PREDETERMINED TIME SYSTEMS: METHODS-TIME MEASUREMENT

IENG 301

FUNDAMENTALS OF WORK STUDY AND ERGONOMICS

METHODS TIME MEASUREMENT (MTM)

- This system is defined as a procedure which analyzes any manual operation or method into basic motions require to perform it, and assigns to each motion a predetermined time standard which is determined by the nature of the motion and the conditions under which it is made.

MTM-1

- The unit of time used is one hundred-thousandth of an hour (0.00001 hour), and is referred to as one time-measurement unit (TMU). Thus, one TMU equals 0.0006 minute.

Reach

- Reach is the basic elemetn used when the predominant purpose is to move hand or finger to a destination. The time for making a reach varies with the following factors:
  - Condition (nature of destination)
  - Length of the motion
  - Type of reach

Reach table

Move

- Move is the basic element used when the predominant purpose is to transport and object to a destination.
- The timefor move is affected by the following variables:
  - Condition (nature of destination)
  - Length of motion
  - Type of move
  - Weight factor (static and dynamic)

Move table

Reach and Move

- There are three types of reach and move
  1. Hand is not moving at the beginning and at the end of reach/move
  2. Hand is moving at either beginning or end of reach/move
  3. Hand is in motion at both beginning and end of reach/move

Turn

- Turn is the motion employed to turn hand, either empty or loaded, by a movement that rotates the hand, wrist and forearm about the long axis of the forearm
- The time depends on two variables;
  - Degrees turned
  - Weight factor

Apply Pressure

- It provides full cycle time or developments by the components as related to other motions

Table 37. Turn—T

Weight	Time TMU for Degrees Turned										
	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°
Small—0 to 2 Pounds	2.8	3.5	4.1	4.8	5.4	6.1	6.8	7.4	8.1	8.7	9.4
Medium—2.1 to 10 Pounds	4.4	5.5	6.5	7.5	8.5	9.6	10.6	11.6	12.7	13.7	14.8
Large—10.1 to 35 Pounds	8.4	10.5	12.3	14.4	16.2	18.3	20.4	22.2	24.3	26.1	28.2

Table 38. Apply Pressure—AP

Full Cycle			Components		
Symbol	TMU	Description	Symbol	TMU	Description
APA	10.6	AF + DM + RLF	AF	3.4	Apply Force
APB	16.2	APA + G2	DM	4.2	Dwell, Minimum
			RLF	3.0	Release Force

Grasp

Grasp is the basic element employed when the predominant purpose is to secure suf-

Grasp

- Grasp is the basic element employed when the predominant purpose is to secure sufficient control of one or more objects with the fingers or hand to permit the performance of the next required basic element.

Table 39. Grasp—G

Type of Grasp	Case	Time TMU	Description	
Pick-up	1A	2.0	Any size object by itself, easily grasped	
	1B	3.5	Object very small or lying close against a flat surface	
	1C1	7.3	Diameter larger than ½"	Interference with Grasp on bottom and one side of nearly cylindrical object.
	1C2	8.7	Diameter ¼" to ½"	
	1C3	10.8	Diameter less than ¼"	
Regrasp	2	5.6	Change grasp without relinquishing control	
Transfer	3	5.6	Control transferred from one hand to the other.	
Select	4A	7.3	Larger than 1" x 1" x 1"	Object jumbled with other objects so that search and select occur.
	4B	9.1	¼" x ¼" x ⅛" to 1" x 1" x 1"	
	4C	12.9	Smaller than ¼" x ¼" x ⅛"	
Contact	5	0	Contact, Sliding, or Hook Grasp.	

Position

- Posiiton is the basic element employed to align, orient and engage one object with another object, where the motions used are so minor that they do not justify classification as other basic elements.
- The time for position is affected by;
  - Class of fit
  - Symmetry
  - Ease of handing

Table 40. Position *—P

Class of Fit		Symmetry	Easy to Handle	Difficult to Handle
1—Loose	No pressure required	S	5.6	11.2
		SS	9.1	14.7
		NS	10.4	16.0
2—Close	Light pressure required	S	16.2	21.8
		SS	19.7	25.3
		NS	21.0	26.6
3—Exact	Heavy pressure required	S	43.0	48.6
		SS	46.5	52.1
		NS	47.8	53.4
Supplementary Rule for Surface Alignment				
P1SE per alignment: $>1/16 \leq 1/4''$		P2SE per alignment: $\leq 1/16''$		

*Distance moved to engage—1" or less.

Release

- Release is the basic element to relinguish control of an object by the fingers or hand.
- Two classifications;
  - Normal release, simple opening of fingers
  - Contact release, release bgins and is completed at the instant the following reach begins

Table 41. Release—RL

Case	Time TMU	Description
1	2.0	Normal release performed by opening fingers as independent motion.
2	0	Contact Release

Disengage

Disengage is the basic element used to break contact between one object and another. It includes an involuntary movement resulting from the sudden ending of resistance. The time for disengage is affected by the following three variables: (1) class of fit, (2) ease of handling, and (3) care of handling (Table 42).

