Building and Construction Authority

Builders' Guide on MEASURING PRODUCTIVITY

A guide to help builders measure productivity of various trades

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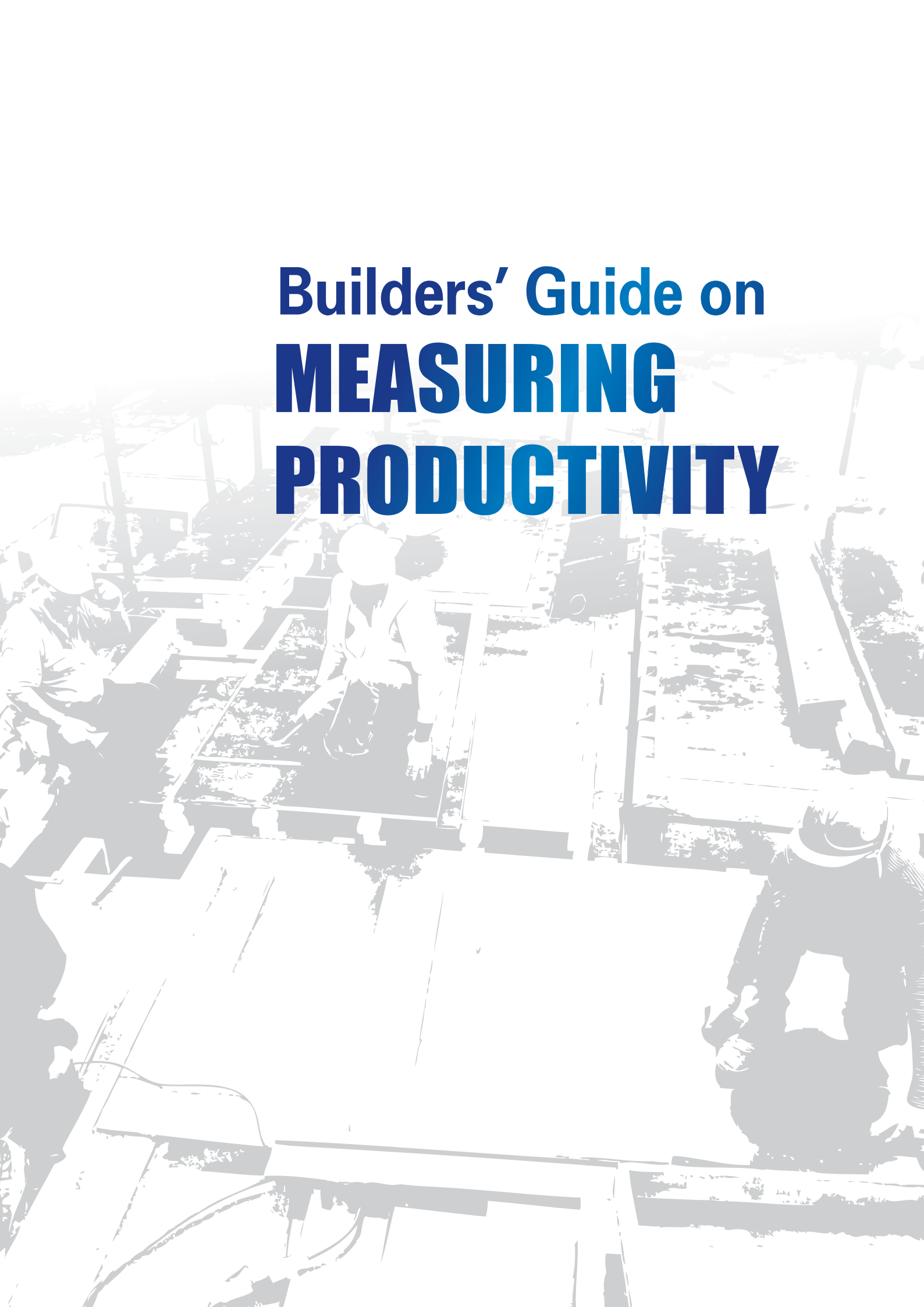

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Building and Construction Authority

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Foreword

The Building and Construction Authority (BCA) formulated the Construction Productivity Roadmap in 2010 with the aim to transform the construction industry and raise its productivity. Under the key thrust of enhancing industry awareness, BCA was tasked to establish benchmark indicators especially at project and trade levels for builders to track their own productivity performance. In order to do this, it is necessary for builders to adopt a common methodology of measuring project and trade productivity. On 15 July 2011, the submission of construction productivity data to BCA became a mandatory requirement for the builders. This was in conjunction with the enhanced buildability framework and applied to projects with Gross Floor Area (GFA) of 5000 square meters or more. The builders used a common platform under the Electronic Productivity Submission System (ePSS) to submit the construction productivity data. These data would primarily be used to establish the project level productivity.

Apart from monitoring the project productivity of building projects, it is also necessary to measure the trade productivity to have an in-depth analysis of the productivity performance in various aspects of site work. Trade productivity would reflect the efficiency and the quality of the workforce. It is particularly useful for planning and scheduling of work processes. BCA has thus produced this Builders' Guide on Measuring Productivity. This Guide provides best practices on how to measure productivity for the 12 key trades which are commonly found in most construction projects. These best practices are illustrated through flowcharts and photographs that showed the activities involved in each trade. Productivity Monitoring Forms have also been developed for each of the key trade and builders would be able to adopt them as a common tool to measure the trade productivity.

BCA has been working closely with a group of builders in developing and using this Guide to study the trade productivity since February 2011. This Guide should come in handy to those who are unsure but want to start measuring the trade productivity in their projects. There is nothing better than learning from those that have embarked on and excelled in the same journey.

TAN TIAN CHONG
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Building and Construction Authority

Acknowledgement

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Name	Designation	Company
Mr Allan Tan	Project Director	Dragages Singapore Pte Ltd
Mr Tnay Kwang Meng	Project Manager	Ho Lee Construction Pte Ltd
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Mr Chao Shi Jie	Construction Manager	Shimizu Corporation
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Mr Hua Tai Suan, Andy	Project Manager	Singa Development Ptd Ltd
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Introduction

The measurement of trade productivity provides the builders a platform to carry out in-depth analysis of their productivity performance. At the trade level, the amount of physical output per manhour is measured. A worker is deemed to be more productive if he produces more output within an hour. The indicator is calculated as follows:

$$\text{Trade Productivity} = \frac{\text{Total units of output}}{\text{Total manhours (hr)}}$$

The unit of measurement for trade productivity would vary for different trades. For example the unit of measurement for formwork installation is area of formwork installed (m^2) / manhour while the unit of measurement for electrical conduit installation is length of conduit installed (m) / manhour.

This guidebook sets out the best practices on how to measure the productivity for the 12 key trades which are commonly found in most construction projects. The Productivity Monitoring Forms that have been developed for each of the key trades gave the activities and parameters that the builders should monitor and measure. Through these forms, the builders would be able to adopt a common platform to measure the trade productivity. To complement the forms, the activities involved in each trade are illustrated through flowcharts and photographs.

All the best practices in this guidebook have been gathered from the builders that have participated in the Productivity Improvement Project (PIP) on Trade & Project Level Productivity Study. References have also been made to international standards, e.g. the ASTM E2691–Practice for Job Productivity Measurements. It is a useful guide for builders who wish to measure the trade productivity in their projects.

1 FORMWORK INSTALLATION

The flowchart below shows the typical processes involved in the installation of table formwork during construction. The sequence for other system formwork will differ. It serves as a guide on the activities that are to be considered during the measurement of productivity for this trade.

1. Dismantling of Table Formwork
2. Lifting of Table Formwork from Previous Floor to Upper Floor
3. Setting Out, Alignment and Level Check
4. Placing of Infill Form, if any

1.1 Table Formwork Installation Process

The following sections show the steps involved when installing table formwork. While the specific construction techniques employed may differ, these are the common stages of work that are commonly carried out on site.

1.1.1 Dismantling of Table Formwork

Dismantling of table formwork include striking of infill forms, lowering down and shifting of formwork out of building.

Lowering down the table formwork

Securing lifting cable to formwork

Shifting of table formwork out of building

1.1.2 Lifting of Table Formwork from Previous Floor to Upper Floor

Lifting of table formwork by crane to the floor above.

1.1.3 Setting Out, Alignment and Level Check

Checking and adjusting the position of table formwork

Positioning the table formwork

Checking and adjusting the level of the table formwork

1.1.4 Placing of Infill Form, if any

Placing of infill panel

1.2 Formwork Installation Productivity Monitoring Form

The Formwork Installation Productivity Monitoring Form has been designed to standardize the monitoring of productivity for formwork installation. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and the methodology before using the form.

Methodology

1) The location where the formwork installation would be monitored should first be identified. It is recommended for the builder to start the monitoring when the installation has reached the stage of a typical floor. The example shows the monitoring on 25th Storey, Zone1 of Block 123.

2) The following should then be calculated or recorded:
   a) Area of horizontal formwork used on that floor
   b) Manpower used during the installation of the formwork; this should include the trade gang, safety & health workers, machine operator that operates the lifting equipment e.g. tower crane. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour. The example shows that about 11.11 manhours were required to install formwork of an area of 25m^2. This is equivalent to 7 men working for approximately 1.6 hours to install 25m^2 of the formwork.

4) The trade productivity is then calculated by dividing the area of formwork by the manhours taken.

5) The following information should be provided in the form:
   a) Type of equipment used. A tower crane was used in the example.
   b) Floor to floor height
   c) Breakdown of the manpower type. The example shows a trade gang of 4 men, 1 tower crane operator, 1 safety supervisor and 1 rigger/signaller.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Dismantling of formwork
   b) Lifting of table formwork from previous floor to upper floor
   c) Setting out, alignment & level checks
   d) Placing of infill form, if any.

   (The form should indicate as a percentage the time taken for each of the above activities)

7) The downtime and waiting time of the tower crane should be excluded from the manhours taken.

