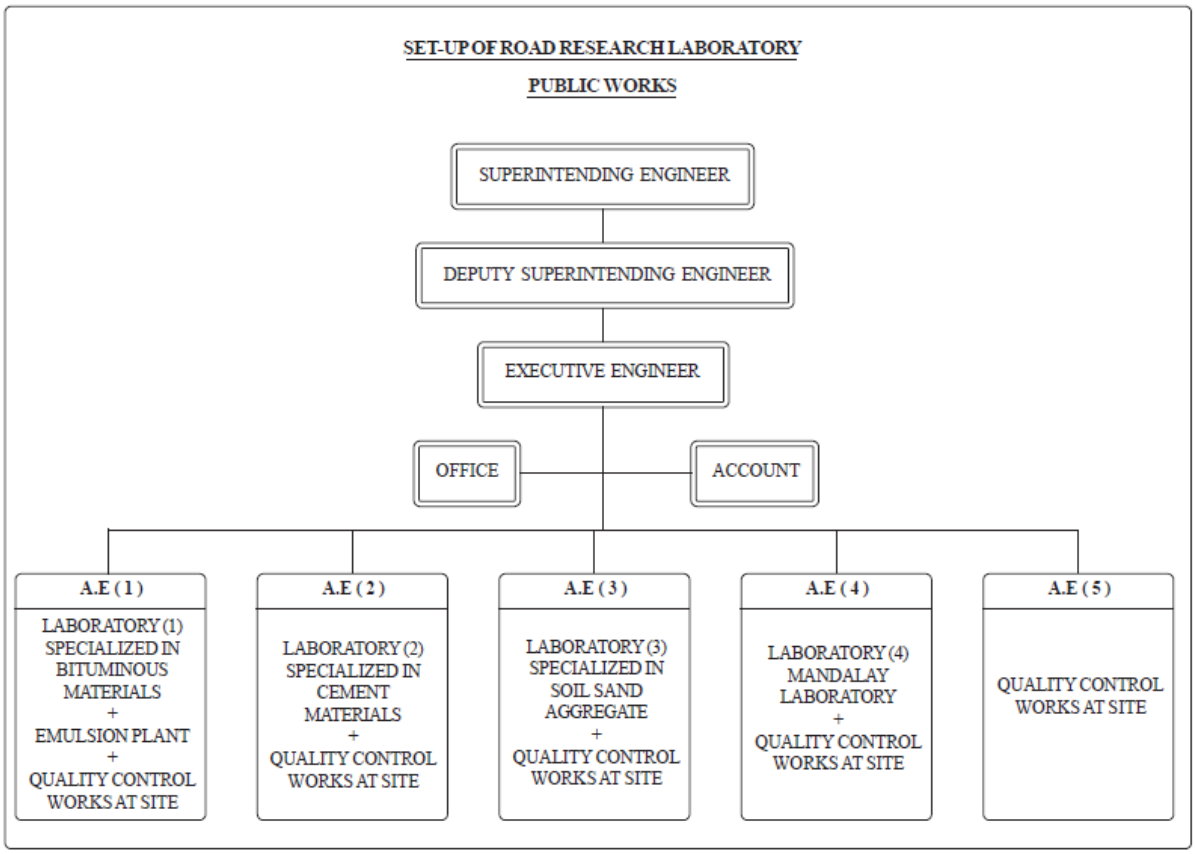


Figure 3.1-4 Organization Chart of RRDS

3.2 Standard Practice of the Construction Management in MOC

3.2.1 Standard Organization of Project Monitoring Unit (PMU)

Once the Construction Work in MOC has initiated, Director General (DG) assigns the member of the Project Monitoring Unit (PMU). The PMU consists of the Project Director (PD), Project Manager (PM) and Project Engineer (PE). Members of each position are selected from the Head Office, Regional Office (R/O) and Construction Unit (C/U) respectively as below.

Table 3.2-1 Member of PMU

	DOH		DOB
Project Director (PD)	Chief Engineer in Head Office DOB		Chief Engineer in Head Office of DOB
Project Manager (PM)	Director of R/O	Deputy Director of C/U	Director (or Deputy) Director of C/U
Project Engineer (PE)	Assistant Director of R/O	Assistant Director of C/U	Assistant Director of C/U
Resident Engineer	Staff Officer and Junior Engineer	Staff Officer and Junior Engineer	Staff Officer and Junior Engineer
Other PMU Members	Finance/M & E Engineers	Finance/M & E Engineers	Finance/M & E Engineers

(1) Project Director (PD)

PD has authority to approve all issues and documents related to the Construction Works. He shall be the top of PMU to be responsible for each project. One PD is able to concurrently perform the PD of few projects. Normally, one Chief Engineer is in charge of construction works in one (1) or two (2) state(s)/region(s).

(2) Project Manager (PM)

PM shall be in charge of project management such as quality, financial, schedule as well as environmental issues. He has also task to report the issues and the progress to PD in monthly basis. All of result and report from Project Engineer (PE) of the construction site shall be approved by the PM.

(3) Project Engineer (PE)

He shall be responsible for supervising the construction site as residential engineer. Investigation for every site works and inspection have to be performed under his responsibility.

3.2.2 Quality Control in DOB

Quality Control Section in DOB is playing roles to investigate physical characteristics of construction materials, and to instruct how to measure and control the characteristics in accordance with predetermined quantitative criteria at the site to ensure the high quality in bridge construction. Quality Control and testing play a vital role in ensuring a high-quality finished product.

(1) Before Concreting

- Testing of materials before they are used to prevent problem developing
- Tests to be performed with all specification requirements for materials
- Ensure compliance of component material to specification requirements
- Ensure preliminary testing is accomplished
- Establish standards of workmanship and provide necessary training

(2) During Concreting

- Inspect start-up of work
- Establish detailed testing schedule based on production schedule
- Conduct inspection during construction to identify and correct deficiencies
- Inspect completed phases before specification acceptance
- Description of records: list of records to be tested

(3) After Concreting

- Provide feedback and system changes to prevent repeated deficiencies.
- For retrospective control, by possibly learning from earlier mistakes

The testing of Quality Control Section includes i) Testing at central laboratory and ii) Field Quality Control Works.

(4) Filed Quality Control Works

All bridge construction projects perform field quality control of concrete. Especially for large construction projects require continuous testing. It is generally equipped for the performance of routine testing associated with quality control during concrete production. This include some kinds of fine and coarse aggregate tests also like in central laboratory.

In field testing for freshly mixed concrete for slump, as well as casting strength specimens, concrete specimen curing, capping and testing, designing or adjusting concrete mixes by statically analysis data shall be performed.

Table 3.2-2 Item of Field Testing

Test of	Test Standard	Standard Title	Requirement	Testing Frequency
Aggregate Gradation	ASTM 136	Sieve Analysis of Fine and Coarse Aggregates	Fine and Coarse Aggregate meets sizing requirements per ASTM C33	-At beginning of placing each mix -At change in quarry source
Aggregate Moisture Content	ASTM C566	Total Evaporate Moisture Content of Aggregate by Drying	Verify that moisture content at batch mix is accurate with material batched	-At beginning of placing each mix -A change in mix design
Fresh Concrete Properties tests performed at site	ASTM C 143 ASTM C1064	Slump of Hydraulic Cement Concrete Temperature of Freshly Mixed Hydraulic Cement Concrete	When tested concrete meets specifications, 1 set of tests each day of placement for each mixture of first batch.	
Compressive Strength	ASTM C31 ASTM C39	Making and Curing Concrete Test Specimens in the filed Compressive Strength of Cylindrical Concrete Specimens	1 set of (dia 150x300) mm Cylinder mold for each day of placement for each mixture. A minimum of 6 samples for strength testing shall be made each time strength samples are collected. -Cure these samples on job site under the same conditions as the concrete the cylinders represent for a minimum of 7 days, then transfer to the testing laboratory until testing at strength design days. -Test 2 cylinders each at 3 days age, 2 cylinders at 7 days age and the last 2 cylinders at strength design age.	

(5) Quality Control Team

- Quality Control Manager (Staff officer)
- Field Superintendents (JE (1) or JE (2))
- Staffs

(6) Steel Bridge Inspection Team

In line with "Organization of Inspection Team for steel bridge" (Letter No. 032/DDG/Maintenance/Bridge/2017-2018) issued on 21st September,2017, MOC has organized Special Inspection Unit to inspect quality of steel bridge in workshop. Six (6) staff officer was appointed as the member of the Special Inspection Unit.

CHAPTER 4 PRE-CONSTRUCTION ACTIVITIES

4.1 Bidding Documents

The Bidding Documents are documents issued by the MOC to provide the prospective bidders all necessary information to prepare responsive bids. These bidding documents are prepared in accordance with "(2) Guideline for Works with Contractor (MOC, September 2016)" or FIDC and together with procurement guidelines of funding bank (ADB, WB, JICA, etc.) in the case of foreign-funded projects. The Bidding Documents shall consist of the following items;

Table 4.1-1 Typical Contents of Bidding Documents

Part	Section	Section Title
Part I:	Section I Section II	Invitation for Apply Eligibility and to Bid (IAEB) Eligibility Requirements
Part II:	Section I Section II Section III Section IV Section V Section VI Section VII Section VIII	Instruction to Bidders (ITB), including Documents comprising the Bid Bid Data Sheet (BDS) General Conditions of Contract (GCC) Special Conditions of Contract (SCC) Specifications (Standard Specifications and Special Provisions) Drawings (Plans) Bills of Quantities (and Unit Price Analysis) Forms

Standard form for the Bidding shall be standardized to smoothly evaluate the bidding document and to keep fairness in evaluation. As the Bidding Documents become part of the Contract Documents when the winning bidder enters into the Contract, those should be kept well and handover to the construction supervision engineer together with a proper check list.

4.2 Contract Document

The Contract documents are legal documents on which the project management and construction supervision are relied. The Contract is the contract between the MOC and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in the GCC and supporting documents.

Table 4.2-1 Typical Formation of the Contract Document

Title of Documents
A. The Contract:
1) Contract Agreement
2) Documents forming part of Contract Agreement
a) Bidding Documents for the Contract (Annex A)
1. General Conditions of Contract (GCC)
2. Special Conditions of Contract (SCC)
3. Drawings/Plans
4. Specifications
5. Invitation for Apply Eligibility and to Bid (IAEB)
6. Instruction to Bidders (ITB)
7. Bid Data Sheet (BDS)
8. Bid Bulletins (Addenda)

b) CONTRACTOR's Calculated Bid in the Form of Bid including its Technical and Financial Proposals
c) CONTRACTOR's Letter of Intent
d) Letter of Acceptance (Notice of Award)
e) Performance Security
f) Credit Line or Cash Deposit Certificate
g) CPM (Critical Path Method) diagram and bar chart with S-curve
B. Supporting Documents for the Contract
1) Approved Program of Work (Annex "I")
2) Addendum
3) Certificates for Availability of Fund
etc.

The documents forming the Contract are to be taken as mutually explanatory of one another. For interpretation, the Contract documents shall be interpreted in the following order of priority:

(a) Contract Agreement
(b) The Letter of Acceptance
(c) The Tender
(d) The Conditions of Contract
(e) The General Conditions
(f) Specifications
(g) Drawings
(h) Any other document listed in the SCC as forming part of this Contract.

4.3 Construction Schedule

The winning bidder (Contractor) and/or appointed Construction Unit should submit construction schedule (diagram and bar chart with S-curve), together with the corresponding monthly equipment and manpower utilization schedule, for approval of the Engineer and/or the authority of MOC.

The principal role of the Engineer and/or the authority is to implement the project as to time, to budget and to the specified quality. The first work of the Engineer and/or the authority is to review and provide comments for correction and resubmission of the construction schedule submitted by the Contractor to complete the project in time. The major review points will be:

- Whether the quantities of the works to be executed agree with the Construction period, construction plant/equipment, materials and manpower schedule.
- Whether the basic sequence of Works meets the requirements of the Contract.
- Whether the program makes opportunities available for other Contractors and the requirements of other authorities such as utility owners in relation to service lines relocation.
- Whether the program is realistic in relation to the seasons and other constraints, including financial capacity of the Contractor.

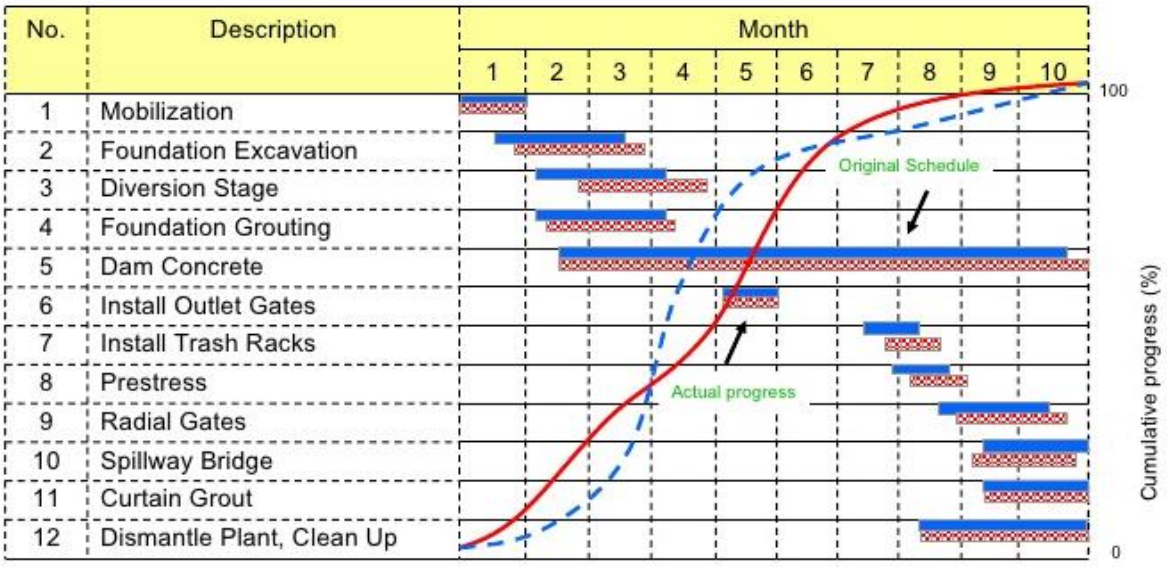


Figure 4.3-1 Sample of S-Curve

4.4 Approval of Contractor's Organization and Key Staff

4.4.1 Submission and Approval of Organization and Key Staff

The Contractor and/or the Construction Unit shall submit the organizational chart to execute the contract for approval of the Engineer/the MOC. The organizational chart includes the name of the Project Manager, Project Engineer, Highway Engineer, Bridge Engineer, Materials Engineer, Plant Engineer, Foreman and other key staff. The Contractor shall submit CVs for the Project Manager and other senior staff for approval of the Engineer / MOC. The qualification and minimum experience of the key staff shall be equivalent or better than those proposed in the Bidding.

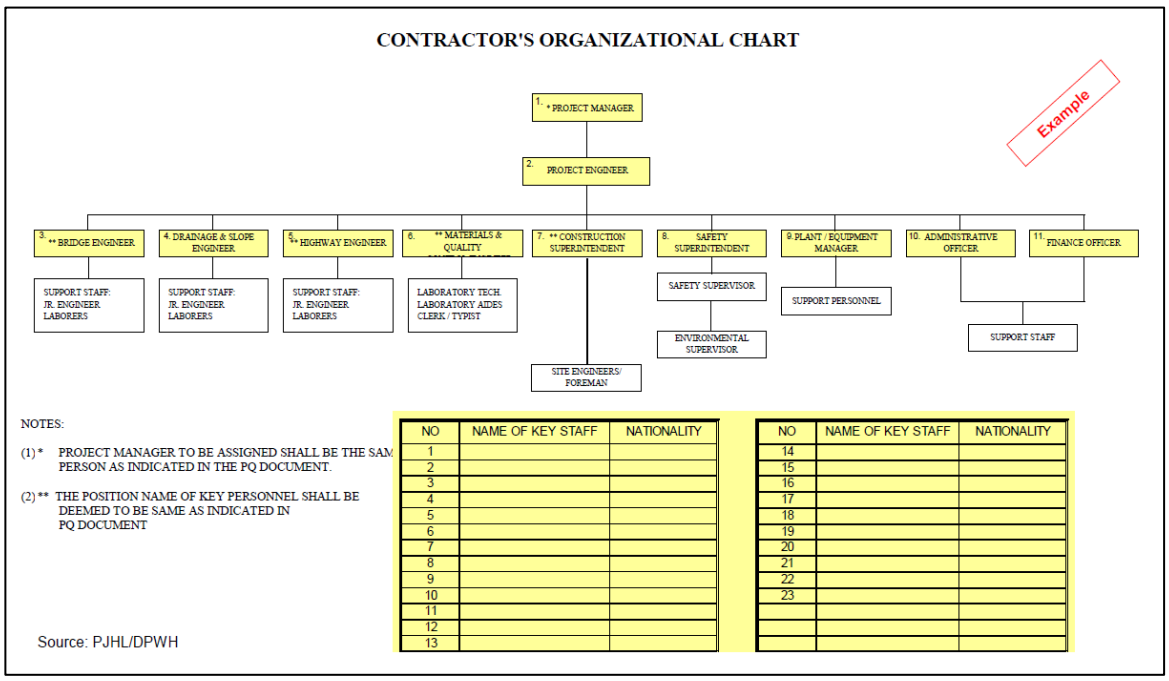


Figure 4.4-1 Sample of Organization Chart for the Contractor

4.4.2 Foreign-Funded Projects

Typical organizational charts of the contractor will be as the shown in the following figure. The Project Manager shall be the head of the project and the delegated authority by his head office for management of the project. He should also be given sufficient authority to approve payment for staff, materials and subcontractors for project operation. The number of personnel and each position shall be described in the Bidding Document.

4.4.3 Locally-Funded Projects

In case of the Local Funded Project regardless performed by private contractor or MOC, organization chart at least consists of i) Project Manager, ii) Safety and Environmental Officer iii) Quality Control Engineer and iv) Administrative Officer shall be officially submitted to Project Director (PD).

4.5 Sub-contractor

A Subcontractor is any person or organization who has subcontracted a part of the work from the contractor as approved by the Engineer and/or the Employer. No contractor shall sub-contract any portion of work without prior approval. In no case, shall subcontracting be allowed for whole of the value of project. Subcontracting of any portion of the Works does not relieve the Contractor of any liability or obligation under this Contract. The Contractor will be responsible for the acts, defaults, and negligence of any subcontractor, its agents, servants or workmen as fully as if these were the Contractor's own acts, defaults, or negligence, or those of its agents, servants or workmen.

All subcontracting arrangements as disclosed and identified during the eligibility check shall not be changed during the implementation of this Contract.

4.6 Land Acquisition and Settlement

4.6.1 Parcellary Survey and ROW Acquisition

"Right-Of-Way (ROW)" refers to the overall width along the road alignment of proposed works with regard to the area of land that must be cleared before the works are commenced. Parcellary survey will be conducted to identify the specified area, land title, land owners and cost required for ROW acquisition and resettlement. The Employer (MOC) has responsibility to complete purchasing land for the "Right-of- Way" and compensation for resettlement before commencement of the Works.

Unless otherwise specified in the Contract, the Employer shall provide access to and possession of the Site including special and/or temporary right-of-way which are necessary for the Works. The Contractor shall obtain, at his risk and cost, any additional rights of way or facilities outside the Site which he may require for the purposes of the Works.

4.6.2 Possession of Site

Prior to any commencement of works, the Employer shall issue the Contractor in writing the possession of site, specifying the relevant stations of the Project as maybe required to enable him to proceed with

the execution of the works. If the Contractor suffers delays or incurs delay or incurs cost from failures on the part of the Employer to give possession of such site, the Employer's representative shall give the contractor a contract time extension and certify such reasonable sum to cover the cost incurred which shall be paid by the Employer.

4.6.3 Relocation of Utilities

Though the Contractor is responsible for identifying utilities affected by the Works, if not shown in the contract documents, arranging their move or providing alternative services, the Engineer/the MOC should confirm the location of all public utilities which shall affect the Works. These include:

- Electricity Authority (power lines, cables, pylons, etc.)
- Water (pipes, irrigation channels, etc.)
- Sanitation and
- Telecommunication.

The Employer coordinates and assists the contractor and the concerned agency in the relocation of affected facilities prior to commencement of any works.

4.7 Performance Security and Insurance

4.7.1 Performance Security

The Contractor shall obtain at his cost a Performance Security for proper project implementation. The Performance Security shall be submitted to the Employer not later than the date specified in the **Letter of Acceptance** and shall be issued in an amount and form as specified in the Special Conditions of Contract and denominated in the currency in which the contract price is payable. The Performance Security shall be valid for the period specified in the SCC. At the Contractor's option, the Performance Security is to be in any of the following form:

- Cash, certified check, cashier's check, bank draft or irrevocable letter of credit in the amount equivalent to Five Percent (5%) of the contract price
- Bank guarantee in the amount equivalent to Ten Percent (10%) of the contract price
- Surety bond in the amount equivalent to Thirty Percent (30%) of the contract price callable upon demand issued by any reputable surety or insurance company
- A combination of the foregoing

The performance security shall be released by the procuring entity after the issuance of the Certificate of Acceptance, provided that there are no claims for labor and materials filed against the contractor or the surety company and provided further that the contractor should have submitted the warranty security. The validity of the Performance Security shall be from the date of Contract signing up to the final acceptance of the project wherein the warranty period shall have commenced. The Performance Security shall bear the provision: "The right to institute action on the penal bond pursuant to Act No. 3688 of any individual firm, partnership, corporation and association supplying the contract with labor and materials for the prosecution of the work is hereby acknowledged and confirmed'.

4.7.2 Insurance

The Contractor shall, under his name and at his own expense, obtain and maintain, for the duration of this Contract, the following insurance coverage:

- Contractor's All Risk Insurance (Works and Equipment)
- Personal injury or death of Contractor's employees
- Comprehensive insurance for third party liability

The Contractor shall provide evidence to the Engineer/ the MOC that the insurances required under this Contract have been affected and shall, within a reasonable time, provide copies of the insurance policies to the Engineer/ the Employer prior to issuance of the "Letter of Acceptance".

The Contractor shall notify the insurers of changes in the nature, extent, or program for the execution of the Works and ensure the adequacy of the insurances at all time in accordance with the terms of this Contract and shall produce to the Employer's Representative the insurance policies in force including the receipts for payment of the current premiums.

If the contractor fails to obtain and keep in force any such insurance and pay such premiums as maybe necessary for the purpose, the employer shall obtain and keep in force the same and shall be deductible from the contractor's collection.

4.8 Commencement of Works

The Commencement Date shall be the date at which the following precedent conditions have all been fulfilled and the Engineer's notification recording the agreement of both Parties on such fulfilment and instructing to commence the Work is received by the Contractor;

(a) signature of the Contract Agreement by both Parties, and if required, approval of the Contract by relevant authorities of the Country;

(b) delivery to the Contractor of reasonable evidence of the Employer's Financial arrangements;

(c) effective access to and possession of the Site given to the Contractor together with such permission(s) as required for the commencement of the Works;

(d) receipt by the Contractor of the Advance Payment under the condition of contract provided that the corresponding bank guarantee has been delivered by the Contractor.

If the said instruction on commencement of the work is not received by the Contractor within 180 days from his receipt of the Letter of Acceptance, the Contractor shall be entitled to terminate the Contract in accordance with the Condition of Contract.