Table 42. Disengage—D

Class of Fit	Height of Recoil	Easy to Handle	Difficult to Handle
1—Loose—Very slight effort, blends with subsequent move.	Up to 1″	4.0	5.7
2—Close—Normal effort, slight recoil.	Over 1″ to 5″	7.5	11.8
3—Tight—Considerable effort, hand recoils markedly.	Over 5″ to 12″	22.9	34.7

Eye Times

- In most work, time for moving and focusing the eye is not a limiting factor and consequently does not affect the time for the operation. When the eyes do drect the hands or body movements, however, eye times must be considered. There are two types of eye time;
  - Eye focus
  - Eye travel time

Eye Times

- Eye focus time is the time required to focus the eyes on an object and look at it long enough to determine certain readliy distinguishable characteristics within the area which may be seen without shifting the eyes.
- Eye travel time is affected by the distance between points from and to which the eye travels, and the perpendiculat distance from the eye to the line of travel

consequently does not affect the time for the operation. When the eyes do direct hands or body movements, however, eye times must be considered. There are types of eye time, eye focus time and eye travel time.

Eye focus time is the time required to focus the eyes on an object and look

Table 43. Eye Travel and Eye Focus—ET and EF

Eye Travel Time $= 15.2 \times \frac{T}{D}$ TMU, with a maximum value of 20 TMU. where T = the distance between points from and to which the eye travels. D = the perpendicular distance from the eye to the line of travel T. Eye Focus Time = 7.3 TMU.
Supplementary Information —Area of Normal Vision = Circle 4″ in Diameter 16″ from Eyes —Reading Formula = 5.05 N Where N = The Number of Words.

Table 46. Conventions for Recording MTM

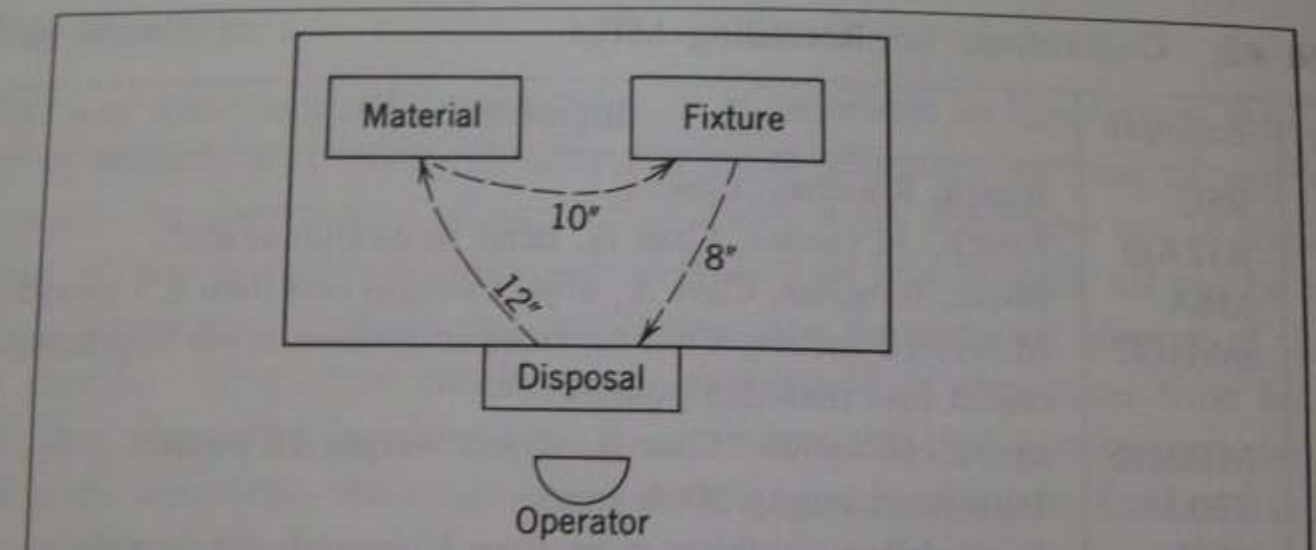
Table	Example	Significance
35	R8C	Reach, 8 inches, Case C
	R12Am	Reach, 12 inches, Case A, hand in motion at end.
36	M6A	Move, 6 inches, Case A, object weighs less than 2.5 pounds
	mM10C	Move, 10 inches, Case C, hand in motion at the beginning, object less than 2.5 pounds
	M16B15	Move, 16 inches, Case B, object weighs 15 pounds
37	T30	Turn hand empty 30 degrees
	T90L	Turn object weighing more than 10 pounds 90 degrees
38	APB	Apply pressure, includes regrasp
39	G1A	Grasp, Case G1A
40	P1NSD	Position, Class 1 fit, nonsymmetrical part, difficult to handle
41	RL1	Release, Case 1
42	D2E	Disengage, Class 2 fit, easy to handle
43	EF	Eye focus
	ET14/10	Eye travel between points 14″ apart where line of travel is 10″ from eyes

When these symbols are recorded, they are written down in such a way as to indicate the hand making the motions, the sequence, and the time values.

LH	*TMU*	*RH*
R12C	14.2	
G4A	7.3	
M10A	11.3	
G3	5.6	G3
	5.2	M2C
	5.6	P1SE
	2.0	RL1
Total	51.2	

This indicates that the following motions take place. The left hand makes a 12-inch Case C reach followed by a G4A to pick up an object. The left hand then moves the object back to the other hand. A transfer grasp puts the object in the right hand which then moves it 2 inches to an exact location, positions it, and releases it.

EXAMPLE The analysis shown in Fig. 234 includes the motions required in order to dispose of one part and obtain the next in a given layout.



	LH	TMU	RH
MOVE part 8 inches from fixture to disposal chute		10.6	M8B
RELEASE part		2.0	RL1
REACH 12 inches to bin for next part	R12C	14.2	
GRASP part	G4B	9.1	
MOVE part 10 inches to fixture	M10C	13.5	
POSITION part in fixture	P2SE	16.2	
Total time		65.6 or 0.039 minute	

Figure 234 Example of MTM analysis—dispose of one part and obtain the next. Machine operation time not shown.