

Site Layout Planning

Introduction

- **Site management**, in general, involves many tasks such as:
 - Site investigation before construction starts
 - Material delivery and procurement management
 - Keeping better site records
 - Keeping good site communication and high level of information flow
 - Monitoring performance regularly
 - Establishing a well co-ordination system among different parts, and
 - **Performing a good site layout planning**

Introduction

- Among the important tasks of site management is the **site layout planning**
- Extensive time loss and cost overruns could result in large projects, if there is no effective site planning
- A detailed planning of the site layout and location of temporary facilities can make improvement by minimizing **travel time, waiting time, and increasing worker morale by showing better and safer work environment**
- The Construction Industry Institute reported in its "Constructability Concepts File, 1987" that temporary facilities are important and can either enhance or adversely affect construction productivity

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Introduction

- Site planning has been the most neglected aspect in the construction industry and the attitude of the engineers has been that it will be done as the project progress
- It is important to realize that the site planning will be the conditions that site personnel will live with for the total duration of the construction period
- Thus the careful pre-planning is imperative
- Significant saving can be occurred if the labor force moved freely and quickly within the site

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Introduction

- *Layout planning has many engineering applications such as:*
- *Layout of manufacturing plants departments*
- *Layout of computer chips on a board*
- *Rooms layout in a building, and*
- ***Construction Site layout***

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Introduction

- *Lack of good site layout planning may lead :*
 - *Material stacks wrongly located, This problem may involve double or triple handling of materials to another location (too far; impede flow, too remote from hoists, etc.)*
 - *Equipment wrongly located (unreachable, insufficient, ..)*
 - *Site huts wrongly located in relation to their effective use (noise , dust, safety, insufficient area, inadequate access.....)*

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Definition

- *Construction site layout involves:*
 - **Identifying,**
 - **Sizing, and**
 - **Placing** temporary facilities (TFs) within the boundaries of construction site
- *These temporary facilities range from **simple lay-down areas to warehouses, fabrication shops, maintenance shops, batch plant, and residence facilities***

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Objective

- *Site layout planning objectives are:*
 - *Site must be designed to maximize efficiency of operations in order to promote worker productivity, to shorten project time and to reduce cost*
 - *It must create a project with a good work environment in order to attract and retain the best personnel and thus contribute to better work quality and productivity*
- *A well planned site including all facilities and utilities lead to:*
 - *increasing productivity and safety*
 - *reducing area(s) needed for temporary construction*
 - *maximizing utilization*

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Site Layout Elements

➤ **Safety:**

- *Fire prevention, fire extinguishers are basic requirements on a construction project*
- *Medical services: a first aid kit is a must. In remote projects a well-equipped medical room with a doctor and nurse is important*
- *Construction safety clothing*
- **Site Accessibility;** *easy accessibility will keep the morale of the equipment and vehicle drivers high, minimize the chance of accidents, and save time in maneuvering to arrive at and leave the project (roads, parking lots)*

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Site Layout Elements

➤ **Information Signs**

- *Site map showing gates escape ways;*
- *Traffic regulatory signs*
- *Display of safety rules*
- *Emergency routes and underground services*
- **Security**
 - *Entrance (proper guard entrance to the site)*
 - *Lighting (standby generator to maintain site lighting)*
 - *Fencing (boundaries should be fenced off from a security point of view)*

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Site Layout Elements

➤ **Accommodation**

- *It is necessary to provide camp accommodation for all type of staff involved in the project*

➤ **Offices**

- *Offices should be close together, close to the site, and in a safe area*
- *Provide proper office equipment*

➤ **Water Supply and Sanitation**

- *It is necessary to have water and toilet facilities in convenient locations to accommodate the work force*

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Site Layout Elements

➤ **Material Handling**

- *One third or more of all construction operations can be classified as material handling*
- *Use of proper equipment for handling and planning for minimizing multiple handling results in cost and time savings*

➤ **Storage and site cleaning**

- *Laydown areas; storage of large materials and equipment*
- *Warehouses: sheltered storage facilities*
- *Material staging areas: materials are stored near the work on a short-term basis*
- *Site cleaning: It is necessary to keep work place clean from*

13/11/2014 *debris*

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Site Layout Elements

➤ **Craft Change-Houses**

- *It provides sheltered space for craft personnel to change and store clothes, wash, and rest during waiting periods*

➤ **Batch plant and Fabrication Shops**

- *Batch plants are provided on projects where it is more economical to produce concrete on site*
- *Aggregate storage piles, cement silos and admixture tanks will accompany an on-site batch plant*
- *Shops are used where materials and equipment are fabricated on site: electrical, mechanical, carpentry, etc.*
- *Testing shops used to house the testing equipment*

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Temporary Facilities Characteristics

- *Satisfying environmental and safety regulations (batch plant, etc.)*
- *Availability of diverse solutions for the same problem (build on site, rent a building, ..)*
- *Relatively short life span of a specific location*
- *Reutilization with a minimum loss for the same or modified function at another location*

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Temporary Facilities Characteristics

- *Easy of assembly, dismantling, and exploitation; Prefabricated modules are ideal for constructing temporary facilities and they are usually easy to assemble and dismantle*
- *Standardization of design; This approach makes the maintenance, transportation and storage of temporary facilities easy. The benefits of the learning curve can be gained from repetitive field operations*

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Facilities Selection

- **Considerations of selecting temporary facilities:**
 - **Construction type:** *The construction of an industrial plant, power plant, requires more storage and fabrication area than other projects such as a highway project*
 - **Type of contract:** *For turn-key contract, the contractor can consolidate the administrative and construction operations, means fewer but larger and more efficient temporary facilities can be selected. On the other hand, if the project is managed under a series of different contracts, this will translate into a higher number of smaller temporary facilities serving each individual contractor*