CHAPTER 5 CONSTRUCTION SUPERVISION

5.1 Study of Design Reports and Drawings

5.1.1 Design Reports and Drawings

Prior to commencement of the Works, the Engineer, and/or the Project Director (PD), should obtain and study the design reports and drawings. They should conduct field reconnaissance survey at the earliest opportunity if they have never seen the site at the pre-construction stage to familiarize with the project site. The following table shows major check points by category of report.

Table 5.1-1 Documentary Requirements Check List for Contract

Report	Category	Check Points
Design Report	• Geometric Design	• Design speed, standard roadway width (cross section, carriageway, shoulder), horizontal and vertical alignment, design grade, sight distance, etc.
	• Earthworks	• Slope and extent of cut and fill; soil classification/type
	• Pavement Design	• AADT (Current and future vehicle type)
		• Type of pavement and treatment (reconstruction, upgrading, rehabilitation, maintenance) including widening
		• Design Parameters (ESAL, CESAL, Design CBR, Materials, Structural Layer Thickness, S'c, fc', etc.)
	• Bridge Design	• Design conditions (design load, dimensions, bearing system, etc)
		• Flood elevation and scouring depth
		• Structural analysis and reinforcing design
	• Drainage Design	• Discharge and flow analysis
		• Location and sizes of drainage structures (RC Box culverts and pipes) and road side drains
	• Slope and scouring protection	• Slope stability analysis, countermeasure design, retaining wall design
		• Scouring analysis and protection design
	• Miscellaneous structure and road facilities	• Location and type
		• Dimensions (length, height, etc)
Geotechnical and Materials	• Geological Formation	• Boring Logs with N-Value
	• Soil Property	• Result of Laboratory Test and Site Test
	• Type of Soil	• Sub-soil classifications, CBR, PI
		• Soft ground, rock
Reports	• Bridge Site Boring Data	• Boring log (soil classification, SPT, depth of bearing layer)
	• Slope stability and/or weak ground	• Location, topographic and geotechnical condition, countermeasure design and/or structures
	• Construction Materials	• Classification of excavation materials (soil type, PI, CBR)
		• Borrow materials (source, soil type, PI, CBR)
		• Subbase and Base Course Materials (source, LA, CBR, stability, density, grading) and available volume for project
		• Concrete Materials (source and quality of coarse and fine aggregate, cement, water)

Report	Category	Check Points
		• Asphaltic Concrete Materials (source and quality of coarse and fine aggregate, bitumen)
Drawings (Plan)	• Plan and Profile	• Location of control points and coordinates, bench marks and elevation
		• Location of curves, structures and road facilities (existing and proposed)
		• Elevation of existing ground and finished Grade
		• Extent of cut and fill
		• Location of cross pipes, ditches
	• Typical Roadway Sections	• Road width and pavement thickness
	• Detailed Cross Sections	• Location of cut and fill (especially high cut or fill), extent of cut and fill slopes
		• Position of earth retaining structures/ slope Protections
	• Bridge and structures	• Plan, profile, elevation, structural details
		• Reinforcement schedule
	• Drainage Schedule and Cross Sections and miscellaneous	• Type, dimensions and locations
		• Reinforcement schedule
	• Schedule of All Other Proposed Structures	• Road signs, guard rails, guide posts, Km posts, ROW posts, etc.
Quantity / Cost Estimate Report	• Quantity Summary	• Check Bills of Quantity with quantity estimation reports
	• Quantity Calculation	• Check any serious calculation errors
	• Cost Estimate	• Check project cost and unit price analysis
Environmental Report	• EIA Report	• Check Environmental Management Plan (EMP)
ROW	• Parcellary Survey	• Obtain Parcellary Survey Drawings
	• Land Acquisition and Resettlement	• Check progress of Land Acquisition and Resettlement Action Plan
Others (Road Safety Audit Report)	• Traffic Control Road Safety Structures, Road Signage, Markings	• Check existence of traffic diversion road and its capability
		• Check villages and shops near ROW
		• Verify accident prone areas and sections that require additional road signs, road alignment improvement, etc.

A check list for field reconnaissance survey should be prepared based on above documents study.

5.1.2 Pre-construction Survey

The Engineer /PD should conduct detailed field pre-construction survey in accordance with a check list prepared through desktop study prior to a joint site inspection with the Contractor and pre-construction meeting. The field reconnaissance should include:

- Project location, including start and end points, bridge location, scouring and protection works, existing drainage structures (location, size and condition);
- Topography and geology;
- Current road conditions and improvement plan in the Drawings;

- Location of towns and villages along the project road, including public facilities (schools, clinics, etc.);
- Type and volume of traffic on the project road and its accesses;
- Progress of ROW acquisition and resettlement;
- Borrow and waste (disposal) areas, and Material sources;
- Access and detour roads;
- Environmental features, including vegetation, water (rivers), noise, flora and fauna, communities, public facilities (school, church, market, hospital), etc. in relation with EMP; and
- Data and information collection through conduct of interviews of nearby residents.

5.1.3 Meteorological Condition

The meteorological condition influences not only the work progress but also quality and cost. The Engineer / PD should collect climate records including rainfall, typhoon, floods and other hydrology conditions from concerned authority near the project site and incorporate such conditions in the implementation management plan.

5.2 Joint Inspection and Pre-construction Meeting

5.2.1 Joint Site Inspection

The objective of a joint inspection with the Contractor is to familiarize with the project site and share knowledge on key issues for implementation of the project prior to a pre-construction meeting. Project briefing should be made during inspection or at office. The participants of joint inspection are as indicated in the following table.

Table 5.2-1 Participants of Joint Site Inspection

Entity	Foreign-funded Projects	Locally-funded Projects
The Engineer (Consultant)	Project Manager* Resident Engineer Key Staff (SE, ME)	-
Representative of the Employer (MOC)	Project Director Assistant Director	Project Engineer* Project Inspector Materials Engineer
The Contractor	Project Manager Other Key Staff	Project Manager Other Key Staff

Note: * Chairperson of the meeting

Major inspection points will be as follows:

Table 5.2-2 Major Inspection Points

Category	Inspection Points
Project Roads	Start and End Points
	Towns, Villages and Public Facilities
	Access road to the project sites
Major Scope of Work	Earthworks (major cuts and fills)
	Pavement (deterioration)
	Bridges
	Slope Protection Works (landslides, slope failures)
	River Scouring Protection Works
	Drainage Structures
Materials Sources	Borrow and Waste (Disposal) Areas
	Sand and Aggregate Sources, including type and classification
Planned Camp Site and Plant Yard	Office, laboratory, equipment yard, workshop
	Concrete Mixing Plant, Asphalt Mixing Plant
	Crushing Plant
ROW Acquisition and Utility Relocation	ROW status (land acquisition and resettlement)
	Public Utility
Environmental Issues & Traffic Control	Land required for contractor's temporary facilities
	Major Environmental points stated in EMP
	Traffic condition and Road safety measures
	Detour (alternative) roads

5.2.2 Pre-construction Meeting

The pre-construction meeting is the first official site meeting between the contractor and the Engineer/ PD, prior to the construction. The Engineer will be the organizer of pre-construction meeting for foreign-funded projects and PD for locally- funded projects. The participants of the meeting will be the same as the joint site inspection.

The objectives of a pre-construction meeting are to discuss the key issues and confirm the procedures, methods, schedule, organization, documents, etc., required for the project implementation. The meeting organizer should invite the participants well in advance and request to submit or prepare required back-up data and information before or at the meeting.

The expected agenda of meeting will be as follows:

Table 5.2-3 Items to be discussed at Pre-construction Meeting

Expected Agenda	Items for Discussion
(1) Objectives and key issues for project implementation	• Project objectives • Scope of works • Key issues
(2) Project organization and staff assignment	• Project organization and staff assignment • Organization and staff assignment of the Contractor • Communication network • Staff Mobilization schedule
(3) Work schedule and monitoring	• Bar Chart/S-Curve and Project Evaluation Review Technique (PERT)/ Critical Path Method (CPM) • Payment (disbursement) schedule • Equipment and material schedule • Weekly and monthly schedule and progress monitoring • Work and inspection request and approval
(4) Work procedures	• Work days and working hours • Instruction and recording • Measurement and Billing preparation • Planned material sources
(5) Material sources and borrow areas	• Quality tests and approval
(6) Quality Control	• Engineer's laboratory • Minimum and testing equipment • Accredited Materials Engineer
(7) Base camp, plant yard and waste areas	• Planned location of contractor's office • Engineer's office • Plant yards • Borrow and waste (disposal) sites
(8) Preparatory Works	• Land arrangement for the above facilities • Supply of contract drawings • Control points and as-staked survey
(9) Existing road maintenance and traffic control	• Shop drawings preparation and approval • Maintenance plan
(10) ECC requirements and EMP	• Re-routing plan (if necessary) • Environmental Management Plan • Current status of ROW, including land acquisition and resettlement)
(11) Facilities of the Engineer	• Engineer's facility (office, quarter, laboratory, survey aid, office supply)
(12) Reporting	• Monthly Progress Report Preparation • Monthly Materials Quality Control Report preparation
(13) Others	• Weekly and monthly project meetings • Coordination meetings with Regional Offices • Project Bill Board • Labor Welfare and Safety • Utility Relocation

Minutes of the Meeting should be taken including recording of action plans as agreed upon during the meeting.

5.2.3 Mobilization

(1) Mobilization and Demobilization

The Contractor shall mobilize and demobilize the required minimum plants, equipment, temporary facilities and personnel for implementation of the project as listed in the Contract Documents. The work and activities under the Mobilization and Demobilization shall include the following:

- The purchase and/or rental of all land required for the Contractor's base camps and construction activities. The location of base camps shall be subject to the approval of the Engineer. The Contractor shall provide sufficient area required for scheduled operations of rock/gravel crushing plant, asphalt and concrete production plants, and other requirements for the completion of the Works;
- Mobilization and installation of construction plant from existing locations or port of unloading to the project sites;
- The construction and maintenance of the Contractor's base camps including offices, living quarters, workshops, stores, etc.;
- Mobilization and demobilization of the Contractor's Equipment and work forces; and
- Demobilization of the sites occupied by the Contractor at the end of the Contract including the removal of all installations, construction plants and equipment.

(2) Equipment

It is the responsibility of the Contractor to provide all the equipment required in the execution, completion and remedy of the Works. The major essential plant/ equipment as required are listed in the Bid / the Contract. His compliance, however, in furnishing the equipment listed as minimum essential equipment in no way releases him of his responsibility of providing additional equipment required for the execution and completion of the Works within the contract time.

Only the equipment and plants appropriate to produce the required quality of work and materials shall be permitted to operate on the project. The contractor shall provide appropriate equipment and plants to meet the construction requirements, and when ordered by the Engineer shall remove unsuitable equipment from the work or stop the operation.

The Contractor shall not demobilize and/or use the mobilized equipment for other projects without prior written approval of the Engineer / PD.

5.3 Progress Management

5.3.1 General

(1) Objectives of Progress Management

The Project Management is defined in this Manual as to accomplish the project objectives (or goals) as originally scoped and planned. The primary challenge of project management is to achieve all of the goals of the project while adhering to the three elements defined as time, cost and quality. The Progress

Management is one of the three project management elements and its mission is to complete the projects/programs within the planned time (contract period).

The Engineer / PD should establish milestones to complete the project/program and monitor progress and achievement. The Contractor has prime responsibility to keep the work in progress. The acceptance of the program by the Engineer shall not relieve the Contractor of any of his duties and responsibilities under the Contract. The Engineer / PD shall monitor and assess achievement of the detailed time program (either original or revised) submitted by the Contractor and approved by the Engineer / PD.

(2) Milestones

A milestone is the end of a stage that marks the completion of a work package or phase, typically marked by a high-level event such as completion of critical works (key deliverable or segment) and taking-over of project. Segmentation of the project schedule into intervals allows earlier indication of schedule problems and a better view into the activities whose completion is critical to the project timeline.

Milestones can add significant value to project scheduling. When combined with a sophisticated scheduling methodology such as Program Evaluation and Review Technique (PERT) or the Critical Path Method (CPM), milestones allow project management to much more accurately determine whether or not the project is on schedule.

Milestones are frequently used to monitor progress, but there are limitations to their effectiveness. They usually show progress only on the critical path, and ignore non- critical activities. It is not common for resources to be moved from non-critical activities to critical activities to ensure that milestones are met. This gives the impression that the project is on schedule when actually some activities are being neglected.

Milestones need to be identified at several levels, depending upon what is important at particular level of management. The higher level of management requires more attention to the overall picture and a few milestones. While at site, more specific project level milestones are required to monitor project schedule and accomplishment.

Milestones often set up at the project level will be as follows:

- Mobilization of critical plant and commencement of production (crusher plant, PCC and AC batching plants);
- Commencement and completion of critical works (PCC Pavement, AC Pavement, earthworks, subbase and base);
- Completion of critical structures (bridges, river scouring protection works, etc.);
- Substantial completion of the project; and
- Final taking over of the project.

(3) Work Program

The Contractor shall, within **twenty-eight (28)** calendar days for foreign assisted projects, submit to the employer for approval complete documentary requirements to include work program that contains the following:

(a) Construction Schedule

- PERT/CPM network diagram of all activities involved in the execution and completion of the Works within the Contract Time, identifying the critical path.
- A time-sequenced Bar Chart based on the PERT/CPM diagram with the progress S-curve, indicating the monthly progress estimates of accomplishments in every major pay item in terms of percentages or quantities.

(b) Construction Methods which shall embody a narrative description of the order of procedure in which the Contractor proposes to carry out each main items of work.

(c) Contractor's Organizational Chart:

- Structural Chart showing the hierarchical order of personnel the Contractor shall assign for superintendence on the execution of the Works.
- Functional Chart showing the respective duties, roles, etc., of every component of the chart.

(d) Manpower Schedule showing the manpower proposed for the execution of the Works.

(e) Equipment Schedule showing the equipment for the execution of the Works.

(f) A Cash Flow and Payment Schedule showing a cash flow estimate, in monthly and quarterly periods, of all payments the Contractor will be entitled to receive under the Contract.

The Engineer / PD shall have the right to reject any part of the original programs submitted with the Bid even if the Bid is accepted and to require the Contractor to revise the original programs to the satisfaction of the Engineer prior to the award and signing of the Contract Agreement. The Contractor shall not commence execution of the Works prior to the acceptance (not receipt) of the Programs.

The Construction Schedule shall be revised and re-submitted at intervals as required by the Engineer / PD. In addition, the Contractor shall immediately advise the Engineer any proposed changes in the Construction Schedule. Revised changes in the Construction Schedule shall show construction operations for each item of work from the time of Notice to Proceed to the anticipated completion date, thereby indicating the periods where works were delayed as well as estimated future periods of construction operations to negate the delay. Each revised Construction Schedule shall be related to the Construction Schedule accepted for Award of Contract and shall show months ahead or behind the schedule for both completed activities and future activities.

(a) Bar Chart / S-Curve/Banana Curve

A bar chart is a simple and the most familiar tool. It can compare two values, work schedule and progress, visually.

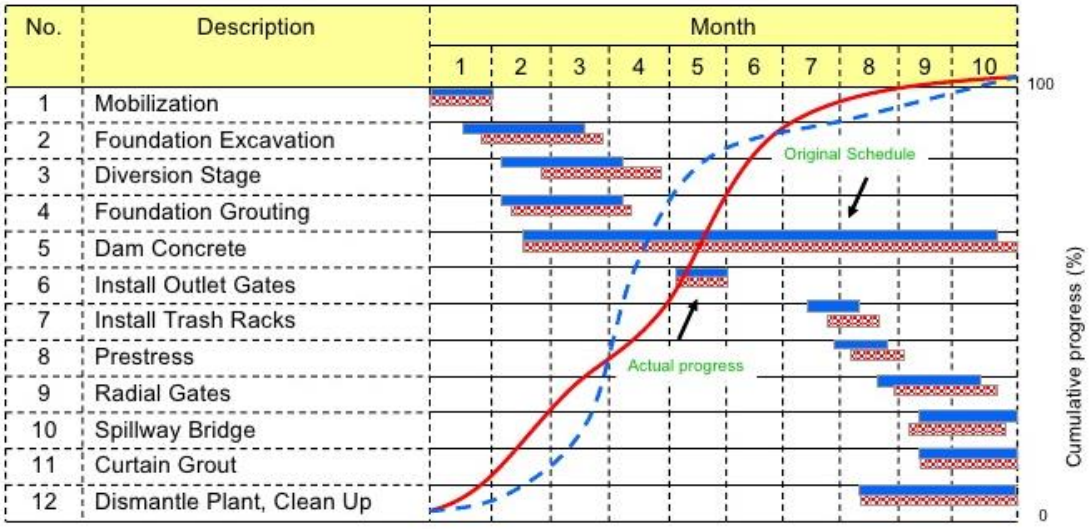


Figure 5.3-1 Sample of Bar-chart and S-Curve

As shown in the above, the S-Curve is a cumulative flow diagram of progress that plots completed work against time. The S-Curve shows a slow start at first, after which it accelerates and then ends by slowing down again toward the completion. However, it does not give how much of each work is in progress and whether there are any bottlenecks in the workflow.

A combination of the Bar Chart and S-curve will give better ideas where project has progress problems, so called "slippage". The Engineer / PD need to identify why work does not progress as planned. What additional resources are required to enhance the progress; equipment, materials, manpower, finance and/or management.

Two progress accumulation lines, so-called "Banana Curve", are plotted at above and below the S-Curve. If the Contractor's progress is above the S-Curve, so called ahead schedule", the Contractor is able to finish the project "on time." However, as long as the Contractor is above the bottom one, they are still considered "on schedule" though "behind schedule" and might be able to complete the project on time if appropriate measures are taken. However, if the Contractor's performance is below the S-Curve, he must improve his performance to be able to finish on time. The Engineer should advise the Contractor to look into his slippage and to take necessary actions at an earliest stage.

(b) PERT/CPM

Originally CPM was developed as "activity-oriented", by breaking down the project into activities which needs to be managed. PERT was "event-oriented" and it viewed the project in terms of milestones which has to take place.

CPM includes a method for analyzing the effects on cost of varying project time, including the ability to handle manpower and equipment resources. PERT does not extend beyond time and does not include resources.

However, both methods have been eventually integrated to be PERT/CPM and used worldwide. The Contractors are obliged to submit a PERT/CPM program as a part of the contract. PERT/CPM is able to control progress based on Critical Path. Especially it is useful in determining what works are intensively monitored to complete the project on time. CPM is also required for assessment of time extension claim as only the works on the Critical Path is entitled for time extension.

(4) Straight Line Diagram

The straight-line diagram is a visual monitoring method showing the work plan and accomplishment on a diagram. It will give information on where work is planned, ongoing and completed. The straight-line diagram is updated every month in coincidence of preparation of monthly report.

(5) Value Engineering

The Contractor may, at any time, submit to the Engineer/PD a written proposal which (in the Contractor's opinion) will, if adopted, i) accelerate completion, ii) reduce the cost to the Employer in executing, maintaining or operating the Works, iii) improve the efficiency or value to the Employer of the completed Works, or iv) otherwise be of benefit to the Employer. The proposal shall be prepared at the cost of the Contractor, if a proposal, which is approved by the Engineer, includes a change in the design of part of the Permanent Works.

5.3.2 Work Schedule and Progress Monitoring Meetings

(1) Weekly Schedule and Progress Meeting

The ground rules of the project implementation should be laid down at the pre- construction meeting. A continued effort is required by the Engineer / PD to ensure that the project keeps running on course as smoothly as possible. One way of maintaining project management is through routine site meetings at weekly and monthly basis. The objectives of the weekly meetings are:

- Weekly basis monitoring on work schedule and progress;
- Discussion on various problems and issues to draw action plans; and
- Guidance on project implementation and/or technical clarification.

The Engineer / PD shall be the organizer of weekly meetings for foreign-funded and locally funded projects. The invitation of meeting should include a) agenda, b) the minutes of the last meeting and c) any data/material that requires discussion in addition to date, time and venue.

The agenda of weekly meeting should include comments/corrections on the last minutes of meeting, monitoring on action plans, schedule and progress on work progress, material production and mobilization, staff and equipment mobilization, quality control, financial issues, problems and others.

The secretary of the meeting will be either from the Implementing Office, Consultant, or the Contractor.

The minutes should contain the points of interest and importance only. The minutes of meetings should clearly state:

- Time and place of meeting;
- Names of participants and who they represent;
- Issues raised / by whom;
- What decisions were taken; and
- Actions to be taken by whom and when.

Minutes of Meetings are formal records and must therefore be signed by the representative of concerned entities; the Employer, the Engineer and the Contractor.

(2) Monthly Schedule and Progress Meeting

The objectives of the monthly meetings are:

- Monthly basis monitoring on work schedule, progress and cost;
- Both physical and financial progresses are measured based on the joint inspection one day before the meeting day or cut-off date to report to the Regional and Central Offices; and
- Plant and equipment conditions and other data required for monthly report.

The way of organizing, key participants and procedure of recording will be same as weekly meetings, but more focus is given on the monthly work progress assessment. One of the weekly meetings at the end of each month can be substituted with the monthly meeting.

5.3.3 Delay of Work and Action Plans

(1) Delay of Work

The Contractor shall promptly give notice to the Engineer / PD of specific probable future events or circumstances which may adversely affect the works, increase the Contract Price or delay the Works.

The Engineer should give notice to the Contractor to submit a revised program if;

- actual progress is too slow to be completed within the Time of Completion, and/or
- progress has fallen (or will fall) behind the current program/schedule.

The revised program and supporting report shall include the revised methods which the Contractor proposes to adopt to increase work progress and complete within the Time of Completion. The Contractor shall adopt these revised methods, which may require the increased working hours and/or mobilization of additional resources including manpower, equipment and/or goods at the risk and cost of the Contractor.

(2) Slow Progress

When there is slow progress of Works at a given point of time, the Contractor is to be instructed to submit revised program and supporting report describing the revised methods which the Contractor proposes to adopt in order to expedite progress and complete within the Time for Completion. Following table shows the example of action to be taken depending on the rate of delay in progress.

Table 5.3-1 Sample of Dealy Stage and Recommended Action

Stage	Condition	Required Actions
a. Early Earning Stage	For negative slippage of five (5%) percent	The Contractor shall be given a warning and submit a "catch-up" program to eliminate the negative slippage. The Engineer shall provide close supervision and monitoring.
b. ICU Stage	For negative slippage of ten (10%) percent	The Contractor shall be given a second warning and submit detailed action program on two weeks basis to accelerate the execution of the Works. Furthermore, the Contractor shall be instructed to mobilize the additional inputs. The Engineer shall exercise closer supervision at every other week.
c. Make or Break Stage	For negative slippage of fifteen (15%) percent	The Contractor shall be issued a final warning. He shall provide a more detailed program of activities with weekly physical targets together with additional inputs. The Engineer shall intensity and evaluate the project performance at least once a week.
d. Terminal Stage	For negative slippage beyond fifteen (15%) percent	The Employer shall initiate termination/rescission of the Contract or take-over of the remaining Works by administration or assignment to another Contractor/appropriate agency.

The Engineer / PD shall instruct the Contractor to submit a "catch-up" program at the early warning stage. The catch-up program must be supported by additional working hours (Sunday work, holiday work, night work, two shift works, etc), equipment and cash flows. The Engineer / PD shall assess the Contractor's proposal and provide further advice and instructions to assure that such program actually works well. The Engineer / PD need to establish their inspection and quality control system for the catch-up program. Any extra cost for construction supervision, including overtime and holiday work allowances shall be charged to the Contractor.