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = 25th Storey, Zone 1 of Block 123
- Area of table formwork for each typical floor at zone 1 = 25m^2
- Floor to floor height = 3200mm

Manpower Size

Trade manpower = 4men
Tower crane operator = 1man
Safety and Health workers = 1 safety supervisor, 1 rigger/signaller

Time taken

Dismantling of formwork	2.22	manhours
Lifting of formwork from previous floor to upper floor		
(Tower crane in operation)	3.33	manhours
(Tower crane downtime)	(0.50	manhours) (excluded)
Setting out, alignment & level checks	2.78	manhours
Placing of infill form, if any.	2.78	manhours
Total	11.11	manhours

Productivity Calculation

$$\text{Trade Productivity} := \frac{\text{Formwork area}}{\text{Total manhours}}$$

$$= \frac{25\text{m}^2}{11.11 \text{ manhours}}$$

$$= 2.25 \text{ m}^2/\text{manhour}$$

Formwork Productivity Monitoring Form

(Horizontal Formwork)

Building and Construction Authority

Project Title: _____

S/no	Location	Area of Form Work[1] (m^2)	Total Manhour Taken[2]	Trade Productivity (m^2/manhour)	Mechanical and Non-mechanical equipment used (if any) Mechanical: Tower Crane, Mobile Crane etc. Non Mechanical: Scaffold/Ladder/Bench, etc.	Floor to Floor Height	Breakdown of Manpower Size			Please indicate the % of time taken in each activities			
							Trade[3]	Machine Operator[4,5]	Safety and Health[6]	1 Dismantling of Table Formwork	2 Lifting of Table Formwork from Previous Floor to Upper Floor	3 Setting Out, Alignment & Level Checks[7]	4 Placing of Infill Form, if any.
E.g.[8]	*Blk 123 25th Sty (Zone1)*	*25*	*11.11*	*2.25*	*1 x Tower Crane*	*3200mm*	*4 men*	*1man*	*2 men*	*20%*	*30%*	*25%*	*25%*
										Percentage of time taken for Activities 1 to 4 MUST add up to 100 %.			
1													
2													
3													

Remark:

Recorded By: _____ Checked By: _____

Date: _____ Date: _____

Notes:

1) The area of the formwork is based on the total plan area of the formwork.
2) The manhours taken **do not** include hours clocked by the site management team.
3) The trade manpower size refers to the gang size only.
4) The machine operator manpower size refers to operators of lifting equipment, transportation equipment and temporary hoist.
5) Mechanical equipment that do not require a designated operator, for example scissor lift shall not be recorded under Machine Operator manpower. Such worker should be recorded under the Trade manpower.
6) The safety and health manpower size refers to safety supervisor, rigger/signaller and housekeeping worker.
7) The manhours taken for the erection/dismantling of scaffolding, if any, shall be recorded under the activities "Setting Out, Alignment & Level Checks".
8) The trade productivity value shown in the example is not meant for benchmarking purpose.

2 REINFORCEMENT PLACING AND FIXING

The flowchart below shows the typical processes involved in the installation of reinforcement during construction. It serves as a guide on the activities that are to be considered during the measurement of productivity for this trade.

1. Preparation of Reinforcement
2. Transportation of Reinforcement to Location
3. Placing and Fixing of Reinforcement
4. Laying and Securing of M&E Services

2.1 Reinforcement Placing And Fixing Process

The following sections show the steps involved when placing and fixing re-bars. While the specific construction techniques employed may differ, these are the common stages of work that are commonly carried out on site.

2.1.1 Preparation of Reinforcement

Cutting of re-bars to required length

Bending of re-bars to required shape using bar bending machine

2.1.2 Transportation of Reinforcement to Location

Transportation of reinforcement to location refer to transporting from the holding area on-site to the working area.

Transporting of prefabricated mesh to working area

Transporting of re-bars to working area

2.1.3 Placing and Fixing of Reinforcement

Sorting of re-bars to ensure the correct size and quantity are in order

Placing of concrete spacer

Fixing of re-bars using hand tool

Fixing of re-bars using mechanical means

2.1.4 Laying and Securing of M&E Services

Securing of conduits to re-bars

Securing of conduits junction box

Fixing of top reinforcements and securing of conduits to ensure they are firmly in position before concreting

2.2 Reinforcement Placing and Fixing Productivity Monitoring Form

The Reinforcement Placing and Fixing Productivity Monitoring Form has been designed to standardize the monitoring of productivity for reinforcement placing and fixing. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and the methodology before using the form.

Methodology

1) The location where the reinforcement placing and fixing would be monitored should first be identified. It is recommended for the builder to start the monitoring when the placing and fixing has reached the stage of a typical floor. The example shows the monitoring on 5th Storey, Zone 2 of Block 123

2) The following should then be calculated or recorded:
   a) Amount of reinforcement used.
   b) Amount of prefab mesh used.
   c) Manpower used during the placing and fixing of reinforcement; this should include the trade gang, safety & health workers, machine operator that operates the lifting equipment e.g. tower crane. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour.

   a) The example shows that about 3.13 manhours were required to place and fix reinforcement of 250kg. This is equivalent to 6 men working for approximately 0.52 manhours to place and fix 250kg of the reinforcement.
   b) The example also show that 1.79 manhours was required to place and fix prefab mesh of 250kg. This is equivalent to 6 men working for approximately 0.30 hours to place and fix 250kg of the prefab mesh.

4) The trade productivity is then calculated by dividing the amount of reinforcement by the manhours taken.

5) The following information should be provided in the form:

   Reinforcement
   a) Type of equipment used. A tower crane was used in the example.
   b) Breakdown of the manpower type. The example shows a trade gang of 3 men, 1 tower crane operator, 1 safety supervisor and 1 rigger/signaller.

   Prefab mesh
   a) Type of equipment used. A tower crane was used in the example.
   b) Breakdown of the manpower type. The example shows a trade gang of 3 men, 1 tower crane operator, 1 safety supervisor and 1 rigger/signaller.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Preparation of reinforcement
   b) Transportation of reinforcement to location
   c) Placing and fixing of reinforcement
   d) Laying and securing of M&E services

   (The form should indicate as a percentage the time taken for each of the above activities)

7) The downtime and waiting time of the tower crane should be excluded from the manhours taken.

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = 5th Storey, Zone 2 of Block 123
- Amount of reinforcement laid = 250kg
- Amount of prefab mesh laid = 250kg

Manpower Size

Trade manpower = 3men (for rebar), 3men (for prefab mesh)
Tower crane operator = 1man (for both)
Safety and Health workers = 1 safety supervisor(for both), 1 rigger/signaller (for both)

Time taken

	Manhours (Rebar)	Manhours (Prefab Mesh)
Preparation of reinforcement	0.63	0
Transportation of reinforcement to location		
Tower crane in operation	0.31	0.72
Tower crane downtime (excluded)	(0.50)	(0.50)
Placing and fixing of reinforcement	1.72	0.81
Laying and securing of M&E services	0.47	0.26
Total	3.13	1.79

Productivity Calculation

		Rebar	Prefab Mesh
Trade Productivity	=	Amt of rebar / Total manhours	Amt of mesh / Total manhours
	=	250 kg / 3.13 manhours	250 kg / 1.79 manhours
	=	80 kg/manhour	140 kg/manhour

Reinforcement Placing And Fixing Productivity Monitoring Form

Building and Construction Authority

Project Title: _____

	S/no	Location	Amt of Rebar Kg (rebar)	Manhour Taken[1]	Trade Productivity[2] kg/manhour	Mechanical and Non-mechanical equipment used (if any) Mechanical: Tower Crane, Mobile Crane,etc. Non Mechanical: Scaffold/Ladder/ Bench, etc.	Breakdown of Manpower Size			Please indicate the % of time taken in each activities			
							Trade[3]	Machine Operator[4]	Safety and Health[5]	1 Preparation of Reinforcement	2 Transportation of Reinforcement to Location[6]	3 Placing and Fixing of Reinforcement	4 Laying and Securing of M&E Services
Rebar	*E.g.*[7]	*Blk 123 5th Sty Zone 2*	*250kg*	*3.13*	*80kg/manhour*	*1 x Tower Crane*	*3 men*	1 man	*2 men*	*20%*	*10%*	*55%*	*15%*
Prefab mesh /cage			*250kg*	*1.79*	*140kg/manhour*	*1 x Tower Crane*	*3 men*	1 man	*2 men*	*0%*	*40%*	*45%*	*15%*
										Percentage of time taken for Activities 1 to 4 MUST add up to 100 %.			
Rebar	1												
Prefab mesh /cage													
Rebar	2												
Prefab mesh /cage													

Remark:

Recorded By: _____ Checked By: _____
Date: _____ Date: _____

Notes:
1) The manhours taken **do not** include hours clocked by the site management team.
2) Reinforcement bar and mesh shall be measured in Kg.
3) The trade manpower size refers to the gang size only.
4) The machine operator manpower size refers to operators of lifting equipment, transportation equipment and temporary hoist.
5) The safety and health manpower size refers to safety supervisor, rigger/signaller and housekeeping worker.
6) The time taken for the transportation of materials within the site by crane or other mechanical means shall be taken into account in the total manhours taken for the specific trade.
7) The trade productivity value shown in the example is not meant for benchmarking purpose.

3 CONCRETE PLACEMENT

The flowchart below shows the key processes involved in the placement of concrete during construction. It serves as a guide on the activities that are to be considered during the measurement of productivity for this trade.

1. Preparation of Concreting Area
2. Transportation of Concrete to Concreting Area
3. Placing of Concrete
4. Spreading and Compacting of Concrete
5. Levelling of Concrete

3.1 Concrete Placement Process

The following sections show the steps involved when carrying out concrete placement. While the specific construction techniques employed may differ, these are the common stages of work that are commonly carried out on site.

3.1.1 Preparation of Concreting Area

Area preparation for concrete placement include the clearing of debris, cleaning of formwork, preparation of concreting equipment and tools.

Clearing of debris from the concreting area

Preparation of concreting equipments and tools

3.1.2 Transportation of Concrete to Concreting Area

Concrete could be transported to the concreting area via concrete bucket, truck-mounted concrete pump, rotary distributor or concrete placing boom.

Crane and concrete bucket

Truck-mounted concrete pump

Rotary distributor for concreting work

Concrete Placing boom

3.1.3 Placing of Concrete

Placing of concrete using concreting bucket

Placing of concrete using pump

3.1.4 Spreading and Compacting of Concrete

Spreading and compacting of concrete could be done using the shovels or the vibrators.

Spreading of concrete with shovels

Compacting of concrete with a vibrator

3.1.5 Levelling of Concrete

Levelling of wet concrete could be done using the trowel or the vibrating screed levellers.

Manual levelling of concrete using trowel

Mechanical levelling of concrete using vibrating screed leveller

3.2 Concrete Placement Productivity Monitoring Form

The Concrete Placement Productivity Monitoring Form has been designed to standardize the monitoring of productivity for concrete placement. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and the methodology before using the form.

Methodology

1) The location where the concrete placement would be monitored should first be identified. It is recommended for the builder to start the monitoring when the concrete placement has reached the stage of a typical floor. The example shows the monitoring on 6th Storey, Zone 3 of Block 123.

2) The following should then be calculated or recorded:
   a) Volume of concrete
   b) Manpower used during the concrete placement; this should include the trade gang, safety & health workers, machine operator that operates the lifting equipment e.g. tower crane. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour. The example shows that about 16.26 manhours were required to place concrete of 20m^3. This is equivalent to 8 men working for approximately 2hours to place concrete of 20m^3.

4) The trade productivity is then calculated by dividing the volume of concrete placed by the manhours taken.

