

CONSTRUCTION MANAGEMENT

Notes by-

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Material Management

- Questions
- 1 Define Management. - Henry Fayols Principle
 - 2 Exp. for FOC & problem
 - 3 Purchase of matl.
 - 4 ABC analysis
 - 5 Overhead, classifⁿ & eg.
 - 6 cost types - v. Imp. - Overhead etc.
 - 7 Elasticity of demand.
 - 8 Quality, FOS & relatⁿ betⁿ cost & quality
 - 9 statistical mt. of control in quality.

* objectives of material management:-

- Primary:-
- 1 Procuring matl. of specified quality, quantity at economical rate & at required demand.
 - 2 To minimise investments.

secondary:

- 1 Locating new sources of supply.

- 2 Reduce the purchasing cost.

- 3 EOQ

- 4 Co-ordinating with various phases of constⁿ such as POSDC.

- 5 Developing skills.

* Functions of material manager:-

- 1 Matl. planning & budgeting.

- 2 Matl. purchasing & procurement

- 3 Receiving, inspection & storage of matl.

- 4 Inventory control.

- 5 Value analysis & standardizatⁿ.

- 6 Scrap disposal, minimizing wastage.

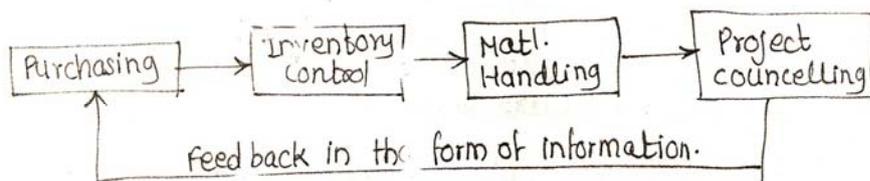
- 7 Co-ordination with POSDC.

* Functions of material management:-

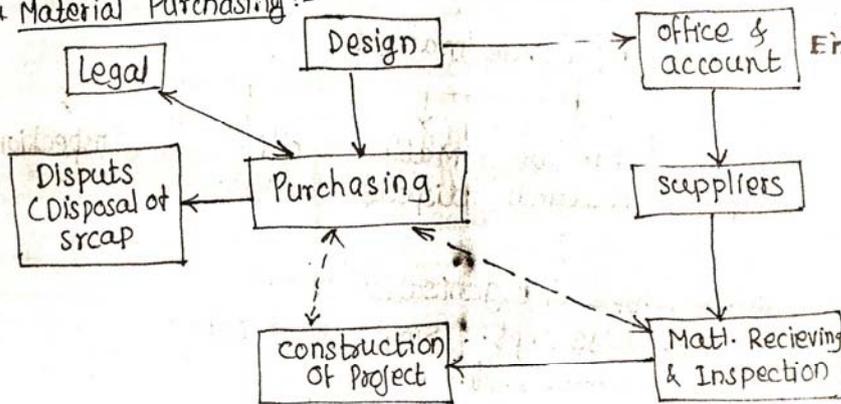
- 1 Purchasing

- 2 Handling

- 3 Inventory



* Material Purchasing :-



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* Methods of Purchasing :-

- ① Inviting Tenders
- ② Fixed Rate contract.

* Procurement of Materials :-

↳ Functions & Responsibilities of purchase dept :-

- ① To get right quality & quantity of matl. at lowest cost.
- ② To reduce time of procurement.
- ③ To adopt proper purchasing procedure.

↳ Methods of Purchasing :-

- ↳ Market Purchasing : for smaller purchase plan
- ↳ Centralised purchasing : for Govt. & big private organisatⁿ.
- ↳ Rate-contract purchasing :

Mpsc 199

↳ steps involved in purchasing :-

- 1) List of suppliers.
- 2) Finding quantity & specification of each matl.
- 3) Preparatⁿ of supply schedule (Based on EOQ)
- 4) selecting 'critical material'
- 5) Inviting tenders.
- 6) Selection of proper supplier based on 'rate' & capacity.
- 7) Procurement of matl. by giving 'purchase order' or indent.
- 8) Inspection of received matl.
- 9) storage of matl.
- 10) Issuing of matl. to various activities from central store.
- 11) Keeping watch on mis-use, waste of matl.
- 12) feedback from site engineer if additional matl. requires.