(3) Liquidated Damages

If the Contractor fails to comply with Time for Completion, the Contractor shall be subject to notice to pay delay damages (Liquidated Damages) to the Employer for this default. These damages shall not relieve the Contractor from his obligation to complete the Works, or from any other duties, obligations or responsibilities which he may have under the Contract.

The Contractor shall pay liquidated damages to the Employer at the rate per day (e.g.0.1% per day) stated in the Special Conditions of Contract for each day that the Completion Date is later than the Intended Completion Date. The total amount of liquidated damages shall not exceed the amount defined in the SCC. The Employer may deduct liquidated damages from payments due to the Contractor. Once the cumulative amount of liquidated damages reaches ten percent (e.g. 10%) of the amount of this Contract, the Employer shall terminate this Contract, without prejudice to other courses of action and remedies open to it.

5.3.4 Suspension of Works

The Employer shall have the authority to suspend the work wholly or partly by written order for such period as may be deemed necessary, due to force majeure or any fortuitous events or for failure on the part of the Contractor to correct bad conditions which are unsafe for workers or for the general public, to carry out valid orders given by the Employer or to perform any provisions of the contract, or due to adjustment of plans to suit field conditions as found necessary during construction. The Contractor shall immediately comply with such order to suspend the work wholly or partly due to the followings:

- There exist right-of-way problems which prohibit the Contractor from performing work in accordance with the approved construction schedule;
- Requisite construction plans which must be owner-furnished are not issued to the contractor precluding any work called for by such plans;
- There is failure on the part of the Employer to deliver government-furnished materials and equipment as stipulated in the contract; and
- Delay in the payment of Contractor's claim for progress billing beyond forty-five (45) calendar days from the time the Contractor's claim has been certified to by Employer's Representative.

In case of total suspension, or suspension of activities along the critical path, which is not due to any fault of the Contractor, the elapsed time between the effective order of suspending operation and the order to resume work shall be allowed the Contractor by adjusting the contract time accordingly.

5.3.5 Extension of Time for Completion

Contract Time Extension is the allowable period for the Contractor to complete the Works in addition to the original Completion Date stated in the Contract. The Contractor shall be entitled subject to Contractor's Claims, to an extension of the Time for Completion if that completion is or will be delayed by any of the following causes:

(a) A variation or other substantial change in the quantity of an item of work included in the Contract;
(b) A cause of delay giving an entitlement to extension of time;
(c) Exceptionally adverse climatic conditions;
(d) Unforeseeable shortages in the availability of personnel or Goods caused by epidemic or governmental actions; and
(e) Any delay, impediment or prevention caused by or attributable to the Employer, the Employer's Personnel, or the Employer's other contractors.

Delays caused by authorities will be applied in case of the following conditions:

(a) The Contractor has diligently followed the procedures laid down by the relevant legally constituted public authorities in the Country;
(b) These authorities delay or disrupt the Contractor's work; and
(c) The delay or disruption was unforeseeable.

If the Contractor considers himself to be entitled to an extension of the Time for Completion, the

Contractor shall give notice to the Engineer in accordance with the Contractor's Claims. When determining each extension of time under Contractor's Claims, the Engineer shall review previous determinations and may increase, but shall not decrease, the total extension of time.

5.3.6 Termination of Contract

(1) Termination for Default of Contractor

The Employer shall terminate the Contract when the Contractor;

- abandons the contract Works, refuses or fails to comply with a valid instruction of the Engineer / PD or fails to proceed expeditiously and without delay despite a written notice by the Engineer/ PD;
- does not actually have on the project Site the minimum essential equipment listed on the Bid necessary to prosecute the Works in accordance with the approved Program of Work and equipment deployment schedule as required for the project;
- does not execute the Works in accordance with the Contract or persistently or flagrantly neglects to carry out its obligations under the Contract;
- neglects or refuses to remove materials or to perform a new work that has been rejected as defective or unsuitable; and
- sub-lets any part of this Contract without required agreement.

All materials on the Site, Plant, Equipment, and Works shall be deemed to be the property of the Employer if the Contract is rescinded because of the Contractor's default.

(2) Termination for Default of the Employer

The Contractor may terminate the Contract with the Employer if the Employer fails to make payment within agreed period, and to perform their responsibility in accordance with the Contact.

(3) Termination for Other Causes

The Employer may terminate the Contract, in whole or in part, at any time for its convenience. The Employer or the Contractor may terminate this Contract if the other party causes a fundamental breach of Contract, including:

(a) The Contractor stops work for twenty-eight (28) days when no stoppage of work is shown on the Program of Work and the stoppage has not been authorized by the Engineer / PD;

(b) The Engineer/ PD instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within twenty-eight (28) days;

(c) The Employer shall terminate this Contract if the Contractor is declared bankrupt or insolvent as determined with finality by a court of competent jurisdiction;

(d) The Engineer / PD gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined;

(e) The Contractor does not maintain a Security, which is required;

(f) The Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid; and

(g) In case it is determined prima facie by the Employer that the Contractor has engaged, before or during the implementation of the contract, in unlawful deeds and behaviors relative to contract acquisition and implementation.

5.4 Cost Management

5.4.1 General

(1) Cost Management

The Project Cost Management is defined in this Guideline as "the management process and efforts of the Engineer / PD for increasing the values (quality) of the works and completion of the project within the budget". The cost management, as one of the key elements for the project management, is a series of activities through planning, detailed engineering, bidding and implementation.

The cost management is non-compromised routine work carried out on a daily, weekly and monthly basis with the cooperation of all project staff. The Engineer / PD should carry out the following activities:

- Control or see to it that works are executed in accordance with the plans and specifications;
- Check interim (monthly) statement on financial aspects (budget);
- Monitor scope of work, quantities and cost which may increase by item, especially for major pay items;
- Take appropriate precautions and actions to avoid cost overrun;
- Conduct value engineering techniques to reduce the cost; and
- Evaluate Contractor's Claims at earliest time and identify effect on the project cost.

(2) Type of Payment and Payment Condition

The types of payment for the Project funded by International Organization are comprised of:

- Advance Payment;
- Monthly Progress Payment;
- Final Payment;
- Release of Retention; and
- Others.

The Contractor shall submit statement of payment in accordance with the Contract Conditions (GCC and SCC). The Employer shall verify and pay to the Contractor within the specified time in the Contract Data (Bid Data Sheet).

Table 5.4-1 Payment Condition to be stipulated in the Contracto

FIDIC GCC (MDG Edition)	
Clause	Title
14	Contract Price and Payment
14.2	Advance Payment
14.3	Application for Interim Payment
14.4	Schedule of Payment
14.5	Plant and Materials for the Works
14.6	Issue of Interim Payment Certificate
14.7	Payment
14.8	Delayed Payment
14.9	Payment of Retention Money
14.10	Statement of Completion
14.11	Application for Final Payment Certificate
14.12	Discharge
14.13	Issue of Final Payment Certificate
14.14	Cessation of Employer's Liability
14.15	Currencies of Payment

(3) Financing Schedule

The Engineer / PD should request the Contractor to submit payment schedule up to the end of project at quarterly basis for disbursement estimate by funding source and currency. The payment schedule shall correspond to the work schedule and considering payment for advance mobilization and retention deduction. The financing schedule should be reviewed at every quarter taking the latest progress into account.

5.4.2 Advance Payment

At the request of the Contractor, the Employer will make an interest-free advance mobilization payment and cash flow support to the Contractor in a lump sum amount not exceeding 10% to 20 % of the total contract price, or as stipulated in Part II (or SCC) of Conditions of Contract, for mobilization and cash flow support.

The Engineer / PD will issue an Interim Payment Certificate for advance payment or its first installment after receiving:

- Performance Security;
- A bank guarantee or surety bond, acceptable to the Employer, in amounts and currencies equal to the advance payment; and
- Such guarantee remains effective until the advance mobilization loan has been completely repaid by the Contractor.

5.4.3 Interim Payment (Monthly Progress Payment)

(1) Payment Procedures and Documents

The Contractor shall submit a monthly statement and the Engineer / PD shall verify and certify it for processing of payment by funding entity (MOC and/or Banks). There are some differences as to payment on plant and materials on site as summarized in the followings;

Table 5.4-2 Procedure of Interim Payment

Foreign-funded Projects	Locally-funded Projects
(a) The Contractor shall submit each month a Statement to the Engineer showing the amounts to be entitled with supporting documents. (b) The Statement shall include the estimated value of the Works executed, addition and deduction, Plant and Materials on site if stipulated in the SCC. (c) The Engineer shall verify and submit to the Employer for payment within **28** days after receiving. (d) The payment shall be made within **56** days after receipt by the Engineer. (e) In the event of the failure of the Employer to make payment within the said period, the Employer needs to pay interest to the Contractor.	(a) The payment shall be made based on Acceptance Certificate (b) The Payment shall be made within 1week after receipt of Invoice. Reference: Guideline for Works with Contractor (MOC 2016)

(2) Materials on Site

Materials delivered on the site but not completely put in place could be paid for payment, as stipulated so in the SCC. This is to help the financial situation of the Contractor to recover a part of his investment on the materials procured and delivered by him on site. The partial payment for the following materials might be authorized in the SCC.

- Asphalt
- Reinforcing Steel
- Structural Steel
- Piles (concrete, steel or sheet piles)
- Pre-stressed Pre-cast concrete products
- Cement

The Contractor should apply in writing for such partial payment and the Employer approves the above request following its inspection, evaluation and recommendation of the Engineer / PD. These materials should have passed satisfactorily the required quality control tests. Partial payment to the Contractor shall be up to a maximum of seventy percent (70%) of the invoiced cost of materials or seventy percent (70%) of the Bid price of the Work Item which these materials shall be incorporated whichever is lower. The quantities of these materials shall not exceed the requirements of the Contract. The Contractor shall post an irrevocable letter of credit in favor of the Employer or bank guarantee from a reputable bank

acceptable to the Employer in the amount equivalent to the partial payment applied for. The partial payment shall be fully deducted from the Contractor's next Interim Payment Certificate without prejudice to his submitting another written request for partial payment with similar conditions aforementioned above.

(3) Disbursement Estimate and Payment Monitoring

The Engineer/ PD should make disbursement schedule for the whole contract period. The disbursement should include advance payment, progress payment and release of retention. The disbursement schedule should be reviewed at every quarter.

Both the Engineer / PD and the Contractor should monitor payment procedures progress in order that the Contractor can receive payment in the specified time in the Contract. The delay of payment will cause cash flow problems and delay of works, especially for small and medium contractors. The Contractor shall be entitled to receive financial charge (interest) on the amount unpaid during the period of delay in accordance with the contract provision.

5.4.4 Final Payment

The Contractor shall request the Employer's Representative to issue a Certificate of Completion of the Works. The Employer shall take over the Site and the Works within seven (7) days from the date the Employer's Representative issues a Certificate of Completion.

Within 84 days after receiving the Taking-Over Certificate for the Works, the Contractor shall submit to the Engineer a Statement at completion with supporting documents, showing:

(a) The value of all work done in accordance with the Contract up to the date stated in the Taking-Over Certificate for the Works;
(b) Any further sums which the Contractor considers to be due; and
(c) An estimate of any other amounts which the Contractor considers will become due to him under the Contract.

The Engineer shall then certify it and the Contractor shall submit to the Engineer a draft final statement with supporting documents.

If the Engineer disagrees with or cannot verify any part of the draft final statement, the Contractor shall submit such further information as the Engineer may reasonably require within 28 days from receipt of said draft and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed. This agreed statement is referred to in these Conditions as the "Final Statement".

5.4.5 Retention Money

Progress payments are subject to retention of ten percent (e.g. 10%), unless otherwise specified in the SCC, referred to as the "retention money." Such retention shall be based on the total amount due to the Contractor prior to any deduction and shall be retained from every progress payment until fifty

percent (50%) of the value of Works, as determined by the Employer, are completed. If, after fifty percent (50%) completion, the Work is satisfactorily done and on schedule, no additional retention shall be made; otherwise, the ten percent (10%) retention shall be imposed.

The total "retention money" shall be due for release upon final acceptance of the Works. The Contractor may, however, request the substitution of the retention money for each progress billing with irrevocable standby letters of credit from a commercial bank, bank guarantees or surety bonds callable on demand, of amounts equivalent to the retention money substituted for and acceptable to the Employer, provided that the project is on schedule and is satisfactorily undertaken by the Contractor. Otherwise, the percentage retained shall be made.

On completion of the whole Works, the Contractor may substitute retention money with an "on demand" Bank guarantee in a form acceptable to the Employer.

5.4.6 Price Adjustments

"Adjustments for Changes in Cost" of the GCC shall be applied, if provided in the Contract, with its details as indicated in the SCC. The amounts payable to the Contractor shall be adjusted per rise or fall in the cost of labor, Goods and other inputs to the Works, by the addition or deduction of the amounts determined by the formulae prescribed in the Contract.

The formulae in the FIDIC MDB GCC shall be of the following general type:

$$Pn = a + b\frac{Ln}{Lo} + c\frac{En}{Eo} + d\frac{Mn}{Mo} + \cdots\cdots$$

Where;

"Pn" is the adjustment multiplier to be applied to the estimated contract value in the relevant currency of the work carried out in period "n", this period being a month unless otherwise stated in the SCC.

"a" is a fixed coefficient, stated in the relevant table of adjustment data, representing the non-adjustable portion in contractual payments.

"b", "c", "d", … are coefficients representing the estimated proportion of each cost element related to the execution of the Works, as stated in the relevant table of adjustment data; such tabulated cost elements may be indicative of resources such as labor, equipment and materials.

"Ln", "En", "Mn", … are the current cost indices or reference prices for period "n", expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the date 49 days prior to the last day of the period (to which the particular Payment Certificate relates).

"Lo", "Eo", "Mo", … are the base cost indices or reference prices, expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the Base Date.

If the Contractor fails to complete the Works within the Time for Completion, adjustment of prices thereafter shall be made using either (i) each index or price applicable on the date 49 days prior to the

expiry of the Time for Completion of the Works, or (ii) the current index or price: whichever is more favorable to the Employer.

The Contract Price shall be adjusted to take account of any increase or decrease in Cost resulting from a change in the Laws of the Country (including the introduction of new Laws and the repeal or modification of existing Laws) or in the judicial or official governmental interpretation of such Laws, made after the Base Date, which affect the Contractor in the performance of obligations under the Contract.

The Employer shall adjust the Contract Price if taxes, duties, and other levies are changed within the period between twenty-eight (28) days before the submission of Bids for the Contract and the date of the last Completion certificate. The adjustment shall be the change in the amount of tax payable by the Contractor, provided such changes are not already reflected in the Contract Price.

5.4.7 Provisional Sum and Daywork

(1) Provisional Sum

Provisional Sum means a sum included in the Contract and so designated in the BOQ for the execution of any part of the Works or for the supply of goods, materials, plant or services. Each Provisional Sum shall only be used, in whole or in part, in accordance with the Engineer's instructions and the Contract Price shall be adjusted accordingly. The total sum paid to the Contractor shall include only such amounts, for the work, supplies or services to which the Provisional Sum relates, as the Engineer shall have instructed.

Provisional Sum may be used to facilitate budgetary approval of Variation Orders without need to seek additional budget. Provisional Sum shall not exceed 3% of the project cost in general. The Provisional Sum may be also used for the execution of additional works beyond the limit of Dayworks.

Works executed under the Provisional Sum shall be valued at the rates or prices set out at the BOQ or as determined by the Engineer. The Contractor shall submit, when required by the Engineer, produce quotations, invoices, vouchers and accounts or receipts in substantiation.

(2) Daywork

For work of a minor or incidental nature, the Engineer/ PD may instruct that a Variation shall be executed on a daywork basis. The work shall then be valued in accordance with the Daywork Schedule (unit price of labor by classification, material and equipment) included in the Contract.

Before ordering Goods for the work, the Contractor shall submit quotations to the Engineer. When applying for payment, the Contractor shall submit invoices, vouchers and accounts or receipts for any Goods.

The Contractor shall deliver each day to the Engineer / PD accurate statements in duplicate which shall include the following details of the resources used in executing the previous day's work:

(a) The names, occupations and time of Contractor's personnel;

(b) The identification, type and time of Contractor's equipment and temporary Works; and

(c) The quantities and types of plant and materials used.

One copy of each statement will be signed by the Engineer and returned to the Contractor. The Contractor shall then submit priced statements of these resources to the Engineer, prior to their inclusion in the next Statement.

Daywork shall not be executed without written order of the Engineer / PD. The Contractor will be paid for Daywork at the rates set down in the Schedule. All profits, overheads and other costs must be included in the rates as incidental to the performance of daywork.

5.5 Quantity Management

5.5.1 Objectives

The quantity management is one of the most important elements for the project management as it directly relates with the project cost. The key reference documents to be referred for the quantity control are GCC, SCC, Specifications, BOQ and Drawings.

The Engineer / PD in cooperation with other staff (Quantity Surveyor and Inspectors) should work to:

- Ensure that the methods used in the measurement of quantities meet the contract requirements and Specifications;
- Verify that the correct quantities of completed work are reported for progress payments. Note that large quantity is not missing in the billings;
- Ensure that a new overall estimate is made for each progress estimate. If computed monthly work quantities are merely added on the previous period, it may result in cumulative errors;
- Check the quantity calculation back-up data submitted by the Contractor for monthly billings. Compare with the quantity estimate data of the detailed design stage;
- Ensure double payment will be avoided by checking field measurement notes (logbook) and drawings;
- Monitor the planned quantity and work progress. If there is any significant difference, instruct the Contractor to identify the causes;
- Where appropriate, do additional checking to assure the sufficiency of the validation. Do not wait until the final stage of construction as correction of over-quantity, especially for major items, would become impossible; and
- At the final statement stage, review all final quantities in detail on all items.
- It must be noted that no payment shall be made to any defective work until the Contractor meets the Specifications, either by removal, replacement or reconstruction and accepted by the Engineer/PD.

5.5.2 Bill of Quantities

The Bill of Quantities (BOQ) provides information on the quantities of Works to be performed by the Contractor and a priced BOQ for use in the periodic valuation of Works executed for payment. Works are itemized in the BOQ in detail to identify the different classes of Works, or between Works of the same nature carried out in different locations or in other circumstances/conditions which may lead to different considerations of cost.

- The BOQ contains items of work for the construction, installation, testing, and commissioning of work to be done by the Contractor.
- The BOQ is used to calculate the Contract Price. The Contractor is paid for the quantity of the work at the rate in the BOQ for each item.
- If the final quantity of any work differs from the quantity in the BOQ for the particular item and is not more than twenty five percent (25%) of the original quantity, provided the aggregate changes for all items do not exceed ten percent (10%) of the Contract price, the Engineer/PD shall make the necessary adjustments to allow the changes subject to applicable laws, rules, and regulations.
- The Contractor must provide the Engineer/PD with a detailed cost breakdown of any rate in the BOQ.

5.5.3 As-staked Plan and Shop-Drawings

(1) As-staked Plan

The Contractor shall prepare and submit As-Staked Plans for the entire project for review and approval of the Engineer/PD based on the As-staked survey at the beginning of the project implementation. The As-Staked Plans and the corresponding back-up quantity calculations must be completed within a reasonable period from the commencement of the project. The Plans shall indicate major modifications, including change in road alignment, change in type or main components of structures, introduction of new work items, etc.

The Contractor shall promptly notify the Engineer/PD of any error, omission, fault or other defects in the design and Specifications of the Works which he discovers when reviewing the Contract or executing the Works. If there is any substantial increase in quantity which resulted to a big cost increase as a result of the As-Staked survey, the Engineer/PD must check and identify the reasons. The Engineer /PD should find some method for implementation of the project within the budget approved by authorized MOC Official. The value engineering may be applicable for managing the cost within the budget.

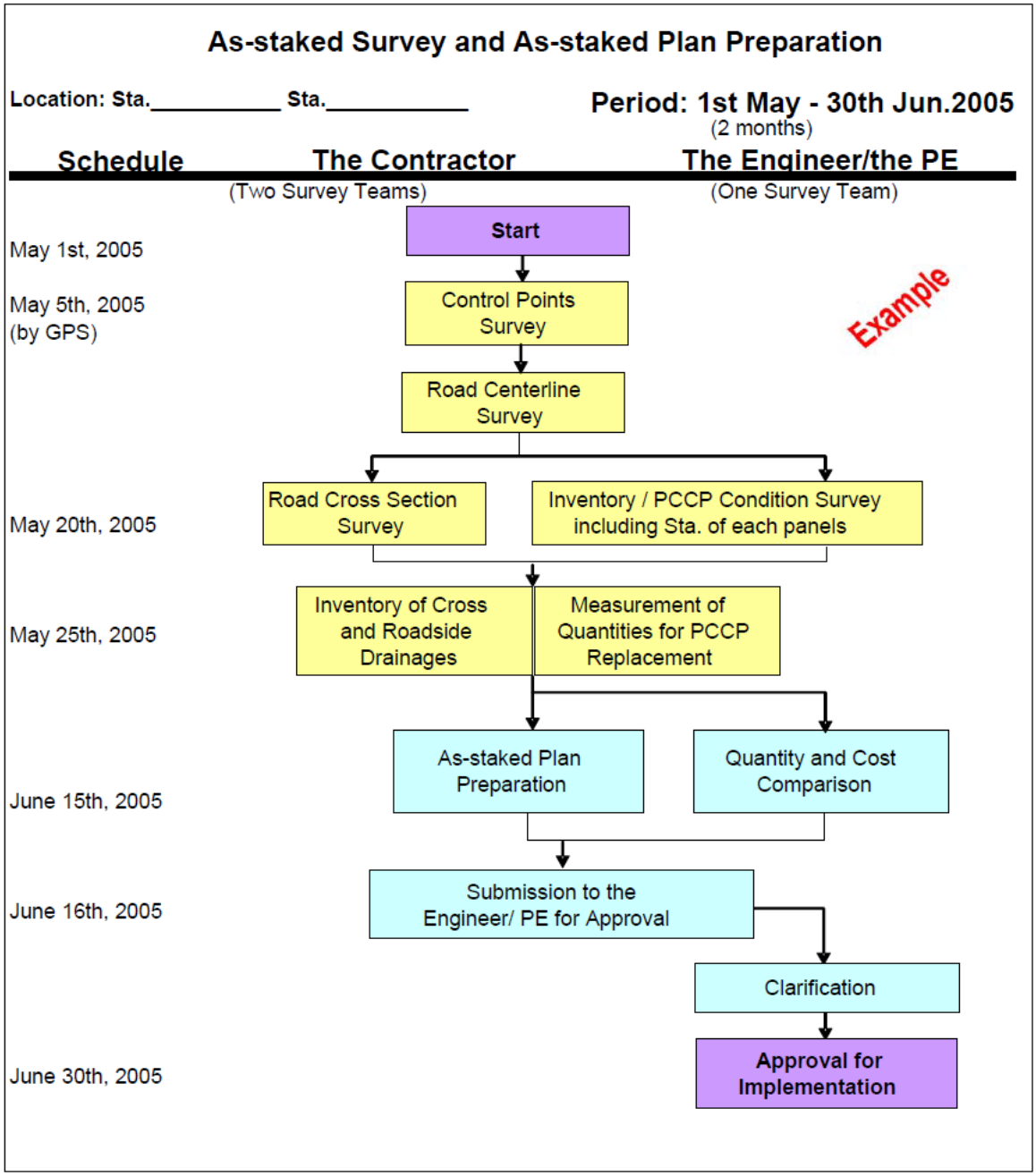


Figure 5.5-1 Flow of As-staked Survey and As-staked Plan Preparation

(2) Shop-Drawings

The Contractor shall submit to the Engineer/PD Shop Drawings for review and approval. The Shop Drawings shall be deemed to include design drawings, fabrication drawings, catalogue, brochures, illustrations, materials lists, design calculations, reference standards and performance data which may be required by the Specifications for the proper execution of the Work.