5) The following information should be provided in the form:
   a) Type of equipment used. A crane and bucket was used in the example.
   b) Breakdown of the manpower type. The example shows a trade gang of 5 men, 1 tower crane operator, 1 safety supervisor and 1 rigger/signaller.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Preparation of concreting area
   b) Transportation of concrete to location
   c) Placing of concrete
   d) Spreading of concrete
   e) Compacting of concrete
   f) Leveling of concrete

   (The form should indicate as a percentage the time taken for each of the above activities)

7) The downtime and waiting time of the tower crane should be excluded from the manhours taken.

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = 6th Storey, Zone 3 of Block 123
- Concrete Volume = 20m^3

Manpower Size

Trade manpower = 5men
Tower crane operator = 1man
Safety and Health workers = 1 safety supervisor, 1 rigger/signaller

Time taken

Preparation of concreting area	1.62	manhours
Transportation of concrete to location		
(Tower crane in operation)	2.44	manhours
(Tower crane downtime)	(0.50	manhours) (excluded)
Placing of concrete	4.06	manhours
Spreading of concrete	4.88	manhours
Compacting of concrete	1.63	manhours
Leveling of concrete	1.63	manhours
Total	16.26	manhours

Productivity Calculation

$$\text{Trade Productivity} = \frac{\text{Volume of concrete}}{\text{Total manhours}}$$

$$= \frac{20\text{m}^3}{16.26 \text{ manhours}}$$

$$= 1.23\text{m}^3/\text{manhour}$$

Concrete Placement Productivity Monitoring Form

Building and Construction Authority

Project Title: _____

S/no	Location	Concrete Volume[1] (m^3)	Total Manhour Taken[2,3]	Trade Productivity (m^3/manhour)	Mechanical and Non-Mechanical Concreting Equipment used (if any) Mechanical: Crane & Bucket, Truck-Mounted Concrete Pump, Concreting Placing Boom, etc. Non Mechanical: Wheelbarrow, etc.	Casting Component	Breakdown of Manpower Size			Please indicate the % of time taken in each activities					
										1	2	3	4	5	6
							Trade[4]	Machine Operator[5]	Safety and Health[6]	Preparation of Concreting Area[7,8]	Transportation of Concrete to Location[9]	Placing of Concrete	Spreading of Concrete	Compacting of Concrete	Levelling of Concrete
E.g.[10]	*Blk 123 6th Sty Zone 3*	*20*	*16.26*	*1.23*	*Crane & Bucket*	*Slab & Beam*	*5 men*	*1 man*	*2 men*	*10%*	*15%*	*25%*	*30%*	*10%*	*10%*
										Percentage of time taken for Activities 1 to 6 MUST add up to 100 %.					
1															
2															
3															

Remark:

Recorded By: _____ Checked By: _____
Date: _____ Date: _____

Notes:
1) Self-compacting concrete shall be highlighted under the remark section.
2) The manhours taken **do not** include hours clocked by the site management team.
3) Activities that are performed off-site **shall not** be included (e.g. prefabrication, pre-installation).
4) The trade manpower size refers to the gang size only.
5) The machine operator manpower size refers to operators of lifting equipment, transportation equipment and temporary hoist.
6) The safety and health manpower size refers safety supervisor, rigger/signaller and housekeeping worker.
7) The manhours taken for the erection/dismantling of scaffolding, if any, shall be recorded under the activities “Preparation of Concreting Area”.
8) The time taken for the setting up of concreting pipes from the concrete pump to the concreting area shall be recorded.
9) The time taken for the transportation of materials within the site by crane or other mechanical means shall be taken into account in the total manhours taken for the specific trade.
10) The trade productivity value shown in the example is not meant for benchmarking purpose.

4 DRYWALL INSTALLATION

The flowchart below shows the typical processes involved in the installation of drywall during construction. It serves as a guide on the activities that are to be considered during the measurement of productivity for this trade.

1. Transportation of Drywall Materials to Location
2. Setting Out
3. Preparation of Drywall Materials
4. Installation of Drywall
5. Sealing of Joints

4.1 Drywall Installation Process

The following sections show the steps involved when installing drywall partition. While the specific construction techniques employed may differ, these are the common stages of work that are commonly carried out on site.

4.1.1 Transportation of Drywall Materials to Location

Transportation of drywall materials to location refer to transporting from the holding area on-site to the working area.

Transporting drywall materials to working area

Placing of drywall materials near working area for easy accessibility

4.1.2 Setting Out

Setting out of drywall installation includes marking of wall position on floor, wall and ceiling.

Transferring the floor marking to adjoining wall/column/ceiling

Setting out the position of the drywall at floor level

4.1.3 Preparation of Drywall Materials

Preparation of drywall materials includes cutting of metal studs to required length and cutting of gypsum boards to actual size and shape.

Cutting of metal studs to required size for drywall framing

Marking out and cutting of the gypsum boards to actual size

4.1.4 Installation of Drywall

The drywall system can be easily installed and quickly relocated according to one's needs. Homeowners can renovate and redesign the interior layouts within a short time. Below is the typical drywall installation process.

Installing the metal studs to form drywall frame

Installing plasterboard to one side of the framing

Installing insulation between panel (M&E work is excluded from the drywall trade.)

Installing second plasterboard

4.1.5 Sealing of Joints

Sealing up the joint between plasterboard (Painting of wall is excluded from the drywall trade.)

Completion of drywall

4.2 Drywall Installation Productivity Monitoring Form

The Drywall Installation Productivity Monitoring Form has been designed to standardize the monitoring of productivity for drywall installation. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and the methodology before using the form.

Methodology

1) The location where the drywall installation would be monitored should first be identified. It is recommended for the builder to start the monitoring when the drywall installation has reached the stage of a typical floor. The example shows the monitoring on Block 123 #05-13 Living Room.

2) The following should then be calculated or recorded:
   a) Area and height of drywall installed
   b) Manpower used during the drywall installation; this should include the trade gang, safety & health workers, machine operator that operates the lifting equipment e.g. tower crane. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour. The example shows that about 6.67 manhours were required to install a drywall of 15m^2. This is equivalent to 7 men working for approximately 0.95 hours to install a drywall of 15m^2.

4) The trade productivity is then calculated by dividing the area of drywall installed by the manhours taken.

5) The following information should be provided in the form:
   a) Type of equipment used. A tower crane was used in the example.
   b) Breakdown of the manpower type. The example shows a trade gang of 4 men, 1 tower crane operator, 1 safety supervisor and 1 rigger/signaller.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Transportation of drywall materials to location
   b) Setting out
   c) Preparation of drywall materials
   d) Installation of drywall
   e) Sealing of joints

   (The form should indicate as a percentage the time taken for each of the above activities)

7) The downtime and waiting time of the tower crane should be excluded from the manhours taken.

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = Block 123 #05-13 Living Room
- Area of drywall = 15m^2
- Room height = 3m

Manpower Size

Trade manpower = 4men
Tower crane operator = 1man
Safety and Health workers = 1 safety supervisor, 1 rigger/signaller

Time taken

Transportation of drywall materials to location		
(Tower crane in operation)	0.67	manhours
(Tower crane downtime)	(0.50	manhours) (excluded)
Setting out	1.00	manhours
Preparation of drywall materials	1.33	manhours
Installation of drywall	2.67	manhours
Sealing of joints	1.00	manhours
Total	6.67	manhours

Productivity Calculation

$$\text{Trade Productivity} = \frac{\text{Area of drywall}}{\text{Total manhours}}$$

$$= \frac{15\text{m}^2}{6.67 \text{ manhours}}$$

$$= 2.25\text{m}^2/\text{manhour}$$

Drywall Installation Productivity Monitoring Form

Building and Construction Authority

Project Title: _____

S/no	Location	Height (m) Area[1] (m^2)	Total Manhour Taken[2,3]	Trade Productivity (m^2/manhour)	Mechanical and Non-mechanical equipment used (if any) Mechanical: Boom/Scissor/Personnel Lifts, etc. Non Mechanical: Scaffold/Ladder/Bench, etc.	Thickness / Width of Partition Board	Breakdown of Manpower Size			Please indicate the % of time taken in each activities				
							Trade[4]	Machine Operator[5,6]	Safety and Health[7]	1 Transportation of Drywall Materials to Location[8]	2 Setting Out[9]	3 Preparation of Drywall Material	4 Installation of Drywall	5 Sealing of Joints[10]
E.g [11]	*Blk 123 #05-13 Living Room*	*3m high 15m^2*	*6.67*	*2.25*	*1 X Tower Crane*	*12mm thk/ 1200mm wide*	*4 men*	*1man*	*2 men*	*10%*	*15%*	*20%*	*40%*	*15%*
										Percentage of time taken for Activities 1 to 5 MUST add up to 100 %.				
1														
2														
3														

Remark:

Recorded By: _____ Checked By: _____
Date: _____ Date: _____

Notes:
1) The areas of drywall is calculated based on length of the drywall (centreline) multiply by the height of the wall.
2) The manhours taken **do not** include hours clocked by the site management team.
3) Activities that are performed off-site **shall not** be included (e.g. prefabrication, pre-installation).
4) The trade manpower size refers to the gang size only.
5) The machine operator manpower size refers to operators of lifting equipment, transportation equipment and temporary hoist.
6) Mechanical equipment that do not require a designated operator, for example scissor lift **shall not** be recorded under Machine Operator manpower.
7) The safety and health manpower size refers safety supervisor, rigger/signaller and housekeeping worker.
8) The time taken for the transportation of materials within the site by crane or other mechanical means shall be taken into account in the total manhours taken for the specific trade.
9) The manhours taken for the erection/dismantling of scaffolding, if any, shall be recorded under the activities “Setting Out”.
10) Painting work and other finishing works shall not be included.
11) The trade productivity value shown in the example is not meant for benchmarking purpose.

5 PAINTING

The flowchart below shows the typical processes involved in painting during construction. It serves as a guide on the activities that are to be considered during the measurement of productivity for this trade.

1. Transportation of Painting Materials to Location
2. Preparation of Painting Surface
3. Application of Sealer Coat
4. Application of 1st Coat and finishing coat

5.1 Painting Process

The following sections show the steps involved during a painting process. While the specific construction techniques employed may differ, these are the common stages of work that are commonly carried out on site.

5.1.1 Transportation of Painting Materials to Location

Transportation of painting materials to location refer to transporting from the holding area on-site to the working area.

Transporting of painting materials to working area

Placing of paint near working area

5.1.2 Preparation of Painting Surface

Protecting surfaces that are not intended to be painted.

Cleaning to remove foreign and unstable matter

5.1.3 Application of Sealer Coat

There are various method of application such as the brush, roller and spray painting. The adoption of each method will depend mainly on the working area and site situation.