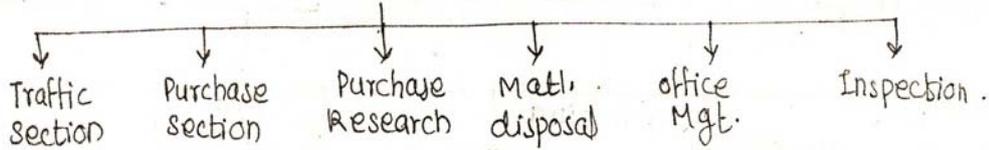
Indents :- Indent (Form No. 7) is a booklet, having each page in triplicate & serially numbered, used for ordering the required material to the supplier.

One copy of indent is kept to the contractor, second is for the supplier & third is used for receiving the material.

* organisation of purchase department:-

Office Memorandum
Date: / /

Material/ Purchase manager.



* In the purchase, types of organisation are:-

- ① Centralised Purchase Dept. : Single plant industry
- ② Decentralised purchase Dept. : Different plant industries.

* Inventory:-

"Inventory is a descriptive list of available quantity of material & money value of each."

* classification of inventory:-

➤ Direct Inventory:- Directly used in cost & becomes its integral part.

- a) Raw matl. inventory:- Processing is reqd. [Timber, Tile]
- b) Work in progress inventory:- Reqd. during work.
- c) finished inventory:- Ready to use.

➤ Indirect inventory:- eg: oil, paint, lubricant, offic matl. i.e. they do not become integral part of finished good.

* Reason for holding inventories:-

- ① To create buffer or safety stock betⁿ input & output.
- ② To ensure delay against delivery of matl.
- ③ To allow possible fluctuation in output.
- ④ To take advantage of "quantity discount."
- ⑤ To purchase the matl. when price is low.

v. Imp. 10M

ECONOMIC ORDER QUANTITY

Inventory cost are:-

- ① Processing or ordering cost
- ② Inventory carrying cost
- ③ stock out cost.

① Processing / ordering cost consist of:-

- a) official procedure cost (i.e. paper, postage etc, telephone).
- b) Receiving cost: Transportatⁿ, Inspection, labour tenders etc.
- c) storing cost.

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a) Inventory carrying cost:-

- a) Interest on capital.
- b) Handling during storing & issuing.
- c) Insurance, deterioration, damage, taxes, wastes etc.

b) stock out :- should be minimum.
 ⇒ Cost due to loss of profit + Overtime + dissatisfaction of customer

as processing cost = [cost of salaries of persons in purchase dept + official expenditure - Tender, specifications, stationary, document, postage, Telephone].

& this cost is somewhat (approx) same for every order.

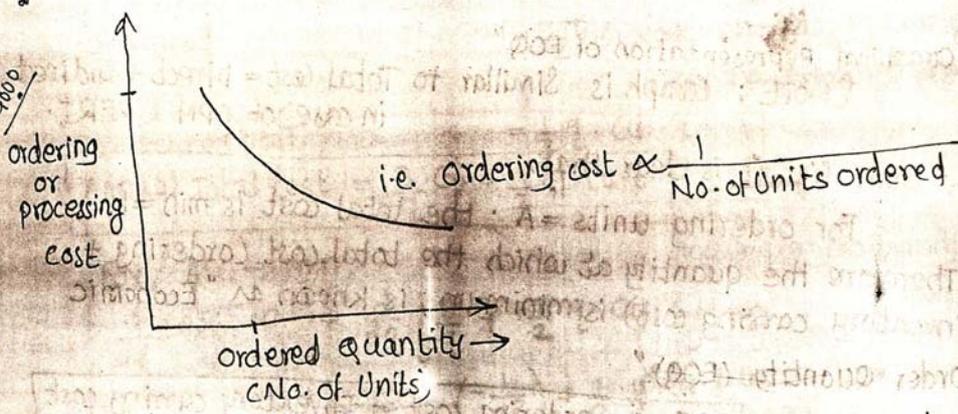
∴ To minimize processing cost ⇒ No. of orders should be less
 ⇒ No. of units (quantity) should be more.