The Contractor shall submit Shop Drawings to the Engineer/PD in sufficient lead time to prevent delays in delivery of materials or in the progress or completion of the work. The Shop Drawings shall be completed in all respects and shall show clear compliance with the Specifications. The Engineer/PD will review submitted Shop Drawings within a reasonable time and return them with comments. The

Contractor shall resubmit the revised Shop Drawings, if required by the Engineer/PD, for further review and approval. Review and approval of the Shop Drawings by the Engineer/PD does not relieve the Contractor of his responsibility for errors, omissions and non-compliance with the contract requirements, even though the Work is done in accordance with such shop drawings.

5.5.4 Activities of Quantity Control

(1) Measurement and Evaluation

The Works shall be measured and valued for payment. The Contractor shall show in application of his statement for Interim Payment and Completion the quantities and other particulars detailing the amounts which he considers to be entitled under the Contract.

Whenever the Engineer/PD require any part of the Works to be measured, reasonable notice shall be given to the Contractor who shall:

(a) Promptly either attend or send another qualified representative to assist the Engineer in making the measurement; and

(b) Supply any particulars requested by the Engineer.

If the Contractor fails to attend or send a representative, the measurement made by the Engineer/PD shall be accepted as correct.

Except as otherwise stated in the Contract and notwithstanding local practice:

(a) Measurement shall be made of the net actual quantity of each item of the Permanent Works in accordance with the Specifications; and

(b) The method of measurement shall be in accordance with the Bill of Quantities or other applicable Schedules.

Quantity Control should also consider any "Variations" ordered by the Engineer /PD during the project implementation for quantity monitoring, including:

- increase or decrease the quantity of any work included in the Contract,
- omit any such work;
- change the character or quality or kind of any such work;
- change the levels, lines, position and dimensions of any part of the Works;
- execute additional work of any kind necessary for the completion of the Works; and
- change any specified sequence or timing of construction of any part of the Works.

The Engineer /PD shall evaluate each item of work, applying the measurement agreed or determined in the above and the appropriate rate or price for the item in the Contract (BOQ). Any item of work included in the BOQ for which no rate or price was specified shall be considered as included in other rates and prices in the BOQ and will not be paid for separately, in principle.

(2) Duties of Quantity Engineer

The Bill of Quantities (BOQ) is estimated quantities. They are subject to a change in accordance with the measurement at the site or the work drawings (shop drawings) submitted by the Contractor reflecting the current site conditions. The earthworks quantities particularly, have a risk of substantial change compared with the contract design drawings (plans) as a result of As-Staked survey.

The Quantity Engineer is responsible for all quantity measurement and estimate. He should monitor all works executed by the Contractor and treat variations instructed by the Engineer. His duties include:

- verify the quantities in the Contract BOQ through a check of quantity estimate data of the design stage;
- carry out quantity measurement at the field;
- keep up-to-date quantity records including field measurements;
- assist the Engineer /PD in the review and comment of shop drawings for quantity estimate;
- assist the Engineer /PD in preparing weekly and monthly reports;
- evaluate variation orders and costs proposed by the Contractor;
- evaluate monthly statement and claims; and
- prepare the forecast of final quantity and construction cost and revise it from time to time.

(3) Inspection Techniques

The following is a summary of recommended inspection techniques to be applied for the quantity control:

- Verify that the items reviewed were measured in the units called for in the BOQ and that the methods of measurement prescribed in the contract were followed;
- Examine project records to ensure that all materials for payment were delivered and incorporated into the project or stockpiled for future incorporation;
- When payment is based on weight or mass, verify the accuracy of the measurements, including calibration of scales;
- Where payment is based on loads delivered to the project, either on a weight or volume basis, verify the procedures for assuring validity in receipt of haul tickets;
- For area or volume measurement, clarify whether measurement is based on actual dimensional checks to the extent necessary to verify the actual work performed (on-site measurement) or by dimensions in the approved drawings/plans; and
- Ensure that measurements were made at the proper time and prior to the subsequent placement (cover) of other courses of materials.

5.5.5 Monitoring and Estimate of Final Quantity

The Engineer /PD shall monitor work quantities provided in the BOQ, especially in the As-Staked plan, shop-drawings and monthly billings. The Engineer /PD shall monitor the progress (quantity) of work item, especially major items and earth works, against the BOQ and forecast the final quantity. If any

items are seemed to exceed the planned quantity in the BOQ, he must investigate reasons and take appropriate actions to correct and/or propose measures to control the project cost within the budget.

5.6 Safety Management

The Safety Management for the Construction consists of following activity to be performed respectively by the Contractor, the Engineer/PD and the Employer comply with *Safety Control Manual.*

- To take care of the safety of all persons entitled to be on the Site;
- To use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons;
- To provide fencing, lighting, guards and watchers of the Works until completion and turning over; and
- To provide any Temporary Works which may be necessary, because of the execution of the Works, for the use and protection of the public and of owners and occupants of land and properties adjacent to the project/works' site.

The Contractor shall take all reasonable precautions to maintain the health and safety of his personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times at the Site. The Contractor shall maintain records and make reports concerning health, safety and welfare of personnel, and damage to property, as the Engineer may reasonably require in accordance with the "*Safety Control Manual*" developed under the JICA Project.

5.7 Recording and Reporting

5.7.1 Objectives and Types of Projects Reports

The project implementation requires many types of reports and records. The objectives of recording and reporting are to keep the project information and data as evidence of proper project implementation, correct processing of payment, report the project status to the Employer and funding agencies (WB, ADB, JICA, etc).

The Engineer /PD need to keep and maintain the following project data during the implementation (construction and maintenance period) and handover them to the Maintenance Department after the final taking over of project for maintenance by MOC.

Table 5.7-1 List of Project Data

Project Reports	Data Type		Hand-over to	
	Hard Copy	Electronic Data	Construction Dep. (MOC Head Office)	Maintenance Dep. (MOC Head Office)
Contract Documents	O	O	O	
Correspondence (Letters)	O		O	
Progress Report (monthly, quarterly)	O	O	O	
Billing and Payment	O	O	O	
Completion Report	O	O	O	O
Shop Drawings	O			
As-built Drawings	O	O		O
Minutes of Meetings	O		O	
Inspection Sheet / Instruction Sheets	O			
Quality Control Data	O	O		O
Quantity Measurements	O		O	O
EMP Data	O			
Photo Data		O	O	
Other Miscellaneous Data	O			

Note: O – Yes

The Construction and Maintenance Department of MOC shall take over important documents which are required for administration and maintenance. These offices shall keep them for a certain period in accordance with regulations and requirements.

5.7.2 Site Diary (Logbook)

All technical staff for the project management and inspection should keep site diary (Logbook). The site diary should fulfill the following basic requirements:

- Provide permanent file evidence that inspections are being made as required by the Contract and Specifications;
- Provide a basis for acceptance of completed work;
- Record field conditions and contractor's performance;
- Record daily project activities, equipment, manpower and resources at site; and
- Record daily management and supervision activity, observations, findings, resolution of identified problems, claims, and any other topics of interest.

The site diary should be clear and concise with facts. The record should be accurate and specific since the content may be used in evaluating contract claims. If no work was performed at all, a daily report shall be stated "No Work" and reasons. The daily record of personnel and equipment is particularly important in view of the possibility of contractor's claims for stand-by cost of the idled personnel and equipment.

Ensure that diary entries are signed by the Engineer /PD and the Contractor or initiated with date. Verify

that discussions with the Contractor are confirmed in writing and are made a part of the official project file. The record includes the following:

(a) Date and weather conditions;
(b) Work of staking party;
(c) Work of inspectors;
(d) Work of office staff;
(e) Construction work in progress;
(f) Contractor's crew, equipment and materials on each item;
(g) Inspections, decisions, and details discussed with inspectors;
(h) Instruction to contractors;
(i) The substance of important communications and discussions with the contractors, concerning activity, progress, change, interpretation of specifications, etc.; and
(j) Any information not covered in other records, which might have bearing in case of future disagreement, such as difficulties encountered in construction and their causes, delays caused by breakdown of equipment, etc.

If more than one shift is operated, such diaries should be transferred from one inspector to his successor each man signing his particular entries.

The Materials Engineers are also required to keep a Log Book on material quality control, recording quality control activities and other information and observation relevant to materials quality control in addition to the above.

In order to ensure uniformity in Monthly Materials and Quality Control Reports, particularly on field tests performed on construction materials used, the standard forms shall be used for the Project.

After completion of the project, the log book shall be handed over to the Employer together with other project files.

5.7.3 Correspondence (Letters)

Letters (writing) shall be official communication means between the Engineer /PD and the Contractor. Any important issues should be transmitted in writing. Submission of important data should be made with a covering letter. The letters should have date and reference numbers.

It is very common that the Engineer gives oral instructions at the site or even at the office. These should be confirmed by letter later if such instructions are seemed very important.

The letters are filed in order and kept at the office by:

Table 5.7-2 Arrangement of Crrespondances

	Foreign-Funded Project with Consultant (the Engineer)	Locally-Funded Project without Consultant
Out-Going:	The Employer	Construction Dep. at MOC Head Office
	The Contractor	Construction Unit of MOC
	The Engineer	-
	Others	-
In-Coming:	The Employer	Construction Dep. at MOC Head Office
	The Contractor	Construction Unit of MOC
	The Engineer	-
	Others	-

5.7.4 Monthly Reports

The Engineer /PD are required to prepare monthly reports and submit them to MOC, funding banks (WB, ADB, JICA, etc) and other concerned entities. The contents of monthly reports are as follows:

Table 5.7-3 Typecal Component of Monthly Report

Content	Foreign-Funded Project with Consultant (The Engineer)	Locally-Funded Project w/o Consultant (PD)
Executive Summary	O	O
Main Report		
- Project Information and Impact	O	O
- Construction Progress and Status	O	O
- Construction Status (Progress)	O	O
- Project Activities and Accomplishment of Quantity	O	O
- Material Testing and QC Activities	O	O
- Contractor's Resources	O	O
- Issue and Problems, and Recommendations and Actions	O	O
Attachments		
- Bar Chart and S-Curve	O	O
- Status of Construction Equipment	O	O
- Status of Contractor's Personnel	O	O
- Weather Report	O	O
- Progress Photographs	O	O
- Letters (List)*	O	O
Consultancy Services for Construction Supervision		
- Overall Implementation	O	-
- Manning Schedule	O	-
- Organization Set-up	O	The Office of PD

Note: Attach letters if they are very important, such as claim or action plans for recovery of delay.

5.7.5 Photographic Record

The Engineer /PD and his inspection staff should take photographs for:

- Periodic record of work progress (weekly or monthly);

- Construction record of important work activities, including concreting, laying of AC pavement, etc.;
- Construction record of the Works which will be covered after construction such as reinforcement, foundation, back fill, drainage pipes, base, subbase, etc.;
- Construction record of the Works which are removed after construction, such as excavation, demolition of obstacles, tree cutting, etc.;
- Material and quality control tests such as field density, CBR, compression, etc.;
- Defects, wrong workmanship, damage by flood, wrong traffic safety control;
- Mobilization of equipment and materials; and
- Any other specific issues and incidents, including visit of VIPs.

Digital Camera should be used for photographic record. These records are transferred to the office computer and periodically restored in CD to avoid loss.

5.8 Variation Orders and Claims

5.8.1 Variation Orders

(1) Variation of Works

Variations may be initiated by the Engineer /PD either by an instruction or by a request for the Contractor to submit a proposal. The Contractor shall execute and be bound by each Variation, unless the Contractor promptly gives notice to the Engineer stating that (i) the Contractor cannot readily obtain the Goods required for the Variation, or (ii) Variation triggers a substantial change in the sequence or progress of the Works. Upon receiving this notice, the Engineer shall cancel, confirm or vary the instruction. Each Variation may include:

(a) Changes in the quantities of any item of work included in the Contract;
(b) Changes in the quality and other characteristics of any item of work;
(c) Changes in the elevations, positions and/or dimensions of any part of the Works;
(d) Omission of any work unless it is to be carried out by others;
(e) Any additional work, Plant, Materials or services necessary for the Permanent Works, including any associated Tests on Completion, boreholes and other testing and exploratory work; and
(f) Changes in the sequence or timing of the execution of the Works.

The Contractor shall not make any alteration and/or modification of the Permanent Works, unless and until the Engineer instructs or approves a Variation.

(2) Form of Variation Orders

A Variation Order may either be in the form of a Change Order or Extra Work Order. A Change Order is issued by the Engineer /PD to cover any increase/decrease in quantities of original Work items in the contract. An Extra Work Order is issued by the Engineer /PD to cover the introduction of new work necessary for the completion, improvement or protection of the project which were not included as items of Work in the original contract.

(3) Claim of Variation Order

In claiming for any Variation Order, the Contractor shall, within twenty-eight (28) calendar days after such work has been commenced or after the circumstances leading to the extra cost deliver a written notice to the Engineer/PD. The notice should include full and detailed particulars of any extra cost. Failure to provide either of such notices in the time stipulated shall constitute a waiver by the contractor for any claim.

The preparation and submission of Variation Orders are as follows:

(a) If the Engineer /PD believe that a Change Order or Extra Work Order should be issued, he shall immediately instruct his technical staff to conduct an on- the-spot investigation to verify the need for the Work;

(b) The Engineer /PD, after being satisfied that such Change Order or Extra Work Order is justified and necessary, shall review the estimated quantities and prices and forward the proposal with the supporting documentation to the MOC for consideration; and

(c) After review of the plans, quantities and estimated unit cost of the items of work involved, the MOC will review and evaluate Change Orders or Extra Work Orders for approval.

(4) Value Engineering

The Contractor may, at any time, submit to the Engineer /PD a written proposal which (in the Contractor's opinion) will, if adopted, (i) accelerate completion, (ii) reduce the cost to the Employer of executing, maintaining or operating the Works, (iii) improve the efficiency or value to the Employer of the completed Works.

The Engineer /PD shall, as soon as practicable after receiving such proposal of Value Engineering, respond with approval, disapproval or comments. The Contractor shall not delay any work whilst awaiting a response.

5.8.2 Claims

The word "claim" is defined in the context of FIDIC Conditions of Contract that "the Contractor makes formal demands for his due in writing". The demands will be either any additional payment or extension time pursuant to the Contract. Some situations which may give rise to claims are as follows:

● disputes over quantities	● suspension of work
● disputes over qualities	● variation and valuation of variations
● applicability of items in BOQ	● delay in payment
● new items	● actions of a nominated sub-contractor
● Specification interpretation	● acceleration
● failure to give possession of site due to delay of ROW acquisition	● remedies
● delay of issue of drawings or instructions	● adverse physical obstructions or condition
● delay in approval	● adverse weather condition (rain, flood)

If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of the GCC, the SCC or otherwise in connection with the Contract, the Contractor shall give notice to the Engineer /PD, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 28 days after the Contractor became aware, or should have become aware, of the event or circumstance.

The Contractor shall keep such contemporary records as may be necessary to substantiate any claim acceptable to the Engineer. Without admitting the Employer's liability, the Engineer /PD may, after receiving any notice for claim, monitor the record- keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Engineer to inspect all these records, and shall (if instructed) submit copies to the Engineer.

The Contractor shall send to the Engineer a fully detailed claim which includes full supporting particulars of the basis of the claim and of the extension of time and/or additional payment claimed.

If the event or circumstance giving rise to the claim has a continuing effect:

(a) This fully detailed claim shall be considered as interim;
(b) The Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Engineer may reasonably require; and
(c) The Contractor shall send a final claim within 28 days after the end of the effects resulting from the event or circumstance.

The Engineer /PD shall respond with approval, or with disapproval and detailed comments based on his evaluation. He may also request any necessary further particulars, but shall nevertheless give his response on the principles of the claim. The Engineer shall proceed to agree or determine (i) the extension of the Time for Completion and/or (ii) the additional payment to which the Contractor is entitled under the Contract. The unit price analysis submitted by the Contractor at his bid will be one of the most important data for cost claim evaluation.

CHAPTER 6 FIELD INSPECTION

6.1 Objectives of Field Inspection

Inspections are primarily being conducted to oversee construction projects and maintenance programs. The objectives of field inspections are as follows:

1) Assure that the project has been implemented in conformity with the plans and specifications. Provide a basis for acceptance of the Project and reimbursement of project costs with public expenditures;
2) Acquire information on problems and condition changes. Provide an opportunity for timely remedial action to solve the problems;
3) Assess the Contractor's capabilities and effectiveness in managing and controlling the projects with respect to:

- Administrative and technical supervision
- Staffing, equipment and facilities
- Performance
- Project documentation, including inspection diaries, test reports, etc.

4) Enhance quality management programs for project implementation;
5) Offer technical and procedural advice. Recommend improved construction techniques and engineering supervision; and
6) Report on special or innovative construction materials, methods, procedures, new equipment, and other technological innovations.

The field inspection and field control shall be based on **Quality Control Manuals** of the MOC, and special provisions provided by the Specification of the Project. The Technical Specification for the Project shall be provided in accordance with the component of the Project. Followings are typical items of the specification commonly applied for road and bridge construction project.

Table 6.1-1 Major Contents of Technical Specification for Road and Bridge Construction

Part A:	Facilities for the Engineer	Part F:	Bridge Construction
Part B:	Other General Requirements	Part G:	Drainage and Slope Protection Structures
Part C:	Earthwork		
Part D:	Subbase and Base Course	Part H:	Miscellaneous Structures
Part E:	Surface Courses	Part I:	Materials Details

Quality Assurance (QA)of the construction for the MOC projects and programs is relied on field inspections. The field inspection is cooperative and coordinative activities of all project supervision staff under the Engineer / RE / ME or the PD in accordance with inspection plan established by project.

Various instructions are given to the Contractor for correct implementation or remedy of works through daily field inspection. Such field instructions should be in writing, including both by

instruction forms and letters and filed for recording. If oral instructions are given at the site, these should be confirmed in writing as soon as possible. The instructions should be clear, concise and conforming with the particular provisions of the contract and specifications. Whenever disputes and conflict arise in relation with the contractor's claims or the Engineer's directions, these written instructions will settle problem/issue.

The Project Director (PD) appointed by the MOC shall be the **head of supervision team** for the locally-funded projects. The Project Manager (PM) of the supervision consultant shall be the head of supervision team for the foreign-funded projects as the consultant is employed by the MOC as the "**the Engineer**".

Table 6.1-2 Sample of Site-Instruction Sheet

<table>
<tr><td colspan="2">NAME OF PROJECT :</td></tr>
<tr><td>Section :

Location:</td><td>CONTRACTOR :</td></tr>
<tr><td>Ref. No. : SI -</td><td>Date :</td></tr>
<tr><td colspan="2">Subject :</td></tr>
<tr><td colspan="2">Instructions:</td></tr>
<tr><td>ISSUED BY THE ENGINEER / PD</td><td>RECEIVED BY THE CONTRACTOR</td></tr>
<tr><td>Signature :

Name:
Position:</td><td>Signature :

Name:
Position:</td></tr>
</table>

6.2 Field Inspection Plan

Major field inspection activities cover **1) Materials Quality Control, 2) Workmanship, 3) Alignment and Dimensions Check, 4) Quantity Measurement and 5) Work Progress Monitoring** in accordance with the "Request for Inspection" by the Contractor and/or at own initiative of the Engineer/ PD. Field inspections also include **checking of mobilization and deployment of resources** (manpower, equipment and materials), **traffic & construction safety, maintenance and EMP**. The Field Inspection Plan should be established depend on work category and pavement type taking each characteristic into account.

6.3 Standard Inspection Sheet

The field inspection and quality control shall be conducted in accordance with the Specifications as a part of contract documents. The Comprehensive Standard Specifications of MOC has not yet developed, therefore, the quality control needs to be conducted based on the technical specification to be developed by each construction project.

On the other hand, four (4) types of quality control manual and one (1) safety control manual have been developed through the Project, the typical quality control work can be performed based on above manuals as long as the works are within scope of the manuals.

The above manual provides the methodology, reference of standard values and inspection sheet for quality control. In this aspect, Standard Inspection Sheet attached to the above manuals shall be applied for inspection works to ensure that all construction and maintenance works are implemented strictly in accordance with the specifications. The Standard Inspection Sheet covers the following check points in the order of the Specification:

- Work Approval
- Scope of Works
- Materials Requirement
- Construction Requirements, including equipment.
- Remarks/Comments.

Following samples of the Inspection Check Sheets (and/or Check List) were introduced in the Quality Control / Safety Control Manuals to be commonly used for the MOC bridge and road construction projects. The Engineer/PD should provide inspection check sheets for other work items as maybe necessary for the construction project.

Table 6.3-1 List of Standard Inspection Check Sheets in this Manual

Part	Item	Description
Concrete Work	CS 01	Management format of Concrete Pouring (Bridge)
	CS 02	Management format of Concrete Pouring (Road)
	CS 03	Quantab Recording Sheet
	CS 04	Check Sheet for Concrete Pouring Activity
Steel Bridge	ST 01	Check Sheet for Execution Condition
	ST 02	Measurement Record for Film Thickness
	ST 03	Quality Control Sheet for Painting Work
PC Bridge	PC 01	List of Checking Items
	PC 02	Cable Tension Strength Control Chart
	PC 03	Testing Report for Grout 1/3 (Basic Physical Properties)
	PC 04	Testing Report for Grout 2/3 (Fluidity, Bleeding, Expansion)
	PC 05	Testing Report for Grout 3/3 (Checking of Grouting Volume & Grouting Pressure)
Bridge Foundation	BF 01	Checking List for All Casing Method
	BF 02	Checking List for Reverse Circulation Method
	BF 03	Checking List for Earth Drilling Method
	BF 04	Example of Inspection Sheet for All Casing Method
	BF 05	Example of Inspection Sheet for Reverse Circulation Drill Method
	BF 06	Example of Inspection Sheet for Earth Drilling Method
	BF 07	Checking List for Pile Driving Method
	BF 08	Example of Inspection Sheet for Pile Driving Method
	BF 09	Checking List for Pre-boring
	BF 10	Example of Inspection Sheet for Pre-boring Method
	BF 11	Checking List for Steel Pipe Sheet Pile
Construction Safety	SF 01	Accident Report Form
	SF 02	Accident List
	SF 03	Prevention Initiative List
	SF 04	Check List for General Safety Measure
	SF 05	Check List for Underground and Overhead Facilities/ Machinery and Equipment/ Transportation
	SF 06	Check List for Temporary Construction
	SF 07	Check List for Bridge Foundation/ Concrete Structure
	SF 08	Check List for Bridge Construction (Bridge Erection)

Note: Other items shall be prepared by the Engineer/PD in accordance with the requirements of project.

6.4 Construction Survey and Staking

The Engineer (or PD) shall furnish the Contractor horizontal and vertical control points and other reference design data for use in establishing control for the completion of each element of the work.