Mixing of paint manually

Setting up of spray painting equipment

Application of sealer coat by spray

Application of sealer coat by roller

5.1.4 Application of 1st & Finishing Coat

Application of 1st and finishing coat using roller or spray

Intercoat preparation such as light sanding with fine-grade, preferably partly worn sandpaper can be used to remove nibs and adherent dust particles

Painting to edges using brush

5.2 Painting Productivity Monitoring Form

The Painting Productivity Monitoring Form has been designed to standardize the monitoring of productivity for painting work. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and the methodology before using the form.

Methodology

1) The location where the painting work would be monitored should first be identified. It is recommended for the builder to start the monitoring when the painting work has reached the stage of a typical floor. The example shows the monitoring on Block 123 #05-13 Living Room.

2) The following should then be calculated or recorded:
   a) Painted area
   b) Manpower used during the painting work; this should include the trade gang and safety & health worker. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour. The example shows that about 4.55 manhours were required to paint an area of $25m^2$ using roller methods. This is equivalent to 3 men working for approximately 1.52 hours to paint an area of $25m^2$.

4) The trade productivity is then calculated by dividing the painted area by the manhours taken.

5) The following information should be provided in the form:
   a) Method of application
   b) Type of equipment used. A materials hoist was used in the example.
   c) Breakdown of the manpower type. The example shows 1 painter, 1 material hoist and 1 general worker.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Transportation of paint materials to location
   b) Preparation of painting surface
   c) Application of sealer coat
   d) Application of 1^{st} coat
   e) Application of finishing coat

   (The form should indicate as a percentage the time taken for each of the above activities)

7) The downtime and waiting time of the material hoist should be excluded from the manhours.

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = Block 123 #05-13 Living Room
- Area to be painted = $25m^2$
- Room height = 2.9m

Manpower Size

Trade manpower = 1man
Material hoist operator = 1man
Safety and Health workers = 1 general worker

Time taken

Transportation of painting materials to location		
(Material hoist in operation)	0.80	manhours
(Material hoist downtime)	(0.50	manhours) (excluded)
Preparation of painting surface	1.41	manhours
Application of sealer coat	0.78	manhours
Application of 1^{st} coat	0.78	manhours
Application of finishing coat	0.78	manhours
Total	4.55	manhours

Productivity Calculation

$$\text{Trade Productivity} = \frac{\text{Total painted area}}{\text{Total manhours}}$$

$$= \frac{25m^2}{4.55 \text{ manhours}}$$

$$= 5.50m^2/\text{manhour}$$

Painting Productivity Monitoring Form

Building and Construction Authority

Project Title: _____

S/no	Location	Painted Area (m^2)	Total Manhour Taken[1,2]	Trade Productivity (m^2/manhour)	Method of Application • Brush • Roller • Spray	Mechanical and Non-mechanical equipment used (if any) Mechanical: Boom/ Scissor/ Personnel Lifts,etc. Non Mechanical: Scaffold/ Ladder/ Bench, etc.	Room Height (mm)	Painted Surface	Breakdown of Manpower Size			Please indicate the % of time taken in each activities				
									Trade Manpower Size[3]	Machine Operator[4]	Safety and Health[5]	1 Transporting Paint Materials to Location[6]	2 Preparation of Painting Surface[7]	3 Application of Sealer Coat	4 Application of 1st Coat	5 Application of Finishing Coat
E.g[8]	*Blk 123 #05-13 Living Room*	*25*	*4.55*	*5.50*	*Roller*	*1 x Material Hoist 1 x Ladder*	*2900*	*Wall*	*1 man*	*1 man*	*1 man*	*16%*	*30%*	*18%*	*18%*	*18%*
												Percentage of time taken for Activities 1 to 5 MUST add up to 100 %.				
1																
2																
3																

Remark:

Recorded By: _____ Checked By: _____
Date: _____ Date: _____

Notes:
1) The manhours taken do not include hours clocked by the site management team.
2) Drying time between coats shall not be recorded
3) The trade manpower size refers to the gang size only.
4) The machine operator manpower size refers to operators of lifting equipment, transportation equipment and temporary hoist.
5) The safety and health manpower size refers safety supervisor, rigger/signaller and housekeeping worker.
6) The time taken for the transportation of materials within the site by crane or other mechanical means shall be taken into account in the total manhours taken for the specific trade.
7) The manhours taken for the erection/dismantling of scaffolding, if any, shall be recorded under the activities “Preparation of Painting Surface”.
8) The trade productivity value shown in the example is not meant for benchmarking purpose.

6 TIMBER DOOR INSTALLATION

The flowchart below shows the typical processes involved in the installation of timber door during construction. It serves as a guide on the activities that are to be considered during the measurement of productivity for this trade.

1. Transportation of Door Materials to Location
2. Setting Out
3. Preparation of Door Frame and Panel
4. Installation of Sub-frame
5. Installation of Main frame and Door Panel
6. Installation of Ironmongery

6.1 Timber Door Installation Process

The following sections show the steps involved when installing timber door. While the specific construction techniques employed may differ, these are the common stages of work that are commonly carried out on site.

6.1.1 Transportation of Door Materials to Location

Transportation of door materials include bringing the door frame, door panel and all ironmongery from the holding area on-site to the working area.

Transporting door materials to working area

Placing of door frames and door panels near working area

6.1.2 Setting Out

Confirming the door location against the approved shop drawing. Verify that the dimensions of the opening are as specified in the drawing

Setting out reference line in relation to wall alignment.

6.1.3 Preparation of Door Frame and Panel

Treating surface of sub-frame

Assembling the pre-cut main frame using finishes nails or screws if the frame is not pre-assembled at the factory

6.1.4 Installation of Sub-Frame

Verify the dimensions of the sub-frame opening

Installing of sub-frame

6.1.5 Installation of Main Frame and Door Panel

Installing of main frame

Installing of door panel

6.1.6 Installation of Ironmongery

Installing the architrave around door frame (if any)

Installing ironmongery to the door panel

Note: All manhours taken for the finishing work such as painting, vanishing, etc. should not be taken into account.

6.2 Timber Door Productivity Monitoring Form

The Timber Door Productivity Monitoring Form has been designed to standardize the monitoring of productivity for timber door. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and the methodology before using the form.

Methodology

1) The location where the door installation would be monitored should first be identified. It is recommended for the builder to start the monitoring when the door installation has reached the stage of a typical floor. The example shows the monitoring on Block 123 #05-13 living room.

2) The following should then be calculated or recorded:
   a) Number of door installed
   b) Manpower used during the door installation; this should include the trade gang and safety & health worker. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour. The example shows that about 16.14 manhours were required to install 5 number of timber door. This is equivalent to 3 men working for approximately 5.38 hours to install 5 number of timber door.

4) The trade productivity is then calculated by dividing the number of door installed by the manhours taken.

5) The following information should be provided in the form:
   a) Method of application
   b) Type of equipment used. A materials hoist was used in the example.
   c) Breakdown of the manpower type. The example shows 1 tradesman, 1 material hoist and 1 general worker.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Transportation of door materials to location
   b) Setting out
   c) Preparation of door frame and door
   d) Installation of sub frame
   e) Installation of door frame and door panel
   f) Installation of ironmongery

   (The form should indicate as a percentage the time taken for each of the above activities)

7) The downtime and waiting time of the material hoist should be excluded from the manhours.

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = Block 123 #05-13 Living Room
- Number of door installed = 5

Manpower Size

Trade manpower = 1man
Material hoist operator=1man
Safety and Health workers = 1 general worker

Time taken

Transportation of door materials to location		
(Material hoist in operation)	0.81	manhours
(Material hoist downtime)	(0.50	manhours) (excluded)
Setting out	1.61	manhours
Preparation of door frame and door	1.61	manhours
Installation of sub frame	2.42	manhours
Installation of door frame and door panel	6.46	manhours
Installation of ironmongery	3.23	manhours
Total	16.14	manhours

Productivity Calculation

$$\text{Trade Productivity} = \frac{\text{Number of doors installed}}{\text{Total manhours}}$$

$$= \frac{5 \text{ num}}{16.14 \text{ manhours}}$$

$$= 0.31 \text{num/manhour}$$

Timber Door Productivity Monitoring Form

(Swing Door Only)

Building and Construction Authority

Project Title: _____

S/no	Location	Num of Door Installed	Total Manhour Taken[1,2,3]	Trade Productivity (num/manhour)	Mechanical and Non-mechanical equipment used (if any) Mechanical: Boom/Scissor/Personnel Lifts, etc. Non Mechanical: Scaffold/Ladder/Bench, etc.	Door Size	Breakdown of Manpower Size			Please indicate the % of time taken in each activities					
							Trade[4]	Machine Operator[5]	Safety and Health[6]	1 Transportation of Materials to Location[7]	2 Setting Out	3 Preparation of Door Frame and Door	4 Installation of Sub-Frame	5 Installation of Door Frame and Door Panel[8]	6 Installation of Ironmongery
E.g.[9]	*Blk 123 #05-13 Living Room*	*5*	*16.14*	*0.31*	*1 x Material Hoist 1 x Ladder*	*900 x 2200*	*1 man*	*1man*	*1 man*	*5%*	*10%*	*10%*	*15%*	*20%*	*20%*
										Percentage of time taken for Activities 1 to 6 MUST add up to 100 %.					
1															
2															
3															

Remark:

Recorded By: _____ Checked By: _____

Date: _____ Date: _____

Notes:

1) The manhours taken **do not** include hours clocked by the site management team.
2) Activities that are performed off-site **shall not** be included (e.g. prefabrication, pre -installation).
3) Finishing works such as painting and varnishing **shall not** be included.
4) The trade manpower size refers to the gang size only.
5) The machine operator manpower size refers to operators of lifting equipment, transportation equipment and temporary hoist.
6) The safety and health manpower size refers to safety supervisor, rigger/signaller and housekeeping worker.
7) The time taken for the transportation of materials within the site by crane or other mechanical means shall be taken into account in the total manhours taken for the specific trade.
8) The manhours taken for the erection/dismantling of scaffolding, if any, shall be recorded under the activities "Installation of Main Frame and Door Panel".
9) The trade productivity value shown in the example is not meant for benchmarking purpose.

7

WALL TILING

The flowchart below shows the typical processes involved in the tiling of wall during construction. It serves as a guide on the activities that are to be considered during measurement of productivity for this trade.

1. Transportation of Tiling Materials to Location
2. Patching and Plastering (if necessary)
3. Setting Out
4. Mixing of Cement Mortar/ Tile Adhesive
5. Laying of Tiles
6. Grouting / Pointing
7. Cleaning of Tiles

7.1 Wall Tiling Process

The following sections show the steps involved when laying wall tiles. While the specific construction techniques employed may differ, these are the common stages of work that are commonly carried out on site.