∴ We get, at Quantity ~~More~~ Less ⇒ More cost
 Quantity More ⇒ Less cost.

ection.

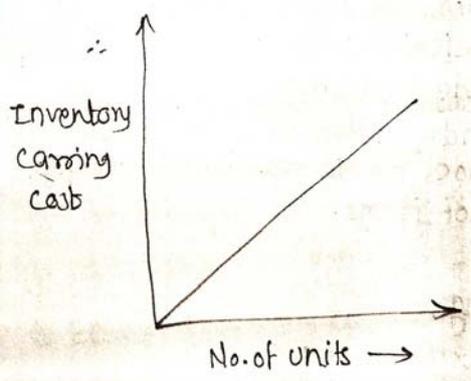
rt.

2000/1000
500/1000
4000



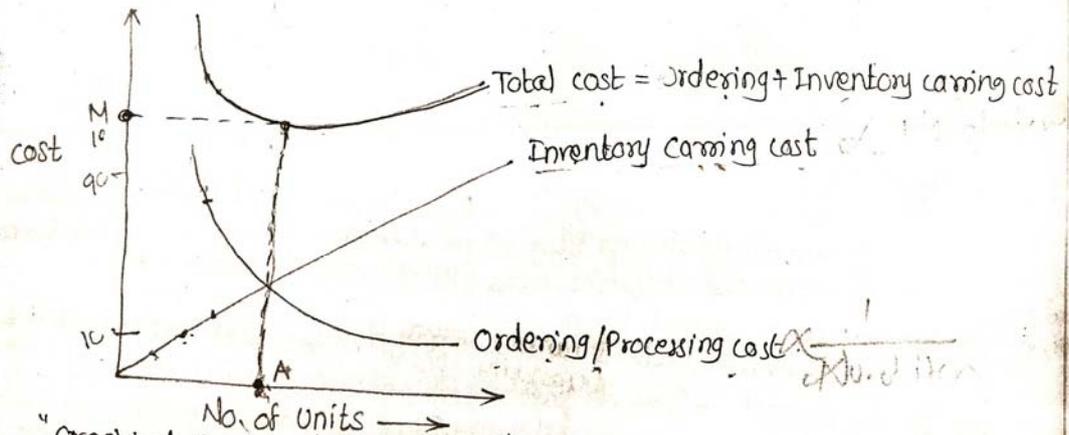
Now, inventory carrying cost = [cost of interest, handling, insurance, deterioration, damage etc]

∴ Inventory carrying cost \propto Ordered quantity



Total inventory cost = Ordering/Processing cost + Inventory carrying cost

∴ overlapping above two graphs,



"Graphical Representation of EOQ"

[NOTE: Graph is similar to Total cost = Direct + Indirect cost] in case of CPM & PERT.

∴ from fig. it is clear that,

For ordering units = A; the total cost is min = M.

∴ Therefore the quantity at which the total cost (Ordering + Inventory carrying cost) is minimum, is known as "Economic Order Quantity (EOQ)".

Thus for $EOQ \Rightarrow$ ordering cost = Inventory carrying cost & Total cost is min.

Mathematical expression for EOQ :-

Assumptions :-

- ① Demand (Requirement) is uniform at constant rate.
- ② Time betⁿ placing of order & receiving order = 0
∴ $Lead\ Time = 0 \Rightarrow$ Ideal condition.
- ③ Price of per item is fixed & independent of No. of quantity.
- ④ Cost of transportⁿ is fixed & does not increase with No. of qty.
- ⑤ Inventory carrying cost \propto No. of items.
- ⑥ Ordering cost $\propto \frac{1}{No. of items}$.
- ⑦ There is no restriction on ordering.