The Contractor shall be responsible for the true setting of the works or improvements and for correctness of positions, levels, dimensions and alignment of all parts of the works. The Contractor shall provide a survey crew supervisor at the project site whenever surveying/staking activity is in progress. Before surveying and staking, the Contractor shall discuss and coordinate the following with the

Engineer:

- Surveying and staking methods;
- Stake marking / concrete monuments;
- Grade control for courses of material;
- Referencing;
- Structure control; and
- Any other procedures and controls necessary for the work.

Established controls shall be within the tolerances shown in the Specification of the Contract. Following table shows sample for the tolerances commonly used in the international project.

Table 6.4-1 Construction Survey and Staking Tolerances

Staking Phase	Horizontal	Vertical
Existing Government network control points	±20 mm	±8 mm x $\sqrt{K}$ (2)
Local supplemental control points set from existing Government network points	±10 mm	±3 mm x $\sqrt{N}$ (3)
Centerline points (4) - (PC), (PT), (POT), and (POC) including references	±10 mm	±10 mm
Other centerline points	±50 mm	±50 mm
Cross-section points and slope stakes (5)	±50 mm	±50 mm
Slope stakes references (5)	±50 mm	±50 mm
Culverts, ditches, and minor drainage structures	±50 mm	±20 mm
Retaining walls and curb and gutter	±20 mm	±10 mm
Bridge substructures	±10 mm (6)	±10 mm
Bridge superstructures	±10 mm (6)	±10 mm
Clearing and grubbing limits	±500 mm	-
Roadway subgrade finish stakes (7)	±50 mm	±10 mm
Roadway finish grade stakes (7)	±50 mm	±10 mm

(1) At 95% confidence level, tolerances are relative to existing Government network control points.
(2) K is the distance in kilometers.
(3) N is the number of instrument setups.
(4) Centerline points: PC - point of curve, PT - point of tangent, POT - point on tangent, POC - point on curve.
(5) Take the cross-sections normal to the centerline + 1 degree.
(6) Bridge control is established as a local network and the tolerances are relative to that network. (7) Include paved ditches.

6.5 Workmanship Inspection

The quality products are attained as a result of good workmanship. The good workmanship is input of experienced skill, art and techniques of workers, plant and equipment operators and supervisors incorporated in the process or procedures of production. The site-in-situ and laboratory tests are for confirmation of the product quality while workmanship is work process and product control during production or manufacturing. The workmanship inspection is most important daily duties of the supervision engineers and inspectors. The workmanship inspection is conducted by both visual

observations and measurement.

The quality products are attained as a result of the Contractor's appropriate quality control and good workmanship. Either the tests or inspection by the Engineer/PD does not relieve / release the Contractor's quality obligations. The Contractor is obligated to comply with the contract and specifications irrespective of the presence of the inspectors.

The in-situ and laboratory tests reflect representative quality. As sampling could not be taken from all sections or portions, the inspection staff (SE, ME, PI) should inspect workmanship to ensure that the standardized and consistent operations are carried out for production. The inspection staff should provide immediate instructions and guidance if any trouble or problems **like rain, high concrete temperature, breakdown of equipment/tools**, etc. happen or he found any wrong practice or sub-standard materials.

It should be noted that the PD and his staff are not only a representative of the MOC but also a representative of the public to witness the contractor's activities. Easy compromise and acceptance on poor quality product shall not be allowed.

6.6 Inspection Request, Approval and Assignment

(1) Inspection Requests and Approval

The Engineer / the PD should establish a project standard form (Table 7.3-1) as a tool for efficient and proper construction supervision activities. The Contractor shall inform the Engineer / PD before executing the works in order that the latter is given a chance to witness the works for approval or disapproval. This will also be for the benefit of the Contractor as his operation is not disturbed while waiting for the required inspection and/or quality tests.

Inspection Requests shall be submitted by the Contractor by 3:00 pm (at the latest) one day before the start of such works required for the Engineer's inspection except Sunday/Holidays. Inspection requests for Monday's works should be submitted on Saturday by 3:00 pm at the latest. The RE will check and decide approval, approval with condition or disapproval and inform the Contractor by 5:00 – 6:00 pm. He will schedule inspectors and/or the ME for inspection. Any change to the request should be informed to the Engineer by 8:00 am of the scheduled working day in order that the RE /PD will be able to make new inspector arrangement or change.

(2) Concrete Pouring Permit

The Engineer/PD should make sure that the Contractor shall submit a concrete pouring permit. He shall approve the Contractor's request after checking and ascertaining that the necessary preparations and procedures have been completed in accordance with the approved plans and specifications. The following is the general procedure of pouring permit application and approval:

1) The Contractor shall submit "work inspection request" together with "concrete pouring permit"

one day (24hrs) before the start of concreting works except Sunday/Holidays. As the Engineer will not receive this on Sundays and Holidays, request of Monday's concreting shall be submitted on Saturday by 3.00 pm at the latest. Inspection requests for the works after Holiday shall be submitted before such Holiday;

2) Concrete pouring permit for structures shall be submitted for each concrete pouring. Concrete pouring permit for RCP casting shall be submitted at weekly basis if casting is continued; and
3) Pre-site checks shall be conducted by the ME, PI and approved by the RE (or the PD). Approval must be forwarded to the Employer's Representative site office before the start of works.

CHAPTER 7 QUALITY ASSURANCE

7.1 Approach of Quality Assurance

Currently, the term 'Quality Control (QC)', as applied to the various stages of project implementation, is considered as the Contractor's responsibility while the term 'Quality Assurance (QA)' refers to the responsibility/obligation of the Employer (MOC) to ensure strict compliance to existing standards/specifications and other pertinent MOC Issuances relative to project implementation.

Quality Assurance (QA) is defined in this Manual as "planned systematic actions to ensure that the quality of a product satisfactorily meets the requirements of the governing Specifications". Quality Assurance is an all-encompassing term that includes Quality Control (QC) by the Contractor, the conduct of assessment/inspection by an independent inspectorate team such as the MOC Quality Control / Assurance Section, the employment/hiring of qualified/competent laboratory and technical personnel by both parties (the Contractor and the MOC) and the acceptance of the project by the Employer (MOC). The Quality Assurance is a "*total system" attained as a result of the combined efforts and resources of the entities involved in the construction of the Project/s* (MOC, Contractor/s and Consultant/s).

7.2 Quality Control Program and Plan/Procedures

The Contractor has the prime responsibility to produce/process the products (i.e., construction materials) to meet/satisfy the quality requirements in accordance with the Specifications prior to incorporating them into the project. The MOC Project Engineer, on the other hand, has the responsibility to **verify/ensure/ascertain** that the Contractor produces the products in accordance with the project Contract and Specifications.

Sub-Clause 4.9 of the FIDIC GC stipulates the following conditions whereby the Contractor is subject to satisfy and comply with:

- The Contractor shall institute **a quality assurance system** to demonstrate compliance with the requirements of the Contract. The Engineer shall be entitled to audit any aspect of the system;
- Details of all procedures and **compliance documents** shall be submitted to the Engineer for information before each design and execution stage is commenced; and
- Compliance with the quality assurance system shall **not relieve the Contractor of any of his duties**, obligations or responsibilities under the Contract.

The Quality Control Program (QCP) is a program/schedule of quality control works in a certain project which involves inspection and testing of construction materials to be incorporated into a work in accordance with the project Contract, Specifications and the Department Orders/Policies issued by MOC.

For projects implemented by Contracts, the PD shall instruct the Contractor (during the Pre-construction Meeting) to submit a **Quality Control Plan** for delivering quality production as part

of the construction methods. It is imperative that the preparation of the quality plan should be a detailed one, taking into account and shall include the following:

1) Site Condition;
2) Laboratory Plan in accordance with the Contract;
3) Process of control testing;
4) The schedule of activities to be undertaken/performed;
5) Materials resources, list of materials to be tested and type of tests to be conducted;
6) Frequency of tests, taking into account the project quantity by item; and
7) Laboratory equipment/apparatus and technical staffs to be employed.

The table hereunder stipulates the quality control activities to be undertaken by the ME in each of the three (3) phases of construction:

Table 7.2-1 Quality control activities to be undertaken by the ME

Phase	Activities
Preparatory Phase:	● Review all contract requirements ● Ensure compliance of component material to the contract requirements ● Coordinate all submittals including certifications ● Ensure establishment of laboratory and equipment, tools and personnel to comply with the contract requirements ● Ensure preliminary testing is accomplished
Startup Phase:	● Review the contract requirements with personnel who will perform the work ● Inspect startup of work ● Establish standards of workmanship ● Provide training as necessary ● Establish detailed testing schedule based on the production schedule
Production Phase:	● Conduct intermittent or continuous inspection during construction to identify and correct deficiencies ● Take samples and test them at site and laboratory to verify the specified quality ● Inspect completed phases before scheduled Government acceptance ● Provide feedback and system changes to prevent repeated deficiencies ● Description of records and documents. List the records and data to be submitted and maintained

The Contactor shall prepare the Quality Control Procedures/Flow Chart on the major quality control and testing of the construction materials in accordance with the Specifications and Standard Test Procedures/Guides (e.g. AASHTO and/or ASTM). The said procedures/flow chart shall include the tests required, the applicable test procedures/guides, frequency of tests and the minimum.

7.3 Quality Control Specifications and Guides

The term of 'Specification' applies to the written contract documents which includes material and workmanship requirements, inspection and testing procedures, and procedures for measurement and payment of work, all of which are principally based on AASHTO and ASTM.

The functions of the Specifications are categorized into two (2) areas, depending on the perspective/viewpoint of the person/s utilizing it:

Table 7.3-1 Major Funcsion of Specification

Category	Function
1) with respect to the owner (Employer) and his engineer	● obligation to define material and workmanship requirements ● inspection and testing during the period of project implementation ● to indicate how the work will be measured and paid for.
2) with respect to the Contractor	● obligation of complying with the contract requirements during the construction period

The Specification is the starting point of quality control. Without it, there can be no quality control. Hereunder are the Specifications that are frequently utilized in the conduct of materials testing and in the efficient prosecution of the projects.

Table 7.3-2 MajorStandards to be refered

	Standard	Issued by
1.	AASHTO Standards Part I, Specifications Part II, Methods of Sampling and Testing	AASHTO
2.	Annual Book of ASTM Standards	ASTM
3.	Other Standards and Special Specifications to be used for the construction, including relevant Department Orders.	MOC

The above Specifications or a copy thereof should be made available at the project site at all times for guidance/ready reference as required under various MOC Issuances as well as in the Special Specifications.

7.4 Project Laboratory

In order to ensure that the quality of materials is properly implemented in contract projects and will thereby result in long, satisfactory performance of the completed works, the Contractors are required to provide competent quality control personnel and **fully equipped quality control laboratory** building before allowing them to start on Items that require field quality control tests. Likewise, the provision of minimum testing equipment is included in the pre-qualification of contractors to ascertain their technical capability and financial capacity to undertake the contract works of the projects. At

the same time, the PD should have in his staff the necessary quality control supervisory personnel to oversee the Contractor's work. Hereunder are the materials testing laboratories and the corresponding conditions set for the respective purposes:

Table 7.4-1 Type Project Laboratory

Type of Laboratory	Application
The Engineer's Laboratory	● This is applicable on most of the foreign-funded projects and some of the locally-funded projects where the consultant is employed as the Engineer ● The Contractor is obliged to provide the Engineer's laboratory in accordance with the Contract. The Engineer (Consultant) will operate the laboratory with apparatus and testing equipment, assistant and consumables furnished or supplied by the Contractor. ● This laboratory may be also used by the Contractor upon approval of the Engineer. The Special Specification must define whether the Contractor is allowed to use the Engineer's laboratory, or he should provide separate laboratory for his own use to avoid duplicated laboratory cost in the Bid.
Use of MOC's Laboratory (BRL or RRL)	● This is applicable for the locally-funded projects where the consultant is not employed as the Engineer. ● The PD uses the laboratory of BRL and RRL or the laboratory established by the Contractor at site.

The ME shall ensure that the testing laboratory provided by the Contractor satisfactorily meets the contract requirements and that the scales/weighing devices are annually calibrated by a duly accredited calibration center/company.

The Contractor may avail the services of private testing laboratories that are accredited by the Government of Myanmar to undertake/conduct materials testing for and in behalf of the MOC. If and when the said Laboratories do not have the capability to conduct the required tests (either due to lack of necessary equipment or that the submitted samples could no longer be accommodated due to the voluminous samples that have to be tested) and after having issued the waiver/certification stating either of the reasons as stated above, only then can the Contractor avail the services of the accredited private testing laboratories. The typical equipment/apparatus required for the conduct of tests on materials in various road construction operations are as follows:

Table 7.4-2 Required Function and Equipment at Project Laboratory

Tests	Required Equipment and Apparatus
Soils	sieves, scales, liquid limit devices, compaction test equipment, field density equipment, hot plates or field stove, oven, sampling equipment, sample containers, drying pans and CBR apparatus, etc.
Soil Aggregates	sieves, sample splitters, scales, hot plates, devices for determination of moisture content and liquid limit, drying pans, and apparatus for making laboratory compaction tests and for determining in-place densities, CBR apparatus, etc.
Hot Mix Asphalt (HMA)	thermometers, sieves, sample splitters, scales, hot plates or field stove, burn-off oven, equipment for taking samples from the pavement, and apparatus for determining pavement density and stability of the HMA mixture
Portland Cement Concrete	slump cone or other specified equipment for determining consistency of the mix, air meter, concrete cylinder or beam molds, sieves, sample splitters, scales, pans, stove or hot plate, and containers for determining unit weights

Note: Those equipment and apparatus should be calibrated by concerned authority or agency.

7.5 Accredited Asphalt and Portland Cement Concrete Batching Plants

An asphalt and/or Portland cement concrete batching plant is required for most of the road construction or maintenance projects under the MOC contracts.

Accreditation refers to the procedure by which an Agency gives formal recognition, under duly established rules and regulations, that a private company is capable of and competent to operate an asphalt/Portland cement concrete batching plant to supply asphalt/concrete mixes to the project/s.

One of the major requirements to be submitted to the Agency by an applicant is his/her company's Quality Manual which contains the following information:

- Company Policy (Mission/Vision/Objectives)
- Information on Physical Plant Layout i. Vicinity Map of the Plant ii. Schematic Flow Diagram
- Batching Procedures/Flow Chart
- Organizational and Manpower Chart, Including Production Staff
- Curriculum Vitae and Job Description of Key Production and Quality Control Personnel
- System of Quality Control, Quality Assurance and Standards being adopted g. Calibration Report of all Measuring Devices/Testing Equipment
- Safety Program/Requirement or Commitment to Safety or Safety Policy
- Sources of Raw Materials (for cement, aggregates, water and admixtures)

- List of Available Laboratory Testing Equipment

The said Manual shall be in accordance with and conform to the accepted standards of quality performance, technical expertise and competence which should be made available for use by the company's quality control personnel. Likewise, **the plant laboratory** shall have adequate catalogue and instruction manuals on the use and operation of all relevant equipment, on the handling and preparation of test items, and on the standard testing techniques, where the absence of such instructions could jeopardize the effectiveness of the whole testing procedure/process.

Upon receiving all the requirements from the applicants, the Agency personnel/accreditors shall inspect the batching plant, evaluate the capabilities of the technical personnel, observe the actual production operations and assess the quality control system. The Agency then issues a Certificate of Accreditation to the applicant who meet the requirements for said accreditation.

The plant shall have a quality control and assurance system manual that complies with accepted standards of quality performance, technical expertise and competence and available for use by the quality control personnel. The plant laboratory shall have adequate catalogue and instruction manuals on the use and operation of all relevant equipment, on the handling and preparation of test items, and on standard testing techniques, where the absence of such instructions could jeopardize the effectiveness of the testing process. The plant laboratory shall ensure that all incoming materials/products are not used or processed until it has been inspected or otherwise verified as conforming to specification requirements.

7.6 Quality Control Activities

7.6.1 Category of Activities and Frequency of Tests

Quality Control activities consist of the following three (3) major areas of responsibility:

Table 7.6-1 Role and Responsibility on Quality Contol

Category	Area of Responsibility	Person in charge
Materials Quality:	● Ensure that only accredited Asphalt and Portland ● Ensure that the types, properties, and procedures for production and storing of materials meet the Specifications ● Only materials that passed the Specifications and approved by the Engineer are used for the construction ● Test results are submitted to the PD & the ME for approval before the materials are incorporated into the Works	● Material Engineer (ME) ● Quality Inspectors ● Laboratory Technicians
Workmanship:	● Good skill, art and/or technique are used for quality ● products in accordance with appropriate construction methodology. ● Check/verify in compliance with specified geometry ● Finished shape (lines and grades), dimensions, strength, etc.	● Field Inspectors ● Technicians
Product Quality:	● Test results on finished product of the Contractor's ● Works meet the specified strength and quality. ● Compliance with specified geometry (line and grades), dimensions, strength, tolerances in length, weight, height, camber, evenness, etc. in the approved plans and specifications	● ME and Quality ● Inspectors Field ● Inspectors

The ME and his staff in cooperation with inspectors shall carry out the following Quality Control activities:

- supervise continuously the Contractor's technicians/foremen in carrying out specified sampling, testing and reporting works;
- instruct the Contractor where to take representative samples and ensure frequency of sampling and testing required in the Specifications;
- ensure that all tests on materials and field operations are correctly recorded by the Contractor's technicians in daily reports or forms and submitted to the Engineer/PD without delay;
- ensure that the Contractor's technicians submit the results of all tests using the standardized laboratory forms;
- submit a monthly summary of all test results to the Engineer, together with recommendations regarding approval or rejection of materials and work, based on the test data and observation; and
- carry out independently from the Contractor's technicians, any sampling and testing for the purpose of confirming the test results submitted by the Contractor, if required. The ME should also conduct a random or surprise sampling and testing in addition to the planned sampling and testing.

The ME needs to work not only with his own staff but also with other inspectors and surveyors as most of the works are correlated. Acceptance on the quality shall be based on the results of sampling and testing along with visual inspection.

Frequencies of Quality Control testing are specified in the Specifications, depending on the characteristics of the overall process. The conduct of these tests on construction materials are intended to be used for the quality assurance and accepting the work by the MOC. Items, type of tests and the frequency requirements for the test shall be stipulated in the Technical Specification in the Contract Document. The Quality Control Manual will be also reference of the quality control test unless otherwise the Specification has no information on the tests.

7.6.2 Quality Control on Construction Materials

Materials used for the road construction are grouped into two (2) major groups:

Table 7.6-2 Required Certificates for Construction Material

Category	Requirements	Representative Materials
Group I: Prefabricated Material	**1. Imported Materials** ● Certificate of Importation ● Mill Test Certificate and Shop Inspection Certificate/Report ● Certificate of Inspection at point of delivery by MOC representative/s **2. Locally Prefabricated Material** ● Mill Test Certificate and Shop Inspection Certificate/Report	Structural Steel, Metal Culvert Pipe, Accessories, etc.

	● Sampling of materials at the factory by MOC representative/s ● Certificate of Inspection at point of delivery by MOC representative/s ● Must have a representative sample each for testing	
Group II: Manufactured, Processed or Natural Products	1. Acceptance Test 2. Retest or Referee Test, if the 1st test failed 3. Pretesting ● Applicable to materials manufactured in bulk such as cement, asphalt, steel bars, etc. ● Pre-tests shall be undertaken by the MOC laboratories in principle ● Sampling shall be attended by the MOC representatives (Lab technician/ME) 4. Testing shall be attended by the MOC representatives (Lab technician/ME)	Cement, Asphalt, Steel Bars, Concrete Mix, Aggregate

7.6.3 Production of Aggregates

The most common materials produced at the site or purchased from nearby quarries are coarse and fine aggregate (sand) for Portland cement and asphalt concrete production. The origin of raw materials for coarse aggregate is river gravel or rock and that for fine aggregate is river sand. The contractors mobilize crushing plants with vibration screens for aggregate production.

The following care should be taken to obtain sound and specified materials:

- Contamination of gravel by too much soil or soft stones
- Lack or insufficient fine components
- Too much flat shapes after crushing
- Insufficient fractured surfaces if crushed from river gravel
- Utilize clean water in cleaning aggregates.
- Proper disposal of used water is necessary to avoid pollution in the environment.
- Aggregates production should be stored on lean concrete base or on the appropriate base and shaded to avoid contamination of foreign materials and high temperature.

The grain size, its distribution and specific characteristics of aggregate differ depending on their incorporation to products (subbase course, base course, asphalt concrete, Portland cement concrete and structural concrete as given in the following table and figures. Generally, the contractor mobilizes only one set of crushing plant and produces the required products arranging a combination of vibrations screens and blending of different size of screened materials. Therefore, operation of the crushing plant should be carefully planned in line with the construction schedule.

Aggregate production crusher plant is a combination of the following crushers and vibration screens, belt conveyors and washing system as an option, depending on raw materials and grading requirement of products:

The following actions shall be taken for non-specification compliance materials encountered at the Source and Production facility:

- If excess contaminated materials or out-of-specification materials are encountered, the PD (and/or the ME) should reject these materials in writing; and
- If a change in material type is encountered within a source, additional sampling and testing shall be performed to characterize the material. If the material meets specification requirements for another material type, then the material will be approved for use. If the material does not meet specification requirements, the material shall not be permitted for use on the Project.
- The apparent omission of a detailed description or definition concerning the quality of materials from the plans and specifications shall be regarded to mean that materials of first-class quality are to be used.

7.6.4 Recording and Filing

The ME is required to prepare a Log Book on Materials Quality Control wherein the daily project activities as well as quality control activities with appropriate/necessary comments/observations are recorded. Said Quality Control Log Book shall be used to verify the following conditions:

- All materials are covered by adequate quality control and acceptance tests, and the frequency of sampling and testing is in accordance with the requirements of Specification;
- The statistically-based method used to verify the contractor's test has been validated by the Engineer; and
- Compare the test results with those conducted by an independent Third Party for calibration (as needed).

The ME should report the following to the PD. Hereunder are the duties and responsibilities of the ME are;

(a) To ascertain that all materials incorporated into the work pass the requirements of the Specification and to strictly comply with the schedule of Minimum Testing Requirements;
(b) To advise the PD on the acceptance or rejection of construction materials intended for use in the project based on test results;
(c) Recommend to the PD the appropriate remedial measures for the correction of the unsatisfactory condition of materials;
(d) To accomplish the weekly Certificate of Quality Control Assurance
(e) To prepare design mix and job mix for concrete and bituminous mixtures, respectively;
(f) To fully acquaint himself with the standard procedures on materials sampling, testing and control;
(g) To ensure that the testing laboratory is adequately equipped so that the progress of the work will not be impeded to laboratory testing and that non-performance of tests should not be a cause of delay in the prosecution of the work;
(h) To submit within the required time-frame the test reports and other pertinent quality control reports to the Implementing Office, all of which are duly noted by the PD;

(i) Verify the veracity of all Certifications, Inspection and Test Reports, among other quality control documents, as conforming to the Standards and Specifications and to assure that the materials represented by the said documents were actually delivered at the project site.

(j) To strictly supervise his laboratory technicians in the performance of field and laboratory tests.

It should be noted that the ME shall verify and certify a summary of quality control report submitted by contractors as a backup data for monthly billings. Only the quantities of works of which quality are accepted will **be certified for payment.**

Statistically-based methods are effective means of ensuring a quality product, and would be a fundamental component in the construction quality management. It is a challenge to be introduced for the MOC projects, especially for Concrete and Asphalt Concrete Production.