7.1.1 Transportation of Tiling Materials to Location

Transportation of tiling materials to location refer to transporting from the holding area on-site to the working area.

Transporting tiling materials to working area

Placing of tiling materials near working area

7.1.2 Patching and Plastering (if necessary)

Patching up all concealed conduits, unwanted recesses and openings

Plastering of wall for even and rough surface to receive the tiles.

7.1.3 Setting Out

Setting out the position of the tiles and marking of reference line for tile laying

7.1.4 Mixing of Cement Mortar / Tile Adhesive

Mixing the tiling adhesive in accordance to the manufacturer's instruction menu

Mixing of cement mortar

7.1.5 Laying of Tiles

Cutting of tiles to required size

Placing of tile to wall surface with reference to the marked line and tapping tile into position

7.1.6 Grouting / Pointing

Spreading grout with a soft trowel

7.1.7 Cleaning of Tiles

Cleaning of tiles with damp cloth or sponge

7.2 Wall Tiling Productivity Monitoring Form

The Wall Tiling Productivity Monitoring Form has been designed to standardize the monitoring of productivity for wall tiling. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and the methodology before using the form.

Methodology

1) The location where the wall tiling would be monitored should first be identified. It is recommended for the builder to start the monitoring when the wall tiling has reached the stage of a typical floor. The example shows the monitoring on Block 123 #05-13 Toilets.

2) The following should then be calculated or recorded:
   a) Tiled area
   b) Tile size
   c) Manpower used during the wall tiling; this should include the trade gang, safety & health workers, machine operator that operates the lifting equipment e.g. material hoist. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour. The example shows that about 12.82 manhours were required to tile an area of 25m^2. This is equivalent to 5 men working for approximately 2.56 hours to tile an area of 25m^2.

4) The trade productivity is then calculated by dividing the tiled area by the manhours taken.

5) The following information should be provided in the form:
   a) Type of equipment used. A materials hoist was used in the example.
   b) Breakdown of the manpower type. The example shows 2 tradesmen, 1 material hoist operator, 1 safety supervisor and 1 rigger/signaller.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Transportation of materials to location
   b) Patching and plastering (if any)
   c) Setting out
   d) Mixing of tile adhesive
   e) Laying of tiles
   f) Grouting / Pointing
   g) Cleaning of tiles

   (The form should indicate as a percentage the time taken for each of the above activities)

7) The downtime and waiting time of the material hoist should be excluded from the manhours taken.

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = Block 123 #05-13 Toilets
- Tiled Area = 25m^2

Manpower Size

Trade manpower = 2men
Material hoist operator = 1man
Safety and Health workers = 1 safety supervisor, 1 rigger/signaller

Time taken

Transportation of tiling materials to location		
(Material hoist in operation)	0.80	manhours
(Material hoist downtime)	(0.50	manhours) (excluded)
Patching and plastering (if any)	1.08	manhours
Setting out	1.62	manhours
Mixing of tile adhesive	0.54	manhours
Laying of tiles	7.16	manhours
Grouting/Pointing	1.08	manhours
Cleaning of Tiles	0.54	manhours
Total	12.82	manhours

Productivity Calculation

$$\text{Trade Productivity} = \frac{\text{Tiled area}}{\text{Total manhours}}$$

$$= \frac{25\ \text{m}^2}{12.82\ \text{manhours}}$$

$$= 1.95\text{m}^2/\text{manhour}$$

Wall Tiling Productivity Monitoring Form

Building and Construction Authority

Project Title: _____

S/no	Location	Tiled Area (m^2)	Manhour Taken[1,2]	Trade Productivity (m^2/manhour)	Mechanical and Non-Mechanical Concreting Equipment used (if any) Mechanical: Tower Crane, Material Hoist, etc. Non Mechanical: Scaffold/ladder/ bench, Wheelbarrow, etc.	Tile Size (mm)	Breakdown of Manpower Size			Please indicate the % of time taken in each activities						
							Trade Manpower Size[3]	Machine Operator Manpower Size[4,5]	Safety and Health Manpower Size[6]	1 Transportation of Materials to Location[7]	2 Patching and Plastering (if any)	3 Setting Out[8]	4 Mixing of Cement Mortar/Tile Adhesive	5 Laying of Tiles	6 Grouting/ Pointing	7 Cleaning of Tiles
E.g.[9]	*Blk 123 #05-13 Toilets*	*25*	*12.82*	*1.95*	*1 x Material Hoist 1 x Wheelbarrow*	*300 x 300*	*2 men*	*1 man*	*2 men*	*6%*	*8%*	*13%*	*4%*	*56%*	*8%*	*5%*
										Percentage of time taken for Activities 1 to 7 MUST add up to 100 %.						
1																
2																
3																

Remark:

Recorded By: _____ Checked By: _____
Date: _____ Date: _____

Notes:
1) The manhours taken do not include hours clocked by the site management team.
2) Activities that are performed off-site shall not be included (e.g. prefabrication, pre-installation).
3) The trade manpower size refers to the gang size only.
4) The machine operator manpower size refers to operators of lifting equipment, transportation equipment and temporary hoist.
5) Mechanical equipment that do not require a designated operator, for example scissor lift shall not be recorded under Machine Operator manpower.
6) The safety and health manpower size refers to safety supervisor, rigger/signaller and housekeeping worker.
7) The time taken for the transportation of materials within the site by crane or other mechanical means shall be taken into account in the total manhours taken for the specific trade.
8) The manhours taken for the erection/dismantling of scaffolding, if any, shall be recorded under the activities “Setting out”.
9) The trade productivity value shown in the example is not meant for benchmarking purpose.

8

FLOOR TILING

The flowchart below shows the typical processes involved in the tiling of floor during construction. It serves as a guide on the activities that are to be considered during the measurement of productivity for this trade.

1. Preparation of Tiling Area
2. Transportation of Tiling Materials to Location
3. Screeding (if necessary)
4. Setting Out
5. Mixing of Cement Mortar / Tile Adhesive
6. Laying of Tiles
7. Grouting / Pointing
8. Cleaning of Tiles

8.1 Floor Tiling Process

The following sections show the steps involved when laying of floor tiles. While the specific construction techniques employed may differ, these are the common stages of work that are commonly carried out on site.

8.1.1 Preparation of Tiling Area

Area preparation include cleaning and washing off dust and debris and checking the level of substrate.

Removing concrete protrusion on the tiling area

Cleaning concrete surface with broom

Checking the level of the substrate

Cleaning concrete surface using water jet

8.1.2 Transportation of Tiling Materials to Location

Transportation of tiling materials to location refer to transporting from the holding area on-site to the working area.

Transporting tiling material using wheel-barrow

Transporting tiling materials to location

8.1.3 Screeding (if necessary)

Finishing screed with wooden float

8.1.4 Setting out

Setting out tile lines on screed

8.1.5 Mixing of Cement Mortar / Tile Adhesive

Mixing the tiling adhesive in accordance to the manufacturer's instruction menu

Mixing of cement mortar

8.1.6 Laying of Tiles

Cutting of tile to required size

Damping screed surface to reduce suction.

Spreading the cement mortar/ tile adhesive within the reach of an arm's length.

Tapping tile onto uniform position using a rubber mallet.

8.1.7 Grouting / Pointing

Removing of dust trapped between tile joint

Pointing of joint between tile with colour grout

8.1.8 Cleaning of Tiles

Cleaning of tile to remove stain or other residue

8.2 Floor Tiling Productivity Monitoring Form

The Floor Tiling Productivity Monitoring Form has been designed to standardize the monitoring of productivity for floor tiling. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and the methodology before using the form.

Methodology

1) The location where the floor tiling would be monitored should first be identified. It is recommended for the builder to start the monitoring when the floor tiling has reached the stage of a typical floor. The example shows the monitoring on Block 123 #05-13 Living Room.

2) The following should then be calculated or recorded:
   a) Tiled area
   b) Tile size
   c) Manpower used during the floor tiling; this should include the trade gang, safety & health workers, machine operator that operates the lifting equipment e.g. material hoist. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour. The example shows that about 11.06 manhours were required to tile an area of 25m^2. This is equivalent to 5 men working for approximately 2.21 hours to tile an area of 25m^2.

4) The trade productivity is then calculated by dividing the tiled area by the manhours taken.

5) The following information should be provided in the form:
   a) Type of equipment used. A materials hoist was used in the example.
   b) Breakdown of the manpower type. The example shows 2 tradesmen, 1 material hoist operator, 1 safety supervisor and 1 rigger/signaller.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Preparation of tiling area
   b) Transportation of tiling materials to location
   c) Screeding (if any)
   d) Setting out
   e) Mixing of tiles adhesive
   f) Laying of tiles
   g) Grouting / Pointing
   h) Cleaning of tiles

   (The form should indicate as a percentage the time taken for each of the above activities)

7) The downtime and waiting time of the material hoist should be excluded from the manhours taken.

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = Block 123 #05-13 Living Room
- Tiled area = 25m^2

Manpower Size

Trade manpower = 2men
Material hoist operator = 1man
Safety and Health workers = 1 safety supervisor, 1 rigger/signaller

Time taken

Preparation of tiling area	1.08	manhours
Transportation of tiling materials to location (Material Hoist in operation)	0.80	manhours
(Material Hoist downtime)	(0.50	manhours) (excluded)
Setting out	1.08	manhours
Mixing of tiles adhesive	0.54	manhours
Laying of tiles	5.94	manhours
Grouting / Pointing	1.08	manhours
Cleaning of tiles	0.54	manhours
Total	11.06	manhours

Productivity Calculation

$$\text{Trade Productivity} = \frac{\text{Tiled area}}{\text{Total manhours}}$$

$$= \frac{25\ \text{m}^2}{11.06\ \text{manhours}}$$

$$= 2.26\text{m}^2/\text{manhours}$$

Floor Tiling Productivity Monitoring Form

Building and Construction Authority

Project Title: _____

S/no	Location	Tile Area (m^2)	Total Manhour Taken[1,2]	Trade Productivity (m^2/manhour)	Mechanical and Non--Mechanical Concreting Equipment used (if any) Mechanical: Tower Crane, Material Hoist, etc. Non Mechanical: Trolley, Wheelbarrow, etc.	Tile Size (mm)	Breakdown of Manpower Size			Please indicate the % of time taken in each activity							
							Trade Manpower Size[3]	Machine Operator Manpower Size[4,5]	Safety and Health Manpower Size[6]	1 Preparation of Tiling Area	2 Transportation of Tiling Materials to Location[7]	3 Screeding (if any)	4 Setting Out	5 Mixing of Cement Mortar/Tiles Adhesive	6 Laying of Tiles	7 Grouting/ Pointing	8 Cleaning of Tiles
E.g.[8]	*Blk 123 #05-13 Living Room*	*25*	*11.06*	*2.26*	*1 x Material Hoist 1 x Wheelbarrow*	*300 x 300*	*2 men*	*1 man*	*2 men*	*9%*	*7%*	*NA*	*10%*	*5%*	*54%*	*10%*	*5%*
										Percentage of time taken for Activity 1 to 8 MUST add up to 100 %.							
1																	
2																	
3																	

Remark:

Recorded By: _____ Checked By: _____
Date: _____ Date: _____

Notes:
1) The manhours taken **do not** include hours clocked by the site management team.
2) Activities that are performed off-site **shall not** be included (e.g. prefabrication, pre-installation).
3) The trade manpower size refers to the gang size only.
4) The machine operator manpower size refers to operators of lifting equipment, transportation equipment and temporary hoist.
5) Mechanical equipment that do not required a designated operator, for example scissor lift **shall not** be recorded under Machine Operator manpower.
6) The safety and health manpower size refers to safety supervisor, rigger/signaller and housekeeping worker.
7) The time taken for the transportation of materials within the site by crane or other mechanical means shall be taken into account in the total manhours taken for the specific trade.+
8) The trade productivity value shown in the example is not meant for benchmarking purpose.