Let S = annual consumption of items (Units)
 C_u = cost per unit item (Rs)
 C_p = cost per procurement (ordering cost) (Rs)
 i = Inventory carrying cost (% of avg. inventory investment) (%)
 q = ordered quantity (Units)
 Q_0 = Economic order quantity (Units)

must Remember.

∴ Annual Total cost = Annual Procurement cost + Inventory carrying cost per year.

① Annual procurement cost = [No. of orders per year] × [Procurement cost per order]
 = $\left[\frac{\text{Annual consumption}}{\text{ordered quantity}} \right] \times \text{Procurement cost per order}$

② Annual inventory carrying cost = [A vg. inventory investment] × [Inventory carrying cost]
 = $\left[\left(\frac{0+1}{2} \right) \times \text{ordered quantity} \times \text{price per unit} \right] \times \text{Inventory carrying cost}$
 = $\frac{1}{2} \times \text{ordered quantity} \times \text{price per unit} \times p \text{ Inventory carrying cost}$

ATC $\frac{1}{2} q \cdot cu \cdot i$
 Annual Total cost = $\frac{S \cdot Cp}{q} + \frac{1}{2} \cdot q \cdot cu \cdot i$

For, ATC \rightarrow min,

$\frac{d}{dq} (ATC) = 0 \Rightarrow \frac{d}{dq} \left[\frac{S \cdot Cp}{q} + \frac{1}{2} \cdot q \cdot cu \cdot i \right] = 0$

$\Rightarrow S \cdot Cp \cdot \left(-\frac{1}{q^2} \right) + \frac{1}{2} \cdot cu \cdot i = 0$

$\Rightarrow \frac{S \cdot Cp}{q^2} = \frac{1}{2} cu \cdot i$

$\Rightarrow q^2 = \frac{2S \cdot Cp}{cu \cdot i}$

$\Rightarrow q_0 = \sqrt{\frac{2 \times S \times Cp}{cu \cdot i}}$

This expression gives Economic order Quantity. (EOQ)

∴ Imp. steps:-

Must Remember.

① Procurement cost = $\frac{S \cdot Cp}{q} = \frac{S \cdot Cp}{\sqrt{\frac{2S \cdot Cp}{cu \cdot i}}} = \sqrt{\frac{S^2 \cdot Cp^2}{2S \cdot Cp / cu \cdot i}}$

② Inventory carrying cost = $\frac{1}{2} \cdot q \times cu \times i = \sqrt{\frac{cu \cdot i \cdot S \cdot Cp}{2}}$

③ EOQ = $q_0 = \sqrt{\frac{2S \cdot Cp}{cu \cdot i}}$

Problem
MPSC '96

10M] On the constⁿ site cement is required in large quantities as follows :-

Typical Problem
Best Solution
"check for Ans."

- ① Annual use = 200 tons, price per bag at site = 150/-
- ② cost of ordering = Rs 100/- per order.
- ③ Inventory carrying cost = 20%.
- ④ suppliers discount at order of quantity as follows -
 - a) less than = 20 tonnes \Rightarrow No discount
 - b) 20 tonnes & less than 40 tonnes \Rightarrow 5%.
 - c) 40 tonnes & above \Rightarrow 10%.

Suggest a suitable order quantity.