Quality control charts combined with statistical analysis will help identify problems and suggest solutions or improvement. A Control Chart is a tool which graphically depicts the average value and the upper and lower control limits. A Control Chart helps to distinguish between normal and unusual variation in a process. The most popular chart will be an Average and Range Control Chart (X-R Chart) as shown in the following figure in the next page.

- If the data fluctuates within the limits, it is the result of common causes within the process and can only be affected if the system is improved or changed;
- If the data falls outside of the limits, it is the result of special causes; and
- If the data show incremental or declining trends, earliest action should be taken for correction before it become out of control.

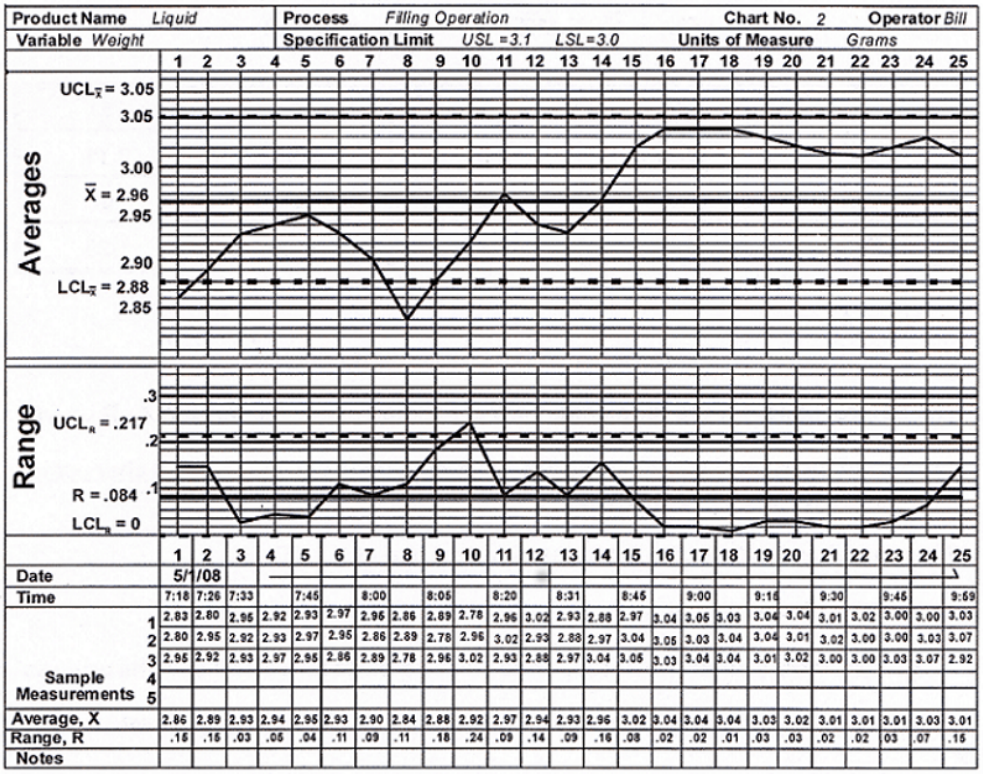


Figure 7.6.1 Statistical Quality Control (X-R Control Chart)

7.7 Calibration of Testing Equipment

To ensure the accuracy of test results obtained from testing equipment used in various MOC projects, the testing equipment should be calibrated regularly. The Certificate of the calibration shall be presented at the time of commencement of use.

CHAPTER 8 PUBLIC RELATIONS, SAFETY AND ENVIRONMENTAL MANAGEMENT

8.1 Public Relations

8.1.1 Public Relation System of MOC

Public Information (PI) is the practice of managing the flow of information between the MOC and the public including stakeholders. Common activities of the PI include presentation at conferences, working with the press, and communication with employees on their activities and achievement.

For excellent service delivery and total public satisfaction, the MOC is recommended to respond to queries, complaints, concerns, and other needs of external stakeholders to include road users, civil society groups, non-governmental organizations, development partners, the academe, other government agencies, etc. The MOC Head Office (Construction Department) is mandated to develop and implement the MOC development communication program to ensure that policies, plans, programs, and activities be known to the public. Likewise, it is the office responsible in providing information and quick-response action to the issues, concerns, problems, and queries regarding the MOC.

The major functions on the Public Relation with the project implementation are:

- Develop a communications program to ensure that policies, plans and activities of the MOC to be known to the public;
- Supervise the preparation of information materials, reports, briefing materials, photo exhibits in line with the communication program;
- Act or provide answers to issues/problems brought about by the media;
- Receive public complaints, problems, and queries and provides direct and quick-response to the general public needs;
- Establish a data bank for all the relevant data and information to the media, researchers, NGOs and the general public about the plans / on-going activities and accomplishments; and
- Provides information on projects, road infrastructure, travel conditions, administration.

8.1.2 Relations with Local Communities and Road Users

The Engineer shall supervise the Contractor's relations with local communities and road users. In siting and operating his plant and facilities in execution of the Works, the Contractor shall at all times bear in mind and to the extent practicable minimize the impact of his activities on the existing communities. Where communities are likely to be affected by major activities such as road widening or the establishment of a camp, quarry, extensive road closure or detour, he shall liaise closely with the concerned communities and their representatives. The Contractor should organize periodic or at-required basis meetings to provide project information, resolve issues and claims and minimize impacts on local communities. The Engineer should enhance communication capacity with local communities and public.

For the safety and convenience of the public and road users, the Contractor shall erect and maintain, as required by conditions prevailing at the site and progress of the works, all reasonable safeguards for safety and protection. It shall include all danger signs and other warnings against hazards. The Contractor shall install and maintain traffic control information boards bearing location of detours and one-way control, type of work, period of traffic control at several strategic points as approved by the Engineer for public and road users.

8.2 Road Safety

8.2.1 Provision of Road Safety Devices along Road Sections

To enhance road safety and guide motorists, road safety devices such as guardrails or protective barriers, including warning or directional signs, shall be provided/ installed along critical sections of all road section constructed by MOC. This directive particularly applies to road sections running along deep ravine and cliffs, at dangerous curves and high embankment.

This item shall be incorporated in the detailed engineering design, programs of work, estimates, budget and bidding and contract documents of aforesaid projects. All works under this item shall be in accordance with the Technical Specification to be provided during the procurement stage.

8.2.2 Traffic Control and Detour

(1) Traffic Control

The convenience of the general public, road users and the residents along the highway and the protection of human lives and properties are of prime importance in the project implementation. At all times during the Works, the Contractor shall insure the least obstruction to traffic. The Contractor shall provide and maintain a safe condition at temporary approaches and crossings of intersecting highways, railroads, private entrances and approaches.

The Contractor shall provide, erect and maintain at all times during the progress or temporary suspension of the Work suitable barricades, fences, signs, and watchmen as necessary or as instructed by the Engineer to insure the safety of the public and road users. All barricades and obstructions shall be protected at night by torches or red signal lights which shall be distributed in an approved manner and kept on lighting from sunset to sunrise.

The Contractor shall submit traffic management and control plan, at least 2- weeks before commencement of works, which will require any traffic disturbance, detours, one way traffic control and night works for approval of the Engineer. The Engineer will direct modifications and additions whenever necessary to such approved plans if they will cause serious traffic jams or endanger public safety.

(2) Road Close and Single Lane Operation

No road shall be closed by the Contractor to the public except with a written permission of the Engineer and the concerned government authorities. Where traffic conditions allow, single lane

operation may be permitted by the Engineer. When the road under construction is being used by the traveling public, special attention shall be taken to provide conditions where the public can travel in comfort and safety without undue delay. Materials stored on the roadway shall be so placed and the work shall be so conducted to cause the least obstruction to the traveling public.

Where half-width construction is adopted to facilitate traffic, the half-width not under construction shall be made available to public traffic under alternate one-way control. The Contractor shall furnish sign boards, separators, flagmen, pilot car and drivers, lighting facilities to direct traffic through the section of road under one-way control and concrete barricades at beginning and end points. The Contractor shall place barricades along the inside edge of the available surface in order that traffic can be confined therein while the other half-width is undergoing construction.

(3) Detour

The Contractor shall provide, construct and maintain detours wherever the work interferes with traffic on existing roads, footways or other ways within a road right-of-way. No detours shall be constructed, and no traffic diverted until the Contractor's proposal thereof has been approved by the Engineer and by the concerned authorities.

Prior to the commencement of the construction and of the use of detours, the Contractor shall provide the Engineer with a full photographic record of the existing roads, pathways, etc. The Contractor shall furnish and erect all detour and traffic control signs required in the Plans and Specifications and at the direction of the Engineer/PD.

All detour roads shall be maintained in good condition at all times by the Contractor. All detours shall be kept graded, compacted and watered to control surface dusts. Where public or private roads are used as detours, such roads shall be restored to a condition equivalent to or better than the existing prior to the commencement of the work.

8.2.3 Joint Site Inspection and Action Plan for Traffic Safety

The Contractor shall appoint an Health and Safety (and accident prevention) officer at the Site, who is responsible for maintaining safety and protection against accidents. This person should be qualified for this responsibility, and shall have the authority to issue instructions and undertake protective measures to prevent accidents.

The Contractor shall prepare a check list covering all items of safety, health and traffic control relevant to the project implementation for approval of the Engineer/PD. The Engineer and the Contractor shall conduct joint periodic inspection based on the approved check list. The Contractor shall submit a joint inspection report covering the inspection results and actions to be taken.

8.3 Safety Measures by the Contractor

8.3.1 Obligation of the Contractor

The Contractor shall:

- comply with all applicable safety regulations;
- take care of the safety of all persons entitled to be on the Site;
- use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons;
- provide fencing, lighting, guards and watchers of the Works until completion and turning over; and
- provide any Temporary Works which may be necessary, because of the execution of the Works, for the use and protection of the public and of owners and occupants of land and properties adjacent to the project/works' site.

The Contractor shall take all reasonable precautions to maintain the health and safety of his personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times at the Site. The Contractor shall maintain records and make reports concerning health, safety and welfare of personnel, and damage to property, as the Engineer may reasonably require.

The Contractor shall be responsible for keeping unauthorized persons off the Site, and authorized persons shall be limited to the Contractor's Personnel, the Employer's Personnel and to any other personnel notified to the Contractor by the Employer or the Engineer.

8.3.2 Load Restriction

The Contractor shall comply with the legal load restrictions in the hauling of materials and plants on public roads. The Contractor shall use every reasonable means to prevent the highways or bridges enroute to and from the project site from being damaged or injured in any way. In particular, he shall choose routes, use vehicles and restrict loads so that any extraordinary traffic for moving of plant and materials shall be limited within the applicable law/regulation.

Should it be found necessary of the Contractor to transport one or more loads of construction plant machinery or pre-constructed units, or parts of units of Work, through a section of a highway or bridge, and it is likely to damage any highway or bridge unless special protection or strengthening is carried out, the Contractor shall, before moving the load, first inform the Engineer of the weight and other particulars of the load to be moved and his proposals of protection and strengthening work.

The Contractor shall bear all responsibility and liability for damages or injury resulting from his failure to abide by relevant provisions. The Contractor shall be responsible for all damages caused by his activities.

8.3.3 Emergency Communication Lines and Coordination with Local Authorities

The Contractor shall establish and maintain emergency communication and coordination lines with the Engineer, the PD, and local authorities, including health (hospital), police, public utility offices and representative of local communities. The Contractor shall inform the Engineer details of any accident as soon as practicable after it happened.

8.4 Environmental Management

8.4.1 Legal Framework and Process

The environmental and social considerations are essential part for sustainable development and of responsibility of the GOM and international funding agencies (WB, ADB, JICA, etc.). Democratic decision-making is indispensable for environmental and social considerations through public and stakeholder participation, information transparency and accountability.

As the international and bilateral donor agencies have its own guidelines on environmental and social considerations, the projects funded by these agencies should be referred to respective guideline. Following figure shows basic flow of Environmental and Social Consideration for development project widely understood.

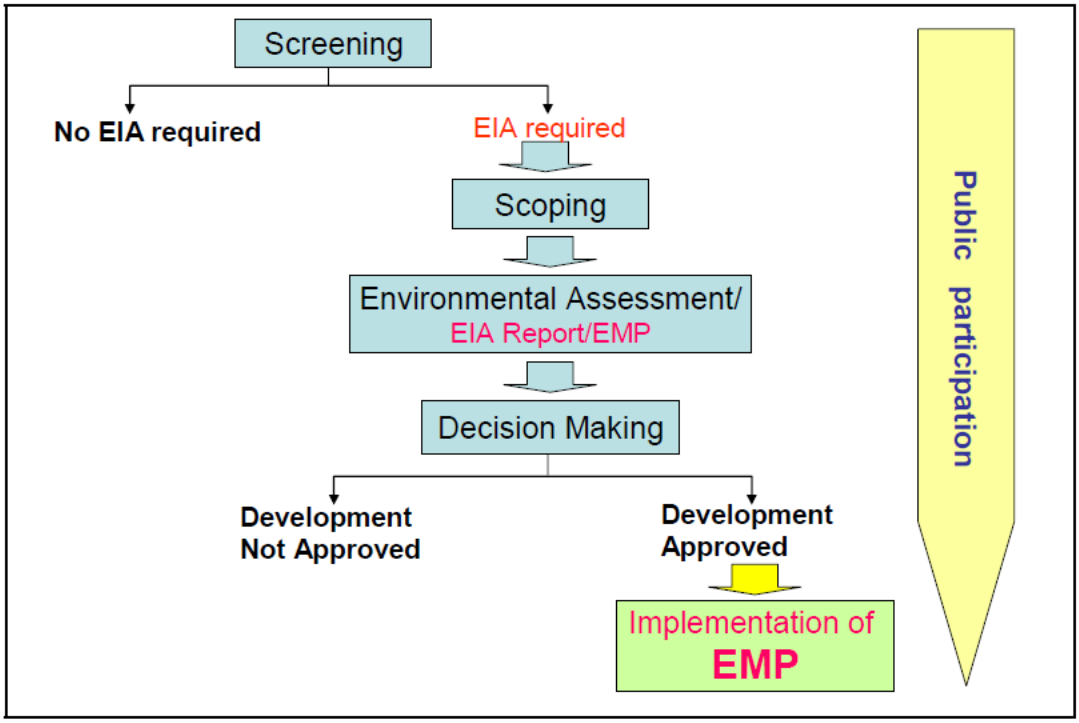


Figure 8.4-1 Common Environmental Consideration Process.

8.4.2 Environmental Impact Assessment (EIA)

The Environmental Impact Assessment (EIA) is defined as process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made.

The objectives of EIA are:

- To present to managers and decision makers a clear assessment of potential impacts on Environment;
- To apply appropriate methodology which assesses and predicts impacts and provides a) means for impact prevention and mitigation, b) the enhancement of project benefits, and c) the minimization of long-term impacts; and

- To provide specific forum for consultation for allowing stakeholders to have direct input to the environmental management process.

The EIA process should result in full consideration of all relevant information on the affected environment, of proposed alternatives and their impacts, and of the measures necessary to monitor and investigate residual effects. The process should have clear EIA content, ensure public access to information, identify the factors that are to be taken into account in decision making and acknowledge limitations. The process should address to the interrelationships of social, economic and biophysical aspects.

8.4.3 Environmental Management Plan (EMP)

Environmental Management Plan (EMP) is a framework comprised of environmental commitments outlined in the EIA report, environmental mitigation measures, standards and plans, and monitoring requirements throughout the project implementation. It is the project specific activity plan designed to minimize the negative impacts identified in the EIA process. The objectives of EMP are:

- To provide a detailed action plan for the implementation of the recommendations made in the impact assessment report;
- To provide goals and targets for environmental control that are measurable and auditable;
- To provide a basis on which the prospective contractor can accurately price
- for environmental management in his tender document;
- To specify particular roles, responsibilities and time scales;
- To provide a basis for monitoring compliance;
- To provide a site management tool;
- To form part of the construction specifications;
- To go beyond the construction phase and cover the whole project cycle including operation;
- To develop the detailed design in an interacted process to form a coherent and consistent operational tool; and
- To see to it that a dynamic plan will be able to incorporate and interpret new and improved measures.

The Contractor shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or properties. The Contractor shall comply with the measures given in the EMP and/or specific provision in the Contract Documents and shall take all reasonable precautions to avoid harm to the living and work environment in accordance with the EMP prepared based on the EIA.

Twelve (12) categories of Environmentally Critical Areas Sanctuaries:

(1) Areas declared as parks, watershed and wildlife reserves
(2) Areas set aside as aesthetic, potential tourist spot
(3) Areas which contributes habitat for any endangered or threatened species of indigenous Myanmar wildlife (flora or fauna)

(4) Areas of unique historic, archeological, geological and scientific interest
(5) Areas which are traditionally occupied by cultural communities or tribes
(6) Areas frequently visited or hard hit by natural calamities
(7) Areas with critical slope
(8) Areas classified as prime agricultural lands
(9) Water bodies
(10) Mangrove areas
(11) Coral reefs
(12) Recharged areas of aquifers

CHAPTER 9 COMPLETION AND TAKING OVER

9.1 Preliminary Inspection

Once the project reaches an accomplishment of about 90%, the MOC shall create an inspectorate team to conduct preliminary inspection and to prepare a punch-list for submission to and approval by the PD. The punch-list shall contain among other things, the remaining works and work deficiencies for necessary correction/remedy works by the contractor within the remaining contract time prior to Final Inspection for Completion. The remedy works shall be monitored and certified with the satisfaction of the Engineer.

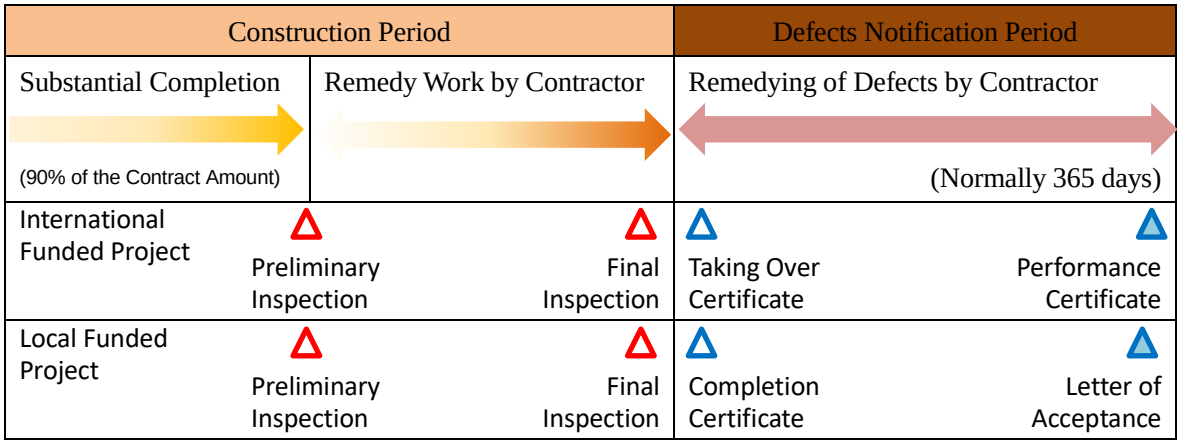


Figure 9.1-1 Procedure to Complete the Project

9.2 Final Inspection for Completion

9.2.1 Submission of Request for Final Inspection for Completion

Together with the request for final inspection, the following documents are required to be submitted to or coordinated with the designated Inspectorate Team:

(1) Certification that the defects/deficiencies noted during the preliminary inspection has been completed by the contractor;
(2) Original plans and specifications
(3) Approved As-Built Plans
(4) Approved Contract Agreement and Bill of Quantities
(5) Approved Variation Order (if any)
(6) Approved Contract Time Suspension/Extension
(7) Monthly Progress Report indicating substantial completion (C > 95%)
(8) Approved Statement of Work Accomplished (latest)
(9) Others as maybe required.

9.2.2 Final Inspection

Final Inspection shall be participated by representatives of the Project Director and the Engineer. The inspectorate team for Final Inspection for Completion shall prepare a Final Punch-List containing the remaining works and work deficiencies for remedy work by the Contractor, their recommendations and the specific time/duration to fully complete the project within the remaining approved contract

time. The composition of inspection team for Final Inspection for Taking Over shall be participated by following members.

Table 9.2-1 Composition of Inspectiorate Team for Final Inspection

Project Type	DOH	DOB
MOC constructed by Construction Unit	Chief Engineer / Project Director from the Construction Unit (as Contractor)/ Director of R/O / Deputy Director / Assistant Director/ Quality Control Section of MOC Head Office	Chief Engineer Project Director (Deputy Director) from Construction Unit (as Contractor) Quality Control Section of MOC (BRL)
MOC Constructed by District Office	Chief Engineer / Project Director from the Construction Unit (as Contractor)/ Assistant Director from District Office/ Director (R/O)/ Deputy Director / Quality Control Section of MOC Head Office	N/A
State / Regional Funded Project:	Project Director from the Construction Unit (as Contractor)/ (Assistant Director from District Office) / Chief Engineer / Director (R/O)/ Deputy Director (CU) / Quality Control Section of MOC Head Office	Chief Engineer Project Director (Deputy Director) from Construction Unit (as Contractor) Quality Control Section of MOC (BRL)
International Fund	Representative of the Contractor Representative of the Consultant (as the Engineer) Representative of PMU (as the Employer)	Representative of the Contractor Representative of the Consultant (as the Engineer) Representative of PMU (as the Employer)

Note: * one representative from each member office

9.2.3 Remedy Works

The Remedy Works of the Contractor, shall be monitored and supervised by the Engineer who shall certify the correctness of the applied methodologies and shall recommend issuance of Taking Over Certificate for the project. Remedy works shall be completed within the approved contract time, otherwise provisions of Liquidated Damages shall be applied.

9.3 Issuance of Taking Over Certificate

The Taking Over Certificate shall be issued by the Engineer (PD) with approval of MOC Head Office upon request of the Contractor and if the following conditions have been complied with:

(a) All the work defects/deficiencies as per Final Inspection for Completion Punch-List has been corrected by the Contractor to the satisfaction of the Engineer/ Project Engineer;

(b) The issuance of the Certificate of Project Completion is recommended by the Engineer/ Project Engineer; and

(c) There are no pending third party claims against the contractor.

9.4 Turn-Over of Sections or Parts (reference only)

The contractor may request, and the Engineer/ Project Engineer may issue Certificate of Completion in respect of:

(a) Any section in respect of which a separate time for completion is provided in the tender;

(b) Any substantial part of the works which have been both completed to the satisfaction of the Engineer and, otherwise as provided for in the contract, occupied or used by the MOC; and

(c) Any part of the Permanent Works which the MOC has elected to occupy or use prior to completion.

9.5 Release of Performance Security

The performance security shall be due for release upon request of the Contractor, after the issuance of the Certificate of Acceptance by the employer and submission of the warranty security by the contractor.

9.6 Handing-over Procedure to Maintenance Section

9.6.1 Items to be handed-over

After the completion of the works (and taking over procedure from the Contractor), following documents shall be handed over to maintenance section for the maintenance activity. In case the computerized database system is developed at maintenance section, all information/data should be converted to PDF File and should be uploaded to the database system for easy review in the future.