9 SUSPENDED CEILING INSTALLATION

The flowchart below shows the typical processes involved in the installation of suspended ceiling during construction. It serves as a guide on the activities that are to be considered during the measurement of productivity for this trade.

1. Transportation of Ceiling Materials to Location
2. Setting Out
3. Installation of Framework
4. Installation of Ceiling Panel

9.1 Suspended Ceiling Installation Process

The following sections show the steps involved when installing suspended ceiling. While the specific construction techniques employed may differ, these are the common stages of work that are commonly carried out on site.

9.1.1 Transportation of Ceiling Material to Location

Transportation of ceiling materials to location refer to transporting from the holding area on-site to the working area.

Transporting ceiling materials to working area

Placing of ceiling materials at working area

9.1.2 Setting Out

Determine the ceiling level

Fixing of wall angel after ceiling level is determined

9.1.3 Installation of Framework

Installing the hanging system for the ceiling framework

Installing the ceiling framework. Ensure the whole framing system is firmly secured to the structural soffit

9.1.4 Installation of Ceiling Panel

Installing plasterboard panel by fastening it to ceiling framework using screws at regular intervals

Filling up all screws holes with joint compound

Plastering of board joint /ceiling surface

9.2 Suspended Ceiling Installation Productivity Monitoring Form

The Suspended Ceiling Installation Productivity Monitoring Form has been designed to standardize the monitoring of productivity for suspended ceiling installation. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and relate to the methodology before using the form.

Methodology

1) The location where the suspended ceiling installation would be monitored should first be identified. It is recommended for the builder to start the monitoring when the suspended ceiling installation has reached the stage of a typical floor. The example shows the monitoring on Block 123 #05-13 Living Room.

2) The following should then be calculated or recorded:
   a) Area of suspended ceiling
   b) Ceiling height
   c) Manpower used during the suspended ceiling installation; this should include the trade gang, safety & health workers, machine operator that operates the lifting equipment e.g. material hoist. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour. The example shows that about 4.02 manhours were required to install a suspended ceiling of 20m^2. This is equivalent to 5 men working for approximately 0.80 hours to install a suspended ceiling of 20m^2.

4) The trade productivity is then calculated by dividing the area of suspended ceiling by the manhours taken.

5) The following information should be provided in the form:
   a) Type of equipment used. A material hoist was used in the example.
   b) Breakdown of the manpower type. The example shows 2 tradesmen, 1 material hoist operator, 1 safety supervisor and 1 rigger/signaller.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Transporting of ceiling materials to location
   b) Setting out
   c) Installation of framework
   d) Installation of ceiling panel

   (The form should indicate as a percentage the time taken for each of the above activities)

7) The downtime and waiting time of the tower crane should be excluded from the manhours taken.

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = Block 123 #05-13 Living Room
- Suspended ceiling area = 20m^2
- Ceiling height = 3200mm

Manpower Size

Trade manpower = 2men
Material hoist operator = 1man
Safety and Health workers = 1 safety supervisor, 1 rigger/signaller.

Time taken

Transportation of ceiling materials to location		
(Material hoist in operation)	0.60	manhours
(Material hoist downtime)	(0.50	manhours) (excluded)
Setting out	1.00	manhours
Installation of framework	1.21	manhours
Installation of ceiling panel	1.21	manhours
Total	4.02	manhours

Productivity Calculation

$$\text{Trade Productivity} = \frac{\text{Suspended ceilling area}}{\text{Total manhours}}$$

$$= \frac{20\ \text{m}^2}{4.02\ \text{manhours}}$$

$$= 4.98\text{m}^2/\text{manhours}$$

Suspended Ceiling Installation Productivity Monitoring Form

Building and Construction Authority

Project Title: _____

S/no	Location	Area Done (m^2)	Total Manhour Taken[1,2]	Trade Productivity (m^2/manhour)	Mechanical and Non-mechanical equipment used (if any) Mechanical: Boom/Scissor/ Personnel lift, etc. Non Mechanical: Scaffold/Ladder/ Bench, etc.	Ceiling Height (mm)	Breakdown of Manpower Size			Please indicate the % of time taken in each activities			
							Trade[3]	Machine Operator[4,5]	Safety and Health[6]	1 Transporting Materials to Location	2 Setting Out[7]	3 Installation of Framework	4 Installation of Ceiling Panel[8]
E.g.[9]	*Blk 123 #05-13 Living Room*	*20*	*4.02*	*4.98*	*1 x Material Hoist 1 x Scissor Lift*	*3200*	*2 men*	1 man	*2 men*	*15%*	*25%*	*30%*	*30%*
										Percentage of time taken for Activities 1 to 4 MUST add up to 100 %.			
1													
2													
3													

Remark:

Recorded By: _____ Checked By: _____
Date: _____ Date: _____

Notes:
1) The manhours taken **do not** include hours clocked by the site management team.
2) Activities that are performed off-site **shall not** be included (e.g. prefabrication, pre--installation).
3) The trade manpower size refers to the gang size only.
4) The machine operator manpower size refers to operators of lifting equipment, transportation equipment and temporary hoist.
5) Mechanical equipment that do not require a designated operator, for example scissor lift **shall not** be recorded under Machine Operator manpower.
6) The safety and health manpower size refers to safety supervisor, rigger/signaller and housekeeping worker.
7) The manhours taken for the erection/dismantling of scaffolding, if any, shall be recorded under the activities “Setting Out”.
8) M&E services and fire protection devices that are incorporated in the ceiling **shall not** be included.
9) The trade productivity value shown in the example is not meant for benchmarking purpose.

10 AIR-CON DUCTING INSTALLATION

The flowchart below shows the key processes involved in the ducting of air-conditioning during construction. It serves as a guide on the activities that are to be considered during the measurement of productivity for this trade.

1. Transportation of Ducting Materials to Location
2. Folding and Forming of Ductwork
3. Setting Out
4. Installation of Ducting
5. Installation of Insulation

10.1 Air-Con Ducting Installation Process

The following sections show the steps involved when carrying out air-con ducting installation. While the specific construction techniques employed may differ, these are the common stages of work that are commonly carried out on site.

10.1.1 Transportation of Ducting Materials to Location

Transportation of ducting materials to location refer to transporting from the holding area on-site to the working area.

Transporting ducting materials to working area

Placing of ducting materials near working area

10.1.2 Folding and Forming of Ductwork

Folding and forming of ductwork include marking out, cutting, bending to shape and assembling the parts together.

Marking and cutting of ductwork to shape

Bending and forming of ductwork section together

Assembling of duct section

10.1.3 Setting Out

Setting out include marking out the ducting route, checking the alignment and fixing of hanger supports to ceiling.

Setting the alignment and fixing the hanger supports

10.1.4 Installation of Ducting

Installation of ductwork after ensuring the correct size is used

10.1.5 Installation of Insulation

Application of adhesive to insulation (if necessary)

Placing of insulation to ductwork

10.2 Air-Con Ducting Installation Productivity Monitoring Form

The Air-Con Ducting Installation Productivity Monitoring Form has been designed to standardize the monitoring of productivity for air-con ducting installation. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and the methodology before using the form.

Methodology

1) The location where the air-con ducting installation would be monitored should first be identified. It is recommended for the builder to start the monitoring when the air-con ducting installation has reached the stage of a typical floor. The example shows the monitoring on Block 123 #05-13 Living Room.

2) The following should then be calculated or recorded:
   a) Length of ducting installed
   b) Ceiling height
   c) Duct size
   d) Whether the ducting is prefabricated, pre-insulated or form and insulated on-site.
   e) Manpower used during the air-con ducting installation; this should include the trade gang, safety & health workers, machine operator that operates the lifting equipment e.g. material hoist. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour. The example shows that about 50 manhours were required to install 20m of air-con ducting. This is equivalent to 5 men working for approximately 10 hours to install 20m of air-con ducting.

4) The trade productivity is then calculated by dividing the length of ducting by the manhours taken.

5) The following information should be provided in the form:
   a) Type of equipment used. A material hoist was used in the example.
   b) Breakdown of the manpower type. The example shows 2 tradesmen, 1 material hoist operator, 1 safety supervisor and 1 rigger/signaller.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Transporting of ducting materials to location
   b) Forming and folding of ducting
   c) Setting out
   d) Installing of ducting
   e) Installing of insulation

   (The form should indicate as a percentage the time taken for each of the above activities)

7) The downtime and waiting time of the material hoist should be excluded from the manhours taken.

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = Block 123 #05-13 Living Room
- Length of ducting = 20m
- Ceiling height = 3200mm

Manpower Size

Trade manpower = 2men
Material hoist operator = 1man
Safety and Health workers = 1 safety supervisor, 1 rigger/signaller.