Solⁿ:-
 $S = 200 \text{ tons} = 4000 \text{ bag.}$
 $C_u = 150 \text{ Rs.}$
 $C_p = 100 \text{ Rs per order.}$
 $C_i = 20\% = 0.2$

1 Ton = 3000 Rs.
 1 Ton = 1000 kg
 1 kg = 50 kg.
 100 kg = 2 Bag
 1000 kg = 20 BAG
 (1 Ton)
 $200 \text{ Ton} = 200 \times 20 \text{ bag}$
 $= 4000 \text{ bags.}$

Price Range
150 <

1 kg = 50 kg = 150 Rs.
 $4000 \text{ bag} = 600,000 \text{ Rs.}$
 $\Rightarrow 200 \text{ Ton} = 600,000 \text{ Rs.}$
 $20 \text{ Ton} = 60,000 \text{ Rs}$
 $40 \text{ Ton} = 120,000 \text{ Rs.}$

1 Ton = 20 bag = 3000 Rs.

Price (Rs)	Range	EOQ	Quantity to be purchased
150/-	< 20 Ton = 400 bag	164 bags.	164 bag
$(1-0.05) \times 150$	20 - 40 Ton = 400-800	167.5 bags.	400 bag
$(1-0.1) \times 150$	> 40 Ton = > 800 bag	173.3 bags.	800 bag.

case (i) $EOQ = \sqrt{\frac{2 \cdot S \cdot C_p}{C_u \cdot i}} = \sqrt{\frac{2 \times 4000 \times 100}{150 \times 0.2}} = 164 \text{ bags.}$

case (ii) $EOQ = \sqrt{\frac{2 \times 4000 \times 100}{142.5 \times 0.2}} = 167.5 \text{ bags.} \Rightarrow 400 \text{ bags}$

case (iii) $EOQ = \sqrt{\frac{2 \times 4000 \times 100}{135 \times 0.2}} = 172.13 \Rightarrow 800 \text{ bags.}$

Ans: Economical purchase = 800 bag per order.
 No. of order reqd = 5 orders.
 Cost for each order = 551,300.
 Total cost = 2,756,500.

Cost Element	Price discount		
	Rs 150	Rs 142.5	Rs 135
Order Quantity \rightarrow	164 bags	400 bags	800 bags
① Matl. cost = $C_u \times S$, $[S = 4000]$	600,000	570,000	540,000
② Procurement cost = $(\frac{S}{q} \times C_p)$ $S = 4000, C_p = 100, q = \text{order}$	2,439	1,000	500
③ Inventory carrying cost = $\frac{1}{2} \cdot q \cdot C_u \cdot i$	2,460	5,700	10,800
Total cost	604,899	576,700	551,300

Economic Purchase.

* Buffer stock :-

Due to uncertainties in the demand & delay in supply, it is necessary to make a stock of critical material & such stock is known as "Buffer stock" (Safety stock).

* Lead Time :-

The total time elapsed betⁿ ordering time of material & the receiving of material is known as "Lead Time". as it is impossible that material receive at the same time time of its ordering. [ordering & receiving of matl. is not simultaneous process in practice].

Lead Time consist of :-

- ① Processing / Procurement / ordering Time. (Collectⁿ of informatⁿ)
- ② Time reqd. to ordering matl.
- ③ Time reqd. to ~~see~~ receive the order.

Imp. * ABC analysis :-

from statistic, it can be seen that :-

Just a handful of items account for bulk of annual expenditure.

i.e. less number of item requires more expenditure.

eg: ~~lock~~ steel reqd. is less in number, but takes more cost.
Brick reqd. are more in number, but take smaller cost.

In ABC analysis, all items are divided in 3 categories as -

- i) A Type item
- ii) B Type item
- iii) C Type item.

depending upon their "annual usage".

This denotes the items for which attention paid should be more.

① A-Type item :- 5-10% items of total item accounts 70-75% of total money spent on material. These items are 'A' Type

These items requires more attention on their purchasing, storing as more money is spent on its inventory.

These items should not be stored in more quantity than reqd, & should be ordered frequently, so that capital should not be blocked. The Economic Order Quantity should be calculated depending upon ordered units & inventory carrying cost & storage cost. It is advisable to make a contract with the supplier to supply these material in various orders & at a constant rate.

eg: Cement, Steel, precast unit etc.

order = 5
= 21756/500