Table 9.6-1 Docment to be Handed-over to Maitenance Section

No.	Title	To be prepared by
1	Completion Report	Construction Unit/Contractor
2	As-built Drawing	Construction Unit/Contractor
3	Photograph at Final Inspection	Construction Unit/Contractor
4	Other Construction Record	Construction Unit/Contractor
5	Design Report	Design Section
6	Topographic Data and Geological Data	Design Section

9.6.2 Procedure to hand-over

Following procedure shall be followed to collect the data and information for handing-over to the maintenance section represented by DDG Maintenance. Construction Section represented by DDG Construction shall be responsible for collection of whole data and document described in Table 9.6-1. With regard to the design such as design report and survey data (Topographic and Geological data) may be handed from Design Section represented by DDG Planning to maintenance section.

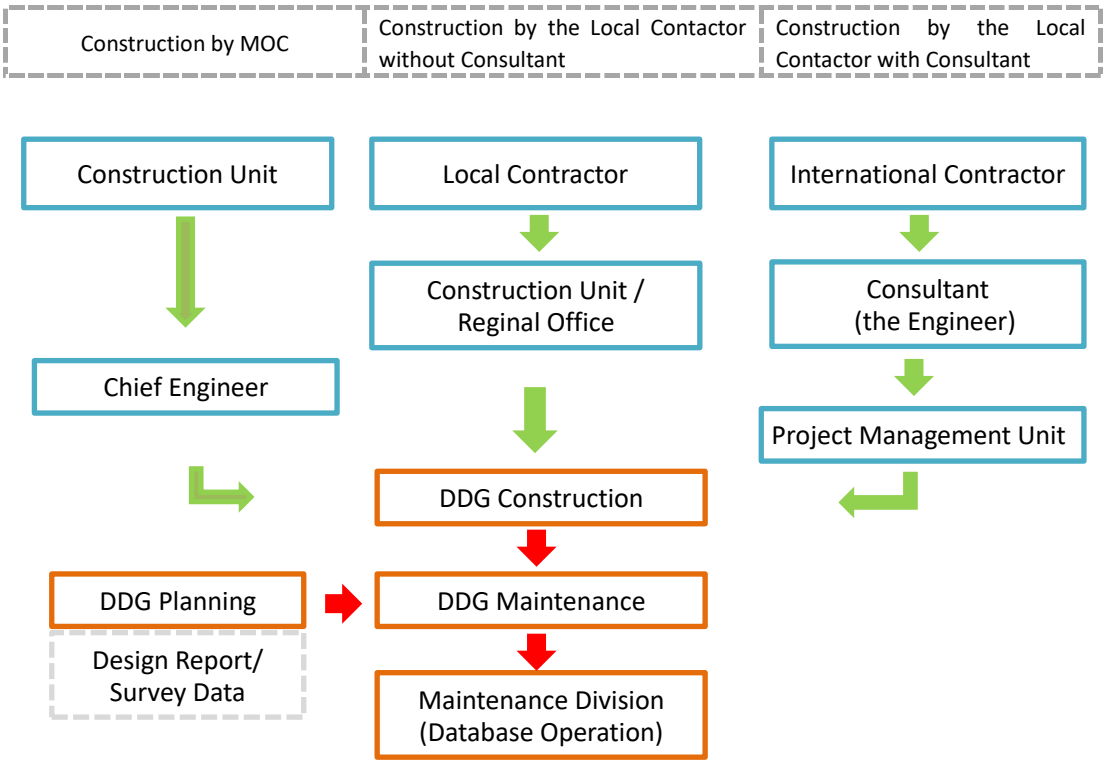


Figure 9.6-1 Procedure for Document Handing Over after Construction

CHAPTER 10 DEFECTS LIABILITY

10.1 Defects Notification Period

The Contractor after issuance of the Taking Over Certificate by the Engineer shall still have the responsibility of keeping the road project function and quality through maintenance and repair of whatever defects/deficiencies that may occur in the projects within the period of one year (1 yr.), this is the Defects Notification Period.

The Engineer/PD shall make a joint inspection with the contractor's representatives at a quarterly basis during the Defects Notification Period and shall direct any remedial and maintenance works that would be deemed as the "defects" by the Contractor such as:

(a) Cracks/Joints Sealing
(b) Reshaping/recompacting of road shoulders
(c) Others as maybe required by the Engineer/PD

10.2 Preliminary Inspection

At the end of the Defects Notification Period, the MOC shall create an Inspectorate Team to conduct preliminary inspection preparatory to final acceptance of the Project and to prepare the Final Punch-List for submission of the Performance Certificate by the Engineer. The Punch-List shall contain among other things, the remaining works and works defects/deficiencies for corrective works by the Contractor and the specific time to complete the remedial works. The Contractor shall undertake the remedial works at his own expense of any damage to the Project on account of the use of materials of inferior quality and/or insufficient quality control.

10.3 Final Inspection for Acceptance of the Project

10.3.1 Submission of Request for Final Inspection

Together with the request, the following documents are required to be submitted to/coordinated with the designated INSPECTORATE TEAM for Final Acceptance of the project:

(a) Certification that the defects/deficiencies noted during the preliminary inspection has been completed by the contractor;
(b) Original plans and specifications
(c) Approved As-Staked Plans
(d) Approved As-Built Plans
(e) Approved Contract Agreement and Bill of Quantities
(f) Approved Variation Order (if any)
(g) Approved Contract Time Suspension/Extension
(h) Monthly Progress Report indicating substantial completion (C>95%) (i) Approved Statement of Work Accomplished (latest)
(j) Others as maybe required

10.3.2 Joint Final Field Inspection

Field inspection shall be participated by representatives of the Contractor, the Engineer and PD in the case of Foreign Assisted Projects as well as MOC funded Projects respectively. The designated Inspectorate Team shall conduct the Final Inspection for acceptance of the project and shall prepare the Final Punch-list containing works and works deficiencies/defects to be corrected by the contractor within ninety (90) calendar days from the time the Engineer/Project Engineer has issued an order to undertake repair.

10.3.3 Remedy Works

The remedial works contained in the Final Inspection Punch-List for Project Acceptance shall be monitored and certified by the Engineer/Project Engineer that the corrective works undertaken by the contractor were already completed and carried out to the Engineer's/Project Engineer's Satisfaction and Issuance of the Certificate of Acceptance is recommended.

10.4 Issuance of Performance Certificate (Completion Certificate)

Performance of the Contractor's obligation shall not be considered to have been completed until the Engineer has issued the ***Performance Certificate*** to the Contractor, stating the date on which the Contractor completed his obligations under the Contract. The Engineer shall issue the Performance Certificate within 28 days after the latest of the expiry dates of the Defects Notification Periods, or as soon thereafter as the Contractor has supplied all the Contractor's Documents and completed and tested all the Works, including remedying any defects. Only the Performance Certificate shall be deemed to constitute acceptance of the Works. Performance Certificate of the Project shall be issued by the Engineer upon request of the Contractor and if the following conditions had been complied with:

(d) Taking Over Certificate were previously issued for the Project; and

(e) The defects/deficiencies as per Final Inspection for Acceptance punch-list has been repaired to the satisfaction of the Engineer/Project Engineer

10.5 Release of Remaining Retention Money (only for Foreign Funded Project)

The remaining "retention money" or an "On demand" bank guarantee shall be released upon final acceptance of the Works.

Appendix

Serial No. :

Type of Design :

Ministry of Construction

Department of Bridge

Check List for Bridge Design (Steel Plate Girder)

Date :

Project Name :

Project No. :

Section :

Examiner :

CMA-2

Summary of Design

Bridge Name			Design Date				
Road Name			Design by				
Location			Engineer				
GPS Coordinate	N	E	Classification				
Bridge Length			Road Class				
Span Arrangement			Horizontal Alignment				
Carraigeway			Vertical Alignment				
Number of Lanes			Deck Type			Thickness	
Skew Angle			Pavement Type			Thickness	
Structural Type	Superstructure		Bearing Type				
	Substructure		Expansion Joint Type				
			Corrosion Prevention				
Specifications	Design		Ground Condition				
	Construction		Erection Method				
	Materials		River	Name			
Grade of Steel				Width			
				HWL			
				LWL			
Weight of Steel			Road	Name			
Unit Steel Weight				Width			
			Railway	Name			
				Width			

Check List for Bridge Design (Steel Plate Girder)

No.	Item	Content	Reference	Check by Examiner			Result	Note
A	General							
1	Type of Design	1) Indication of type and level of design	A-1-1					
		2) Understanding of purposes of design						
2	Qualification	1) Conformity to requirement						
	of Designer	Academic background						
		Registration/Certificate of qualification						
		Experience						
3	Development Plan	1) Conformity to higher development plan						
		2) Consultation with relevant Authorities						
		3) Instruction of Ministry of Construction						
		4) Instruction of Ministry of Environment						
		5) Instruction of Ministry of Transport						
4	Design Standard	1) Application of suitable design standard	A-4-1					
		2) Application of suitable material standard	A-4-2					
		3) Application of suitable construction standard	A-4-3					
		4) Application of suitable geometric standard						
5	Previous Reports	1) Pre-feasibility study						
		2) Feasibility study						
		3) Environmental Impact Assessment						
		4) Topographic survey						
		5) Geological survey						
6	New technology	1) Application of new technology						

Check List for Bridge Design (Steel Plate Girder)

No.	Item	Content	Reference	Check by Examiner			Result	Note
B	**Design Condition**							
1	Road class	1) Design speed						
		2) Number of lanes						
		3) Width of lane						
		4) Carriageway configuration						
		5) Width of walkway						
2	Natural condition	1) Temperature change	B-2-1					
		2) Rainfall						
		3) Ground condition						
		4) River condition						
		5) Scenic area						
3	Social condition	1) Impact to people						
		2) Land use						
4	Design loads	1) Vehicle load	B-4-1					
		2) Dynamic influence	B-4-2					
		3) Influence of multi-lane loading	B-4-3					
		4) Wind force						
		5) Earthquake						
		6) Combination of loads	B-4-6					
5	Clearance	1) Clearance under bridge						
		2) Clearance above road surface	B-5-2					
6	Pavement	1) Type of pavement						
		2) Thickness of pavement						

Check List for Bridge Design (Steel Plate Girder)

No.	Item	Content	Reference	Check by Examiner			Result	Note
C	**Superstructure**							
1	Basic dimension	1) Bridge length	C-1-1					
		2) Span arrangement	C-1-2					
		3) Structural type	C-1-3					
		4) Support condition						
		5) Skew angle	C-1-5					
2	Main girder	1) Depth of plate girder	C-2-1					
		2) Arrangement of girders	C-2-2					
		3) Thickness of web plate	C-2-3					
		4) Thickness of lower flange						
		5) Thickness of upper flange	C-2-5					
		6) Position of horizontal stiffeners	C-2-6					
		7) Position of vertical stiffeners	C-2-7					
		8) Block size	C-2-8					
3	Cross frame/	1) Arrangement of cross frame						
	Cross beam	2) Type of cross frame						
4	Deck	1) Type of deck						
		2) Grade of reinforcement	C-4-2					
		3) Grade of concrete	C-4-3					
		4) Depth of deck	C-4-4					
		5) Direction of reinforcement						
		6) Size of reinforcement	C-4-6					
		7) Cover						
5	Materials	1) Grade of steel	C-5-1					
		2) Thickness of steel plate	C-5-2					
		3) Grade of high strength bolt	C-5-3					
		4) Block size	C-5-4					
6	Other	1) Slenderness ratio	C-6-1					
		2) HTB hole size/Edge distance	C-6-2					

Check List for Bridge Design (Steel Plate Girder)

No.	Item	Content	Reference	Check by Examiner			Result	Note
D	**Substructure**							
1	Abutment	1) Structural type	D-1-1					
		2) Elevation of bearing seat						
		3) Size of bearing seat	D-1-3					
		4) Support condition						
		5) Approach slab						
2	Pier							
		1) Structural type	D-2-1					
		2) Elevation of bearing seat						
		3) Size of bearing seat						
		4) Support condition						
E	**Ancillary**							
1	Bearing support	1) Type						
		2) Load capacity						
		3) Movement capacity	E-1-3					
		4) Corrosion prevention						
		5) Anchor						
2	Expansion joint	1) Type						
		2) Load capacity						
		3) Movement capacity	E-1-3					
		4) Corrosion prevention						
		5) Anchor						
3	Barrier/Parapet	1) Type						
		2) Height						
4	Drainage	1) Type						
		2) Location						
5	Maintenance facility	1) Type	E-5-1					
		2) Location						

Check List for Bridge Design (Steel Plate Girder)

No.	Item	Content	Reference	Check by Examiner			Result	Note
F	**Drawings**							
	/Material List							
1	Drawings	1) Contents	F-1-1					
		2) Size/Scale	F-1-2					
		3) Location						
		4) Project Title						
		5) Designer's signature/Date						
		6) Checker's signature/Date						
		7) Design condition						
		8) Plan view						
		9) Road alignment						
		10) Girder						
		11) Cross frame/Cross beam						
		12) Deck						
		13) Bar schedule						
		14) Bearing support						
		15) Expansion joint						
		16) Camber diagram						
		17) Construction plan						
2	Material list	1) Size						
		2) Grade						
		3) Quantity						
		4) Steel weight/carriageway area	F-2-4					
		5) Reinforcement/carriageway area	F-2-5					
		6) Paint area/Steel weight						
		6) Recyclable						
G	**Cost Estimate**							
		1) Unit costs						
		2) Cost reduction						

A-1-1 Indication of type and level of design

Level
Plannig
Preliminary
Basic
Detail

A-4-1 Application of suitable design standard

Typical Design Standard
Myanmar Road Bridge Design Standard
AASHTO LRFD Bridge Design Standard
Japan Highway Bridge Design Standard (JHBS)
AASHTO Bridge Design Standard

A-4-2 Application of suitable material standard

Typical Material Standard
Myanmar Industrial Standard
Amerian Standard for Tesiting and Materials (ASTM)
Japan Industrial Standard (JIS)
AASHTO LRFD Bridge Design Standard

A-4-3 Application of suitable construction standard

Typical Construction Standard
Myanmar Road Bridge Construction Standard
AASHTO LRFD Bridge Construction Standard
Japan Highway Bridge Design Standard

B-5-2 Clearance above road surface

Vertical Clarance	Explanation
4.5 m	
Less than 4.5 m	

B-2-1 Temperature change

State/Division	Temperature
Kachin, Sagaing, Chin	-10～+50 Deg
Shan, Kayah, Kayin	-10～+50 Deg
Mandalay, Magway	-10～+50 Deg
Bago, Nay Pyi Taw	-10～+50 Deg
Ayeyarwady, Rakhaine	-10～+50 Deg
Yangon	-10～+50 Deg
Mon, Tanintharyi	0～+50 Deg

B-4-1 Vehicle load

Typical Design Load	Design Standard
HS20	AASHTO
HS25	AASHTO
JBHD B	JHBS

B-4-2 Dynamic influence
(Example of AASHTO LRFD)

Component	IM
Deck Joints—All Limit States	75%
All Other Components:	
• Fatigue and Fracture Limit State	15%
• All Other Limit States	33%

B-4-3 Influence of multi-lane loading (Example of AASHTO LRFD)

Number of Loaded Lanes	Multiple Presence Factors, *m*
1	1.20
2	1.00
3	0.85
>3	0.65

Table 3.4.1-1—Load Combinations and Load Factors

Load Combination Limit State	*DC DD DW EH EV ES EL PS CR SH*	*LL IM CE BR PL LS*	*WA*	*WS*	*WL*	*FR*	*TU*	*TG*	*SE*	Use One of These at a Time				
										EQ	*BL*	*IC*	*CT*	*CV*
Strength I (unless noted)	γ_p	1.75	1.00	—	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Strength II	γ_p	1.35	1.00	—	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Strength III	γ_p	—	1.00	1.40	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Strength IV	γ_p	—	1.00	—	—	1.00	0.50/1.20	—	—	—	—	—	—	—
Strength V	γ_p	1.35	1.00	0.40	1.0	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Extreme Event I	γ_p	γEQ	1.00	—	—	1.00	—	—	—	1.00	—	—	—	—
Extreme Event II	γ_p	0.50	1.00	—	—	1.00	—	—	—	—	1.00	1.00	1.00	1.00
Service I	1.00	1.00	1.00	0.30	1.0	1.00	1.00/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Service II	1.00	1.30	1.00	—	—	1.00	1.00/1.20	—	—	—	—	—	—	—
Service III	1.00	0.80	1.00	—	—	1.00	1.00/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Service IV	1.00	—	1.00	0.70	—	1.00	1.00/1.20	—	1.0	—	—	—	—	—
Fatigue I—*LL, IM & CE* only	—	1.50	—	—	—	—	—	—	—	—	—	—	—	—
Fatigue II—*LL, IM & CE* only	—	0.75	—	—	—	—	—	—	—	—	—	—	—	—

- Permanent Loads

CR = force effects due to creep
DD = downdrag force
DC = dead load of structural components and nonstructural attachments
DW = dead load of wearing surfaces and utilities
EH = horizontal earth pressure load
EL = miscellaneous locked-in force effects resulting from the construction process, including jacking apart of cantilevers in segmental construction
ES = earth surcharge load
EV = vertical pressure from dead load of earth fill

Table 3.4.1-2—Load Factors for Permanent Loads, γ_p

Type of Load, Foundation Type, and Method Used to Calculate Downdrag		Load Factor Maximum	Load Factor Minimum
DC: Component and Attachments		1.25	0.90
DC: Strength IV only		1.50	0.90
DD: Downdrag	Piles, α Tomlinson Method	1.4	0.25
	Piles, λ Method	1.05	0.30
	Drilled shafts, O'Neill and Reese (1999) Method	1.25	0.35
DW: Wearing Surfaces and Utilities		1.50	0.65
EH: Horizontal Earth Pressure			
• Active		1.50	0.90
• At-Rest		1.35	0.90
• *AEP* for anchored walls		1.35	N/A
EL: Locked-in Construction Stresses		1.00	1.00
EV: Vertical Earth Pressure			
• Overall Stability		1.00	N/A
• Retaining Walls and Abutments		1.35	1.00
• Rigid Buried Structure		1.30	0.90
• Rigid Frames		1.35	0.90
• Flexible Buried Structures			
○ Metal Box Culverts and Structural Plate Culverts with Deep Corrugations		1.5	0.9
○ Thermoplastic culverts		1.3	0.9
○ All others		1.95	0.9
ES: Earth Surcharge		1.50	0.75

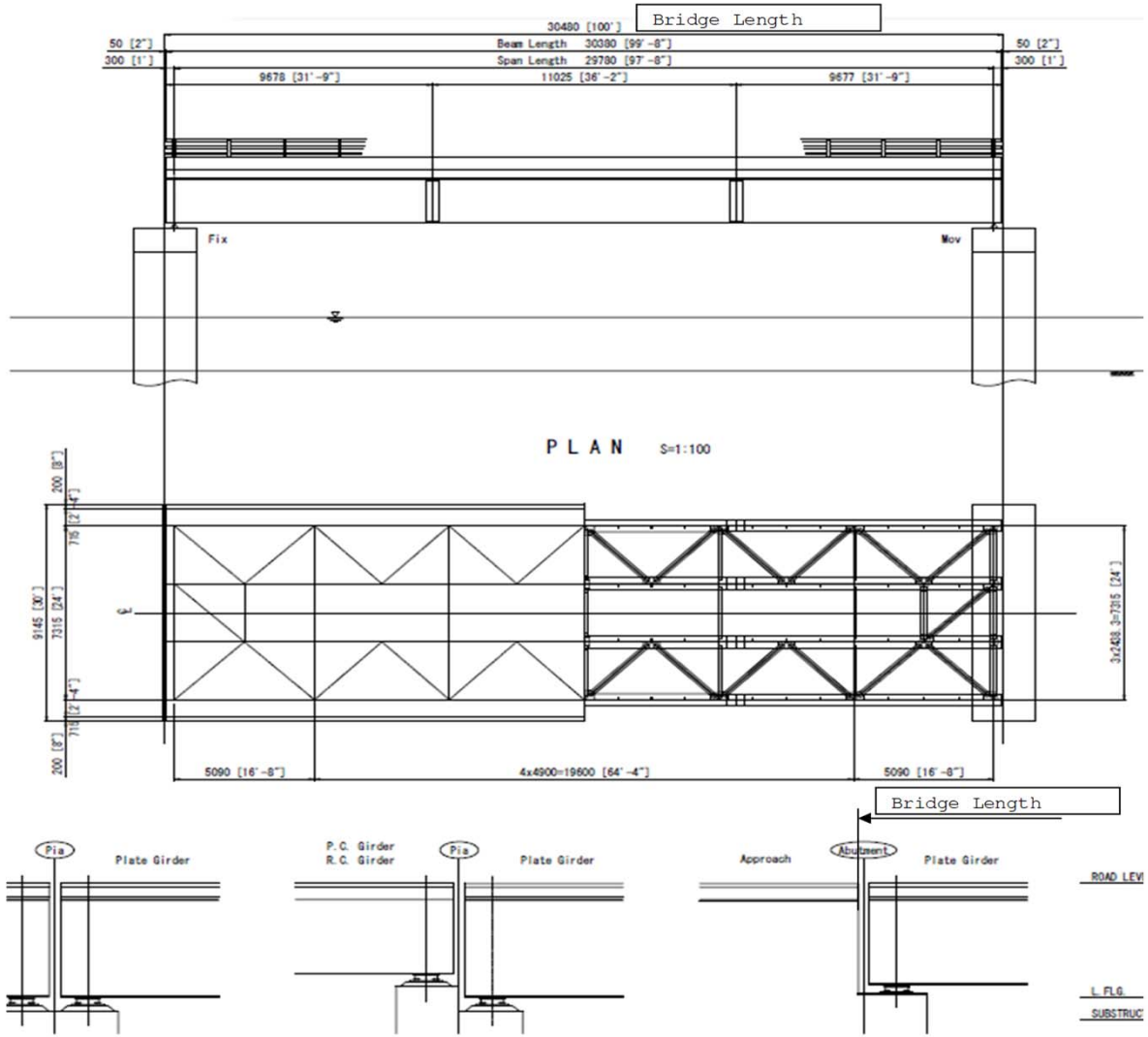
PS = secondary forces from post-tensioning
SH = force effects due to shrinkage

- Transient Loads

BL = blast loading
BR = vehicular braking force
CE = vehicular centrifugal force
CT = vehicular collision force
CV = vessel collision force
EQ = earthquake load
FR = friction load
IC = ice load
IM = vehicular dynamic load allowance
LL = vehicular live load
LS = live load surcharge
PL = pedestrian live load
SE = force effect due to settlement
TG = force effect due to temperature gradient
TU = force effect due to uniform temperature
WA = water load and stream pressure
WL = wind on live load
WS = wind load on structure