Time taken

Transportation of ducting materials to location		
(Material hoist in operation)	5.00	manhours
(Material hoist downtime)	(3.00	manhours) (excluded)
Forming and folding of ducting	9.50	manhours
Setting out	9.50	manhours
Installing of ducting	14.00	manhours
Installing of insulation	12.00	manhours
Total	50.00	manhours

Productivity Calculation

$$\text{Trade Productivity} = \frac{\text{Length of ducting}}{\text{Total manhours}}$$

$$= \frac{20\ \text{m}}{50\ \text{manhours}}$$

$$= 0.40\text{m/manhours}$$

Air-Con Ducting Installation Productivity Monitoring Form

(For Main Ducting Only)

Building and Construction Authority

Project Title: _____

S/no	Location	Duct Length (m)	Total Manhour Taken[1,2]	Trade Productivity (m/manhour)	Mechanical and Non-mechanical equipment used (if any) Mechanical: Boom/scissor/ personnel lifts, etc. Non Mechanical: Scaffold/ladder/ bench, etc.	Ceiling Height (mm)	Duct Size	Type of Ducting A) Prefabricated and insulated on-site B) Prefabricated and pre-insulated C) On-site fabrication and insulation	Breakdown of Manpower Size			Please indicate the % of time taken in each activities				
									Trade[3]	Machine Operator[4,5]	Safety and Health[6]	1 Transportation of Ducting Materials to Location[7]	2 Forming and Folding of Ducting	3 Setting Out[8]	4 Installing of Ducting	5 Installing of Insulation
E.g.[9]	*Blk 123 #05-13 Living Room*	*20m*	*50*	*0.40*	*1 x Material Hoist 1 x Scissor Lift*	*3200*	*450 x 200*	*On-site forming and insulated*	*2 men*	*1 man*	*2 men*	*10%*	*19%*	*19%*	*28%*	*24%*
												Percentage of time taken for Activities 1 to 5 MUST add up to 100 %.				
1																
2																
3																

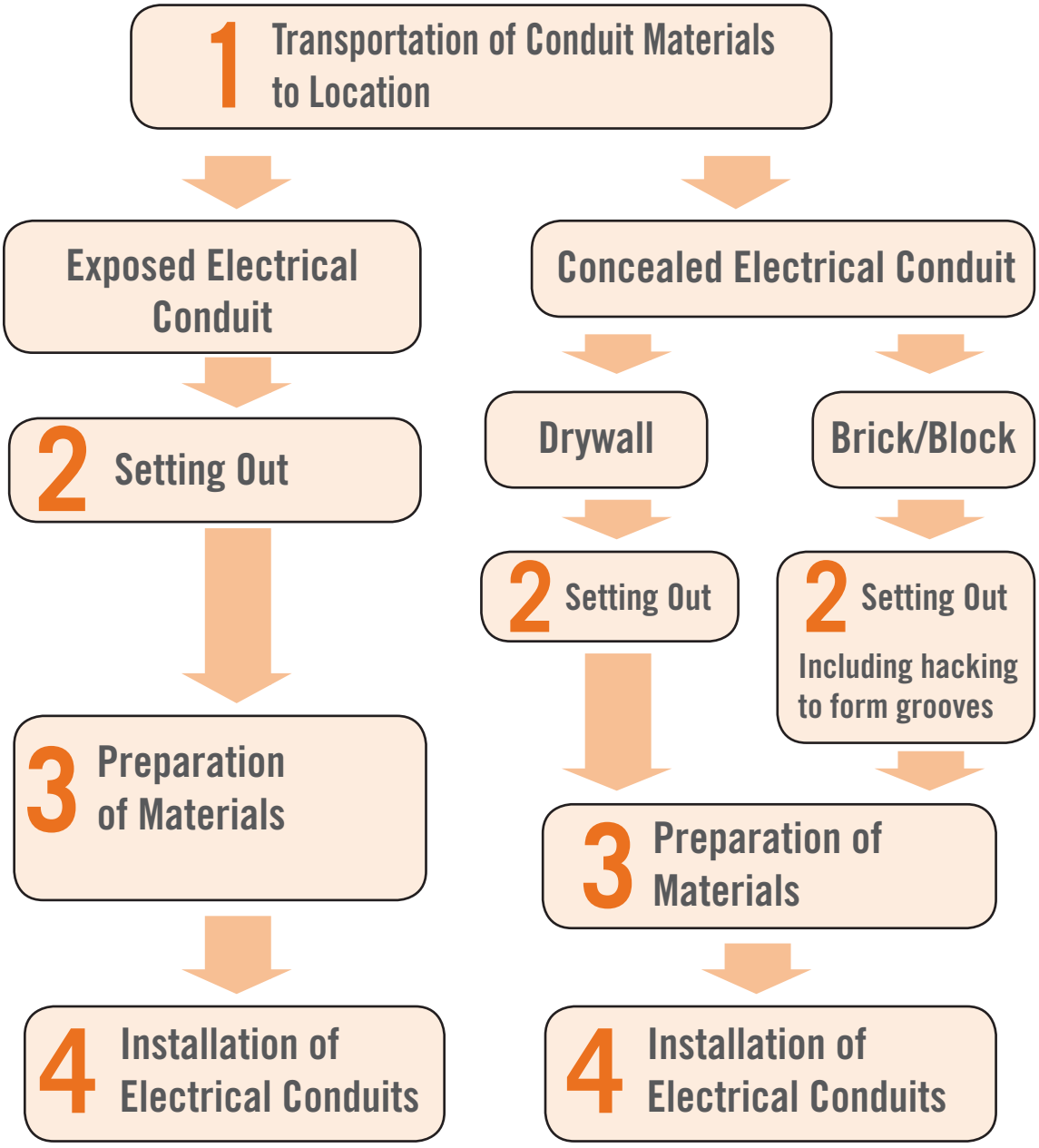
Remark :

Recorded By: _____ Checked By: _____
Date: _____ Date: _____

Notes:
1) The manhours taken **do not** include hours clocked by the site management team.
2) Activities that are performed off-site **shall not** be included (e.g. prefabrication, pre-installation).
3) The trade manpower size refers to the gang size only.
4) The machine operator manpower size refer to operators of lifting equipment, transportation equipment and temporary hoist.
5) Mechanical equipment that do not require a designated operator, for example scissor lift **shall not** be recorded under Machine Operator Manpower.
6) The safety and health manpower size refers to safety supervisor, rigger/signaller and housekeeping worker.
7) The time taken for the transportation of materials within the site by crane or other mechanical means shall be taken into account in the total manhour taken for the specific trade.
8) The manhours taken for the erection / dismantling of scaffold, if any, shall be recorded under the activities 'Setting Out'.
9) The trade productivity value shown in the example is not meant for benchmarking purpose.

11 ELECTRICAL CONDUIT INSTALLATION

The flowchart below shows the typical processes involved in the installation of electrical conduit during construction. It serves as a guide on the activities that are to be considered during the measurement of productivity for this trade.



11.1 Electrical Conduit Installation Process

The following sections show the steps involved when installing electrical conduit. While the specific construction techniques employed or type of material used may differ, these are the common stages of work that are commonly carried out on site.

11.1.1 Transportation of Conduit Materials to Location

Transportation of conduit materials to location refer to transporting from the holding area on-site to the working area.

Transporting electrical conduits to working area

Placing of electrical conduits near working area

11.1.2 Setting Out

Setting out include marking the electrical conduit routing and creating opening through wall for pipe penetration. The time taken for hacking of block/ brickwall to conceal conduit is included.

Marking of pipe routing

11.1.3 Preparation of Materials

Preparation of materials includes cutting of electrical conduit, bending to required shaped and forming of tread for junction connection.

Bending of electrical conduit in-progress

11.1.4 Installation of Electrical Conduits

Fixing electrical conduit to holding bracket (Patching of grooves and opening shall not be included)

Installing of holding bracket for electrical conduit

Laying and securing of the M & E Services in slab

11.2 Electrical Conduit Installation Productivity Monitoring Form

The Electrical Conduit Installation Productivity Monitoring Form has been designed to standardize the monitoring of productivity for electrical conduit installation. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and relate to the methodology before using the form.

Methodology

1) The location where the electrical conduit installation would be monitored should first be identified. It is recommended for the builder to start the monitoring when the electrical conduit installation has reached the stage of a typical floor. The example shows the monitoring on Block 123 #05-13 Kitchen.

2) The following should then be calculated or recorded:
   a) Length of conduit installed
   b) Type of installation
   c) Conduit material
   d) Ceiling height
   e) Manpower used during the electrical conduit installation; this should include the trade gang and safety & health workers. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour. The example shows that about 6.31 manhours were required to install 20m of electrical conduit. This is equivalent to 4 men working for approximately 1.58 hours to install 20m of electrical conduit.

4) The trade productivity is then calculated by dividing the length of electrical conduit by the manhours taken.

5) The following information should be provided in the form:
   a) Type of equipment used. A material hoist was used in the example.
   b) Breakdown of the manpower type. The example shows 2 tradesmen, 1 material hoist operator and 1 general worker.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Transporting of conduit materials to location
   b) Setting out
   c) Preparation of conduit materials
   d) Installation of electrical conduits

   (The form should indicate as a percentage the time taken for each of the above activities)

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = Block 123 #05-13 Kitchen
- Length of conduit = 20m
- Ceiling height = 2900mm

Manpower Size

Trade manpower = 2men
Material hoist operator = 1man
Safety and Health workers = 1 general worker

Time taken

Transportation of conduit materials to location		
(Material hoist in operation)	0.80	manhours
(Material hoist downtime)	(0.50	manhours) (excluded)
Setting out	1.20	manhours
Preparation of materials	1.89	manhours
Installation of electrical conduits	2.42	manhours
Total	6.31	manhours

Productivity Calculation

$$\text{Trade Productivity} = \frac{\text{Length of conduit}}{\text{Total manhours}}$$

$$= \frac{20\ m^2}{6.31\ \text{manhours}}$$

$$= 3.01 m/\text{manhours}$$

Electrical Conduit Installation Productivity Monitoring Form

Building and Construction Authority

Project Title: _____

S/no	Location	Length (m)	Total Manhour Taken[1,2]	Trade Productivity (m/manhour)	Mechanical and Non-mechanical equipment used (if any) Mechanical: Boom/Scissor/ Personnel Lifts, etc. Non Mechanical: Scaffold/Ladder/ Bench, etc.	Type of Installation 1) Exposed Conduit 2) Concealed (Drywall) 3) Concealed (Brick/Block) 4) M&E Conduits in Slab	Conduit Material • UPVC • GI • Others	Ceiling Height (mm)	Breakdown of Manpower Size			Please indicate the % of time taken in each activities			
									Trade Manpower[3]	Machine Operator[4]	Safety and Health Manpower Size[5]	1 Transportation of Conduit Materials to Location[6]	2 Setting Out[7]	3 Preparation of Conduit Materials	4 Installation of Electrical Conduits[8]
E.g.[9]	*Blk 123 #05-13 Kitchen*	*20*	*6.31*	*3.01*	*1 x Material Hoist 1 x Ladder*	*Exposed Conduit*	*GI*	*2900*	*2 men*	*1 man*	*1 man*	*12%*	*19%*	*30%*	*39%*
												Percentage of time taken for Activities 1 to 4 MUST add up to 100 %.			
1															
2															
3															

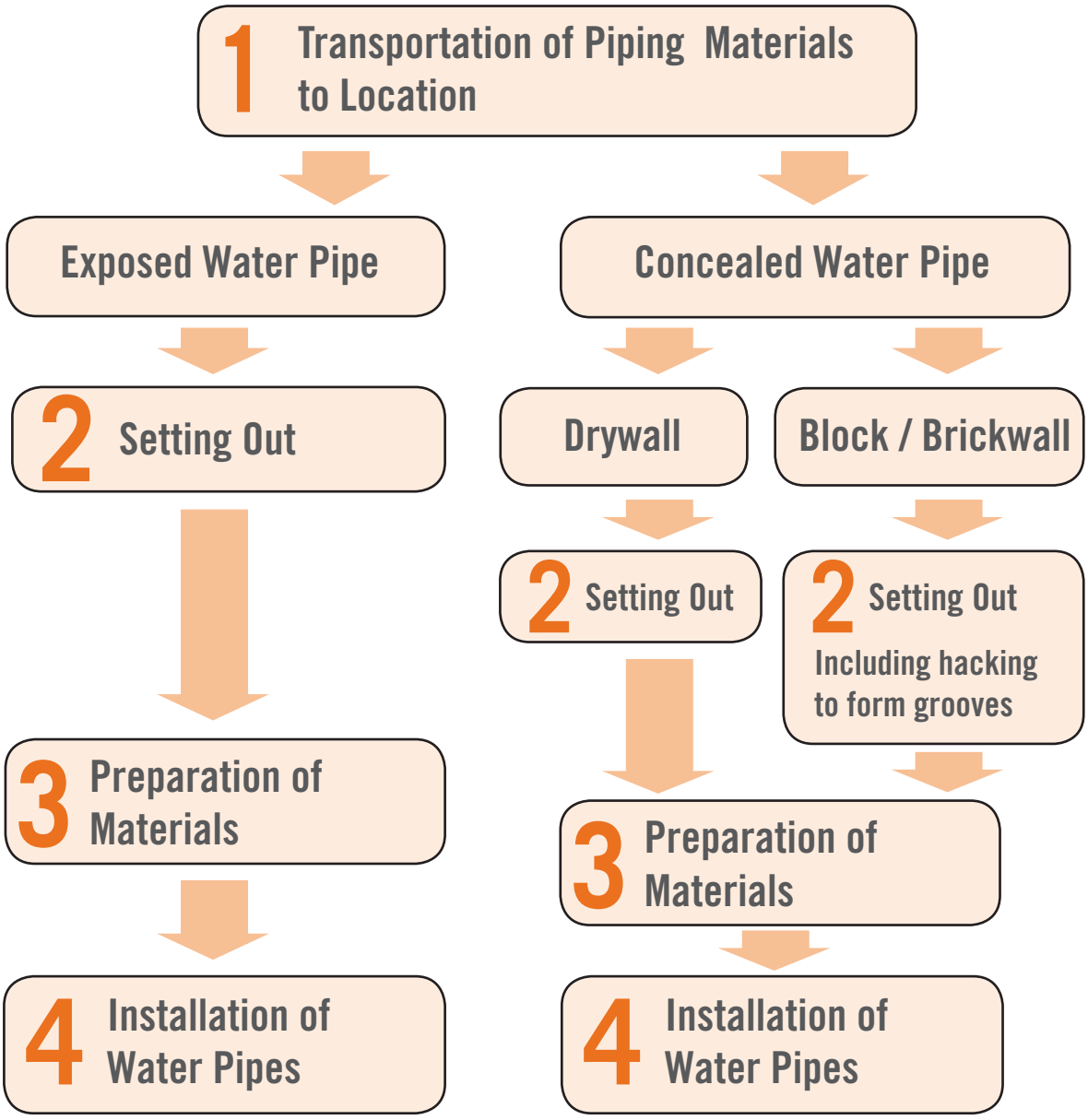
Remark:

Recorded By: _____ Checked By: _____
Date: _____ Date: _____

Notes:
1) The manhours taken **do not** include hours clocked by the site management team.
2) Activities that are performed off-site **shall not** be included (e.g. prefabrication, pre-installation).
3) The trade manpower size refers to the gang size only.
4) The machine operator manpower size refers to operators of lifting equipment, transportation equipment and temporary hoist.
5) The safety and health manpower size refers to safety supervisor, rigger/signaller and housekeeping worker.
6) The time taken for the transportation of materials within the site by crane or other mechanical means shall be taken into account in the total manhours taken for the specific trade.
7) The manhours taken for the erection/dismantling of scaffolding, if any, shall be recorded under the activities “Setting Out”.
8) The installation of M&E conduits in slab during the structural stage should be monitored separately in m/manhour.
9) The trade productivity value shown in the example is not meant for benchmarking purpose.

12 WATER PIPE INSTALLATION

The flowchart below shows the typical processes involved in the installation of water pipe during construction. It serves as a guide on the activities that are to be considered during the measurement of productivity for this trade.



12.1 Water Pipe Installation Process

The following sections show the steps involved when installing water pipe. While the specific construction techniques employed may differ, these are the common stages of work that are commonly carried out on site.

12.1.1 Transportation of Piping Materials to Location

Transportation of piping materials to location refer to transporting from the holding area on-site to the working area.

Transporting piping materials to working area

Placing of piping materials near working area

12.1.2 Setting Out

Setting out include marking the water pipe routing and creating opening through wall for pipe penetration. The time take for hacking of block/ brickwall to conceal the water pipe shall be included.

Hacking of grooves and opening (if necessary)

12.1.3 Preparation of Water Pipes

Preparation of water pipe include the marking & cutting of the water pipe.

Measuring and marking on water pipe

Bending of water pipe

Cutting of water pipe to required length

Cutting of PEX pipe

12.1.4 Installation of Water Pipes

Installation of water pipes includes jointing of water pipe and mounting to wall bracket. There are various methods of jointing such as the following:

Jointing of water pipe by crimped connection

Jointing of water pipe by soldered connection

Joining of water pipe by threaded connection

Jointing of PEX pipe by pressed connection

12.2 Water Pipe Installation Productivity Monitoring Form

The Water Pipe Installation Productivity Monitoring Form has been designed to standardize the monitoring of productivity for water pipe installation. The methodology gives the step by step guide on how to carry out the monitoring and the items to be included in the form. Builders should read the case example and relate to the methodology before using the form.

Methodology

1) The location where the water pipe installation would be monitored should first be identified. It is recommended for the builder to start the monitoring when the water pipe installation has reached the stage of a typical floor. The example shows the monitoring on Block 123 #05-13 Kitchen.

2) The following should then be calculated or recorded:
   a) Pipe length
   b) Method of connection
   c) Concealed or exposed piping
   d) Piping material
   e) Ceiling height
   f) Manpower used during the water pipe installation; this should include the trade gang and safety & health workers. Work done by the site management team such as planning should not be included as their main role is management and does not influence the installation work directly.

3) The unit used for the manpower is manhour. 1 manhour is defined as 1 man working for 1 hour. The example shows that about 8 manhours were required to install 20m of water pipe. This is equivalent to 4 men working for approximately 2.00 hours to install 20m of water pipe.

4) The trade productivity is then calculated by dividing the length of water pipe by the manhours taken.

5) The following information should be provided in the form:
   a) Type of equipment used. A material hoist was used in the example.
   b) Breakdown of the manpower type. The example shows 2 tradesmen, 1 material hoist operator and 1 general worker.

6) The manpower and time should be recorded when workers are carrying out the following activities:
   a) Transporting of piping materials to location
   b) Setting out
   c) Preparation of piping materials
   d) Installation of water pipe

   (The form should indicate as a percentage the time taken for each of the above activities)

Case Example

Project Information

This project consists of 3 blocks of residential buildings:-
- Location = Block 123 #05-13 Kitchen
- Length of water pipe = 20m
- Ceiling height = 2900mm

Manpower Size

Trade manpower = 2men
Material hoist operator = 1man
Safety and Health Workers = 1 general worker

Time taken

Transportation of ducting materials to location		
(Material hoist in operation)	0.80	manhours
(Material hoist downtime)	(0.50	manhours) (excluded)
Setting out	1.20	manhours
Preparation of piping materials	2.80	manhours
Installation of water pipe	3.20	manhours
Total	8.00	manhours

Productivity Calculation

$$\text{Trade Productivity} = \frac{\text{Length of water pipe}}{\text{Total manhours}}$$

$$= \frac{20\ \text{m}}{8\ \text{manhours}}$$

$$= 2.50\text{m/manhours}$$

Water Pipe Installation Productivity Monitoring Form

Building and Construction Authority

Project Title: _____

S/no	Location	Pipe Length (m)	Total Manhour Taken[1,2]	Trade Productivity (m/manhour)	Mechanical and Non-mechanical equipment used (if any) Mechanical: Boom/Scissor/ Personnel Lifts, etc. Non Mechanical: Scaffold/Ladder/ Bench, etc.	Method of Connection • Soldered connection • Crimped or pressed connection • Threaded connection	Concealed / Exposed Piping	Piping Material • Copper • PEX • PPR	Ceiling Height (mm)	Breakdown of Manpower Size			Please indicate the % of time taken in each activities			
										Trade[3]	Machine Operator[4]	Safety and Health[5]	1 Transportation of Piping Materials to Location[6]	2 Setting Out[7,8]	3 Preparation of Materials	4 Installation of Water Pipe[9]
E.g.[10]	*Blk 123 #05-13 Kitchen*	*20m*	*8*	*2.5*	*1xMaterial Hoist 1xLadder*	*Soldered connection*	Exposed	*Copper*	*3200*	*2 men*	*1 man*	*1 man*	*10%*	*15%*	*35%*	*40%*
													Percentage of time taken for Activities 1 to 4 MUST add up to 100 %.			
1																
2																
3																

Remark:

Recorded By: _____ Checked By: _____
Date: _____ Date: _____

Notes:
1) The manhours taken **do not** include hours clocked by the site management team.
2) Activities that are performed off-site **shall not** be included (e.g. prefabrication, pre-installation).
3) The trade manpower size refers to the gang size only.
4) The machine operator manpower size refers to operators of lifting equipment, transportation equipment and temporary hoist.
5) The safety and health manpower size refers to safety supervisor, rigger/signaller and housekeeping worker.
6) The time taken for the transportation of materials within the site by crane or other mechanical means shall be taken into account in the total manhours taken for the specific trade.
7) The time taken to hack away opening or groove for concealment of piping shall be recorded. Patching of void to seal up opening or concealed piping **shall not** be recorded.
8) The manhours taken for the erection/dismantling of scaffolding, if any, shall be recorded under the activities “Setting Out”.
9) The time taken for testing of water leakage or rectification work to leaking parts **shall not** be included.
10) The trade productivity value shown in the example is not meant for benchmarking purpose.

References

1. ASTM E2691 Practice for Job Productivity Measurements by ASTM International

2. Good Industry Practices - Ceramic Tiling (Second Edition) by Building and Construction Authority

3. Good Industry Practices - Timber Doors by Building and Construction Authority

4. Good Industry Practices - Painting (Second Edition) by Building and Construction Authority

Notes

Notes

Building and Construction Authority

We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.

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