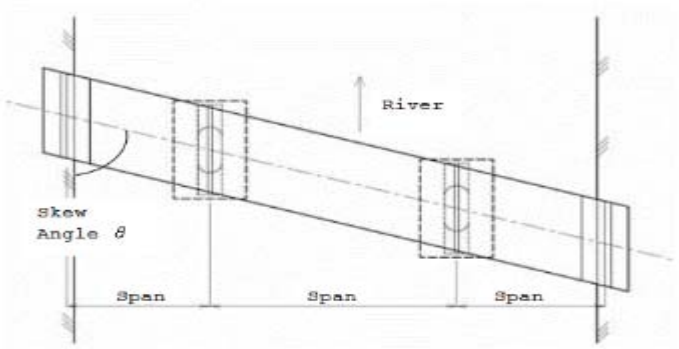
C-1-1 Bridge length

C-1-2 Span arrangement



C-1-5 Skew angle

Recommendation $\theta \geq 75$ deg

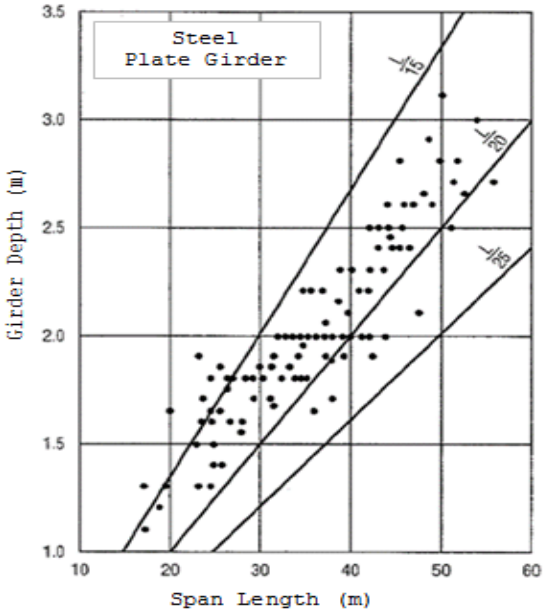


C-1-3 Structural type

Type of Superstructure
Steel Plate Girder (non-composite)
Steel Plate Girder (composite)
Steel Box Girder
Steel Truss
Steel Arch
Steel Cable-stayed Bridge
Steel Suspension Bridge

Structural Type	Span Length (m)																									
	0		10		20		30		40		50		60		70		80		90		100		110		120		130	
RC Box Culvert																										
RC Slab																										
Steel H Girder																										
Steel Plate Girder (Simple Span)																										
Steel Plate Girder (Continuous Span)																										
Steel Box Girder (Simple Span)																										
Steel Box Girder (Continuous Span)																										
Steel Truss (Simple Span)																										
Steel Truss (Continuous Span)																										

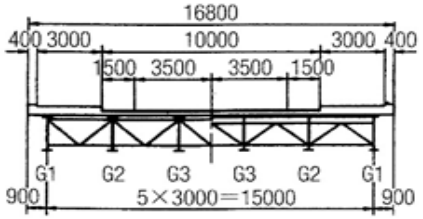
C-2-1 Depth of plate girder



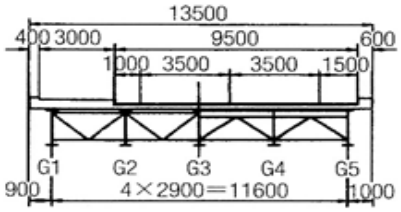
C-2-2 Arrangement of girders

a) Major Trunk Road

Example (1)

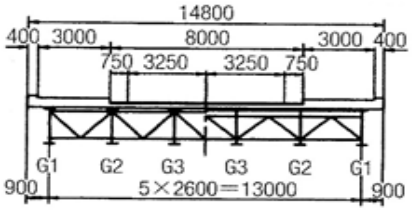


Example (2)

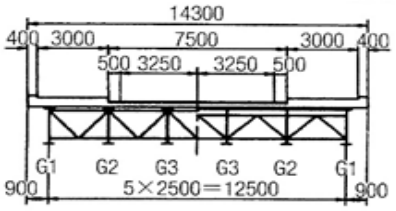


b) Trunk Road

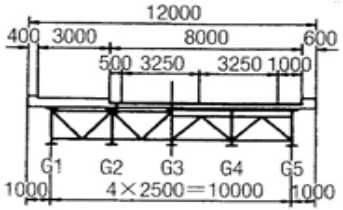
Example (3)



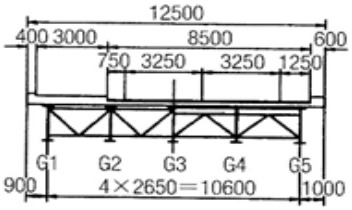
Example (4)



Example (5)

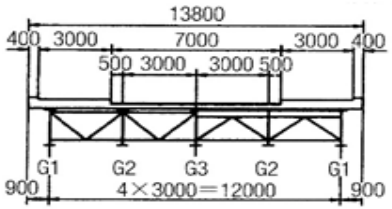


Example (6)

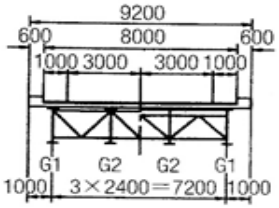


c) Sub-Trunk Road

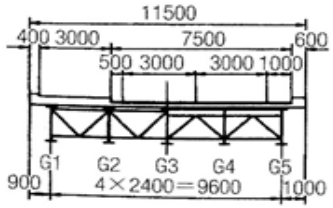
Example (7)



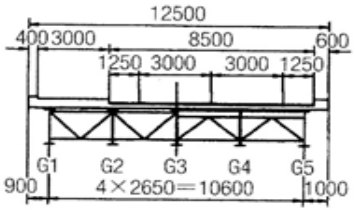
Example (8)



Example (9)



Example (10)



C-2-3 Thickness of web plate

Minimum Thickness of Web of Plate Girder (mm)

Grade / Horizntal Stiffener	SS400 SM400	SM490	SM490Y SM520
Without Stiffener	b/152	b/131	b/124
With 1 Stiffener	b/256	b/221	b/208
With 2 Stiffeners	b/311	b/311	b/293

JHBS

C-2-5 Thickness of upper flange

Minimum Thickness of Upper Flange Plate (mm)

RC Deck Connection	Min. Thickness
Shear Connectors welded on Flange	10

JHBS

C-4-2 Grade of reinforcement

C-4-3 Grade of concrete

C-4-4 Depth of deck

Minimum Thickness of RC Deck (mm)

Deck for Vehicle	160
Deck for Pedestrians	140

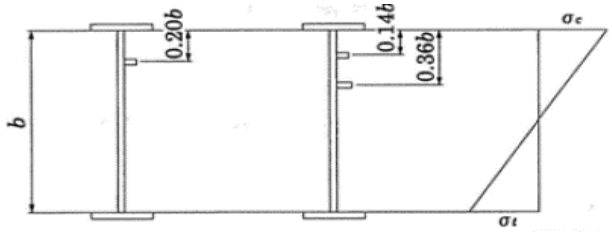
JHBS

C-4-6 Size of reinforcement

Common Practice

Deformed Reinforcement Bar				
D13	D16	D19	D22	D25
D29	D32	D35	D38	D51

C-2-6 Position of horizontal stiffeners



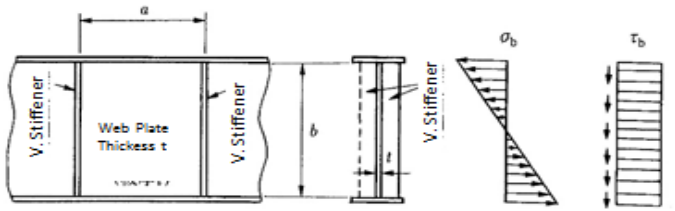
C-2-7

Position of vertical stiffeners

Max. Web Plate Depth without Vertical Stiffener

Grade	SS400 SM400 SMA400W	SMA490	SM490Y SM520 SMA490W	SM570 SMA570W
Max. Web Plate Depth b	70t	60t	57t	50t

t : Plate Thickness



Space of Vertical Stiffeners

C-5-1 Grade of steel

AASHTO Desigination M270 (Equivalent ASTM Designation A709)

Grade	36	50	50S	50W	HPS50W
Max. Plate Thickness	100	100	100	100	100
Min. Tensile Strength (Mpa)	400	450	450	490	490
Min. Yield Strength (Mpa)	248	344	344	344	344

JIS

Thickeness (mm)		6-16	17-40	41-75	76-
SS400	Min. Tensile Strength (Mpa)	400	400	400	400
	Min. Yield Strength (Mpa)	245	235	215	215
SM400, SMA400W	Min. Tensile Strength (Mpa)	400	400	400	400
	Min. Yield Strength (Mpa)	245	235	215	215
SM490	Min. Tensile Strength (Mpa)	490	490	490	490
	Min. Yield Strength (Mpa)	325	315	295	295
SM490Y, SMA490W	Min. Tensile Strength (Mpa)	490	490	490	490
	Min. Yield Strength (Mpa)	365	355	335	325
SM520	Min. Tensile Strength (Mpa)	520	520	520	520
	Min. Yield Strength (Mpa)	365	355	335	325

C-5-2 Thickness of steel plate

Applicable Thickness of Steel Plate

grade \ Thickness of Steel Plate (mm)	6	8	16	25	32	40	50	100
SS400		■	■	■	■	■	■	■
SM400A		■	■	■	■			
SM400B		■	■	■	■	■		
SM400C		■	■	■	■	■	■	■
SM490A		■	■	■				
SM490B		■	■	■	■	■		
SM490C		■	■	■	■	■	■	■
SM490YA		■						
SM490YB		■	■	■	■	■		
SM520C		■	■	■	■	■	■	■

JHBS

C-5-3 Grade of high strength bolt

Nominal Resistance of a Slip-critical HT Bolt (kN)

Size \ Grade	F10T	S10T
M20	66	66
M22	82	82
M24	95	95

JHBS

C-5-4 Block size

Common Practice

Max. Length	Max. Height (Width)
12 m	3.5 m

C-6-1 Slenderness ratio

Limiting Slenderness Ration

Member		ℓ / r
Compression	Main Member	120
	Secondary Member	150
Tension	Main Member	200
	Secondary Member	240

JHBS

ℓ : Unbraced length of member (mm)

r : Radius of gyration (mm)

C-6-2 HTB hole size/Edge distance

Maximum Hole Size

Size	Standard	Over Size
M20	22	24
M22	24	28
M24	26	30

AASHTO LRFD

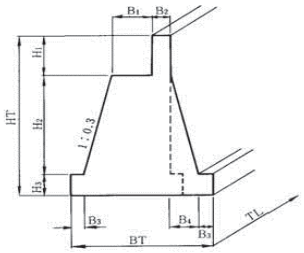
Minimum Edge Distance

Size	Sheared Edge	Rolled Edges of Plate/Shapes
M20	34	26
M22	38	28
M24	42	30

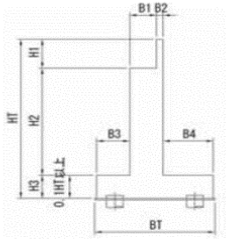
AASHTO LRFD

D-1-1 Structural type

Structural Type
Grabity Type
Inverse T Type
Butress Type
Frame Type



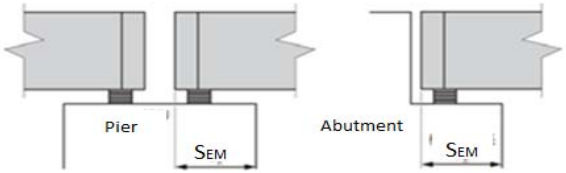
Grabity Type



Inverese T Type

D-1-3 Size of bearing seat

$$S_{EM} \geq 0.7 + 0.005 \times \text{Span}$$

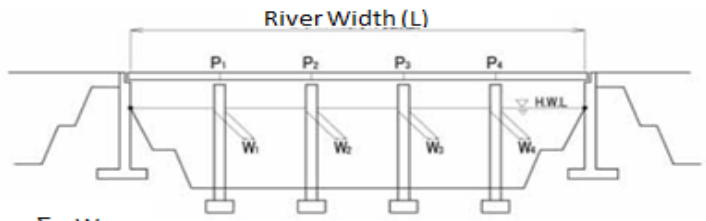


D-2-1 Structural type

Structural Type
Grabity Type
Inverse T Type
Butress Type
Frame Type

D-2-5 Blockage Rate

$$\text{Blockage Rate} \leqq 5\,\%$$



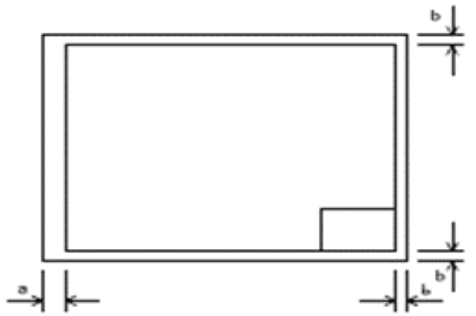
$$\text{Blockage Ratio} = \frac{\sum W}{L} \times 100\ (\%)$$

F-1-1 Contents

No.	Name of drawing	Scale	Necessary Information	
1	Location	1/25,000 ～ 1/50,000	North Direction, Location, Carriageway width	
2	General view	1/50 ～ 1/500	Structural type, Design condition, geological data, location of boring	
3	Alignment plan		Horizontal, Vertical alignment, Coordinates	
4	General view of structure	1/50 ～ 1/500		
5	Detail of superstructure	1/20 ～ 1/100	Main girder, Transverse beam, Cross frame, Floor system, Deck floor, Bearings, Expansion joint, Drainage, Barrier, Inspection way, Camber	
6	Detail of substructure	1/20 ～ 1/100	Abutment, Pier	
7	Detail of foundation	1/20 ～ 1/100	Pile, Well, V Caisson	
8	Detail of temporary works	1/20 ～ 1/100	Retaining wall, Temporary bridge,	

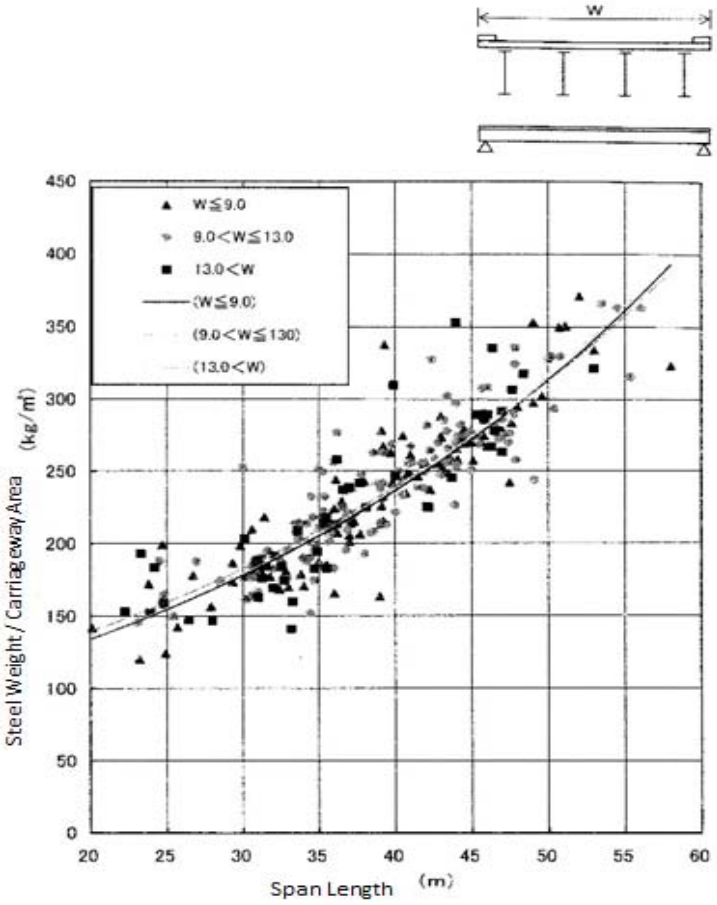
F-1-2 Size/Scale

Size of Drawing is A1

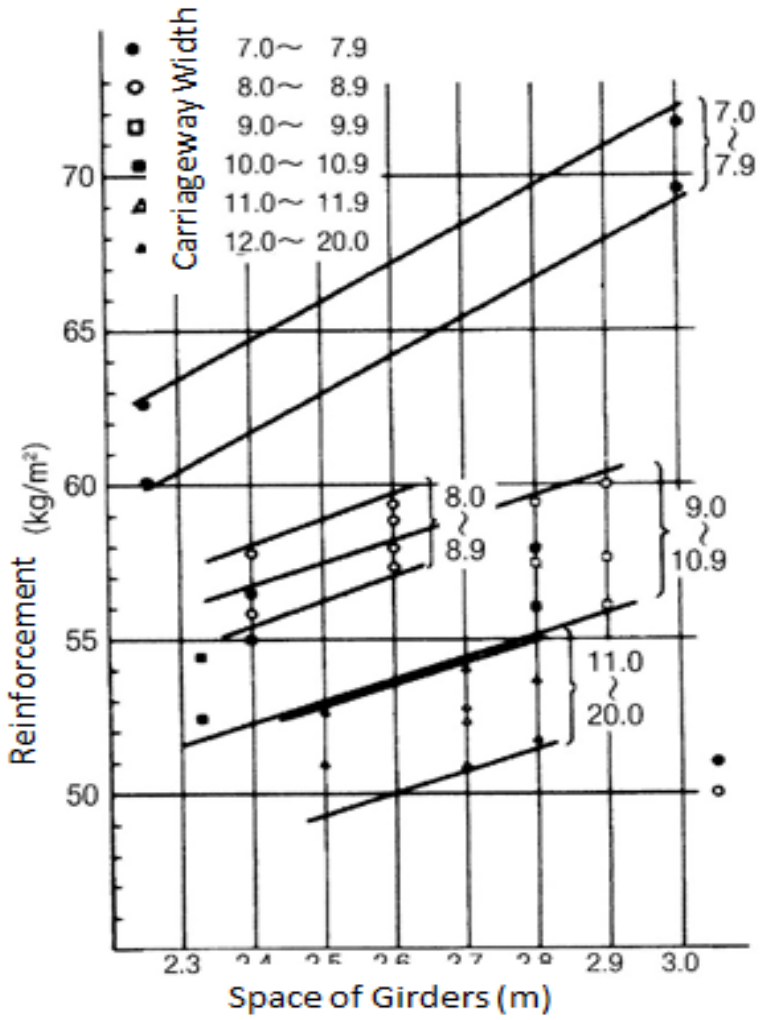


$a \geq 40\ mm$
$b \geq 20\ mm$

F-2-4 Steel weght/carriageway area



F-2-5 Reinforcement/carriageway area



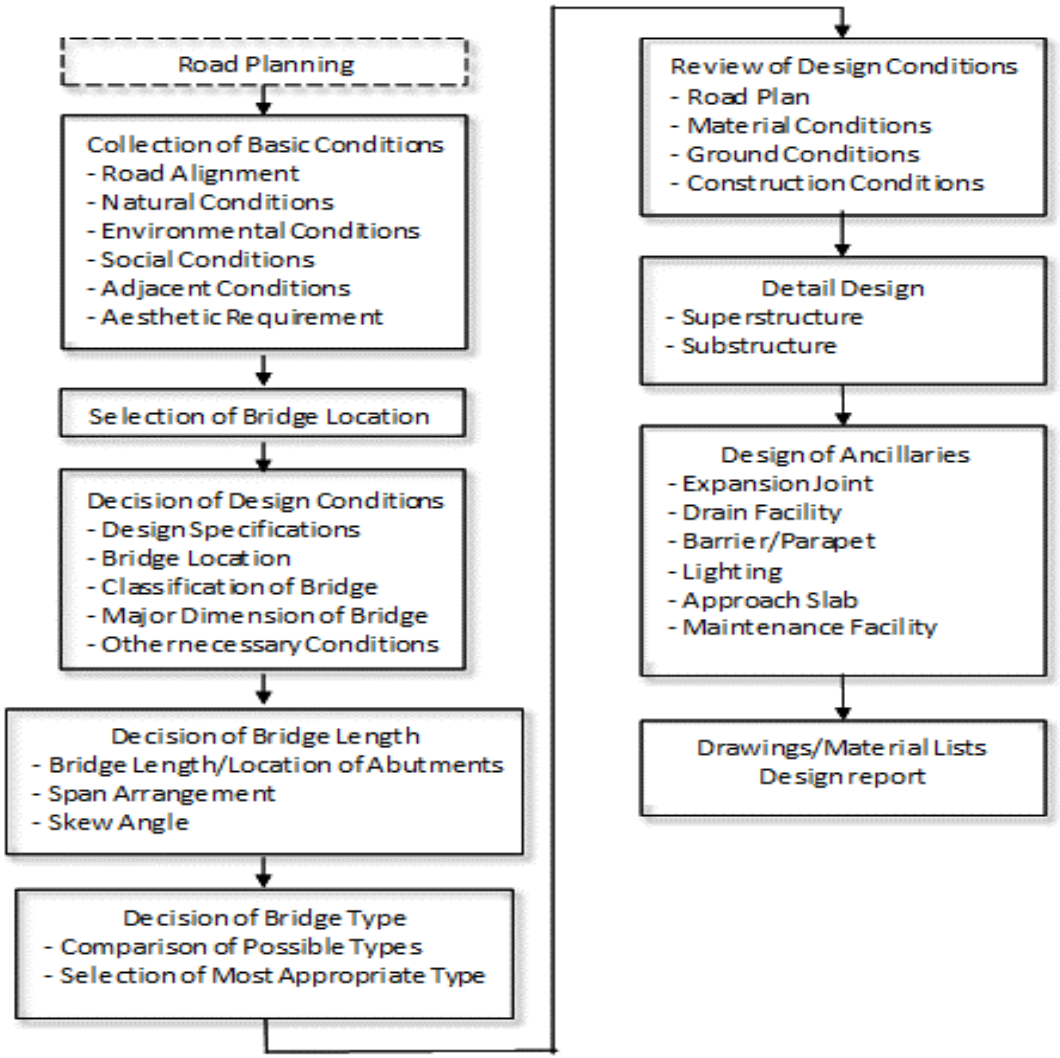


Figure 1 Flow of Planning

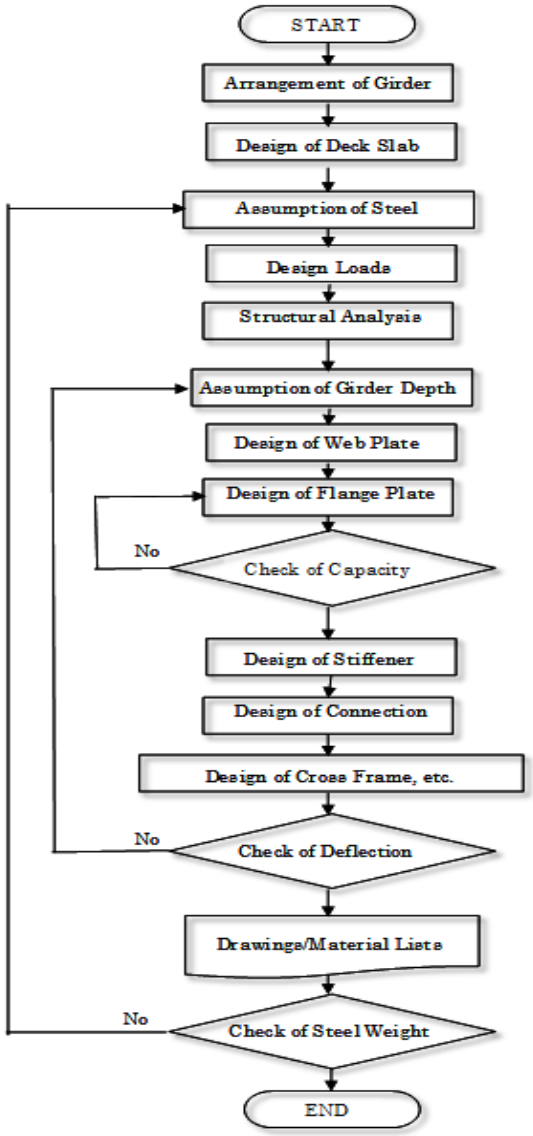


Figure 2 Flow of Design