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Facilities Selection

➤ **Considerations of selecting temporary facilities:**

- **Project size:** A small project can be managed from a trailer or portable structure. While a five to ten year project may need temporary facilities of a more permanent nature
- **Project location:** Projects located in uninhabited regions or in places where skilled labor is scarce require additional facilities for eating and living. Project far from industrial centers require more on site services such as batch plant, equipment maintenance shops, long term storage area, and even some other recreational centers for the families

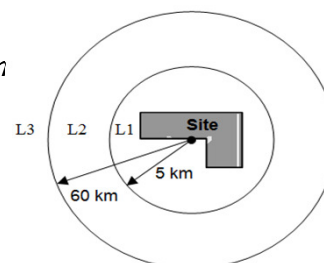
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Facilities Selection

- The selection of some of the temporary facilities depends on the manpower permanent resident from the site
- **L1: local labor force (5 km from site). No lodging or transportation needs**
- **L2: nearby labor force (5 - 60 km from site). No lodging needs, but daily transportation needed**
- **L3: far away (more than 60 km from site). Lodging facilities needed**



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Facilities Selection

➤ *Temporary facilities list*

Facility No.	Facility Name
1	Job office
2	Owner representatives office
3	Subcontractors office
4	First aid office
5	Information and guard house
6	Toilet on site
7	Staff/Engineer dormitory
8	Staff/Engineer family dormitory
9	Labor dormitory
10	Labor family dormitory
11	Dinning room for labor
12	Bathroom for labor
13	Restroom for labor
14	Equipment maintenance shop
15	Parking lot for mechanics
16	Prefabricated rebar storage yard
17	Rebar fabrication yard
18	Fabricated rebar storage yard
19	Carpentry shop

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Facilities Selection

➤ *Temporary facilities list*

Facility No.	Facility Name
19	Carpentry shop
20	Storage yard for lumber
21	Storage yard for formed lumber
22	Cement warehouse
23	Batch-plant and aggregate storage
24	Craft change-house
25	Sampling / Testing lab
26	Pipe jointing yard
27	Pipe storage yard
28	Welding shop
29	Parking lot
30	Tank
31	Long term laydown storage
32	Machine room
33	Electrical shop
34	Steel fabrication shop
35	Sandblast shop
36	Painting shop
37	Scaffold storage yard
38	Material warehouse

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Temporary Facilities Sizing

- *The size of temporary facilities is mainly based on*
 - *Manpower requirements*
 - *Estimated quantity of work*
 - *Production rate of resources*
 - *Availability of site space, and*
 - *Cost considerations*
 - *safety regulations*

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Temporary Facilities Sizing

- ***Rules of thumb of sizing temporary facilities***

Temporary Facility	Minimum (m ²)	Average (m ²)	Maximum (m ²)
- Craft change house per worker	0.09	1.02	2.7
- Office per office worker	5.4	8.7	13.5
- Number of workers per parking space	1	1.7	4
- Area required for each unit parking	22.5	30	36

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Temporary Facilities Sizing

► **Rules of thumb of sizing temporary facilities: offices**

Office	Size Range (m ²)
- Project Manager	12 – 25
- Construction Manager	9 – 14
- Mechanical/ Electrical/ Civil Engineer per Engineer	9 – 11
- Purchasing (total)	46 – 84
- Schedule & Cost Control (total)	28 – 93
- Accounting (total)	37 – 80
- First Aid & Safety per Office	17 – 19
- Clerical (total)	28 – 74
- Estimator	11

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Temporary Facilities Sizing

► **Rules of thumb of sizing temporary facilities: project cost**

Facility	Area (m ² / \$ Million)
Warehouse	2.80
Laydown Areas	28.9
Fabrication Shop	0.38
Equipment Shop	0.37
Administration office	1.11

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Temporary Facilities Sizing

➤ **Material Storage Area**

$$A_n = (Q_{\max} / I_m) / q_n$$

Where: $Q_{\max} = q_{\text{daily}} * t * k$, $q_{\text{daily}} = Q_{\text{total}} / T$

- Q_{\max} : Maximum estimated quantity in storage space;
- I_m : Utilization index for materials;
- q_n : quantity of materials can be stored per m²;
- Q_{total} : Total quantity of materials required for the project;
- q_{daily} : estimated quantity required per day;
- T : construction period (not total project duration);
- t : Average stock (days); and
- k : Fluctuation factor

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Temporary Facilities Sizing

➤ **Material Storage Area**

Description	Delivery & Storage method	Unit	Average Stock t (days)	q_n quantity / m ²	I_m Utilization factor	Waste %
Cement	Bags	ton	30	1.5 - 1.8	0.5 - 0.6	1.5
	Bulk	ton	30	-----	-----	0.5
Aggregate for Concrete	Bulk	m ³	60	1.5 - 2.0	0.6 - 0.7	2.0
Bricks	Units	unit	30	700-1000	0.7 - 0.8	2 - 3
Concrete blocks	Pieces	unit	30	75 - 100	0.7 - 0.8	3-3.5
Lumber	Pieces	m ³	45	1.7 - 2.6	0.6 - 0.7	2-3
Reinforcing bars	Bars	ton	75	1.3 - 1.5	0.75 - 0.8	1-1.2
Concrete pipes	Pieces	ton	30	0.8 - 1.1	0.6 - 0.7	1.0
Iron pipes	Pieces	ton	75	0.6 - 1.5	0.6 - 0.7	0.5
Fuel	Barrels	ton	30	0.5 - 0.7	0.7 - 0.8	1.0

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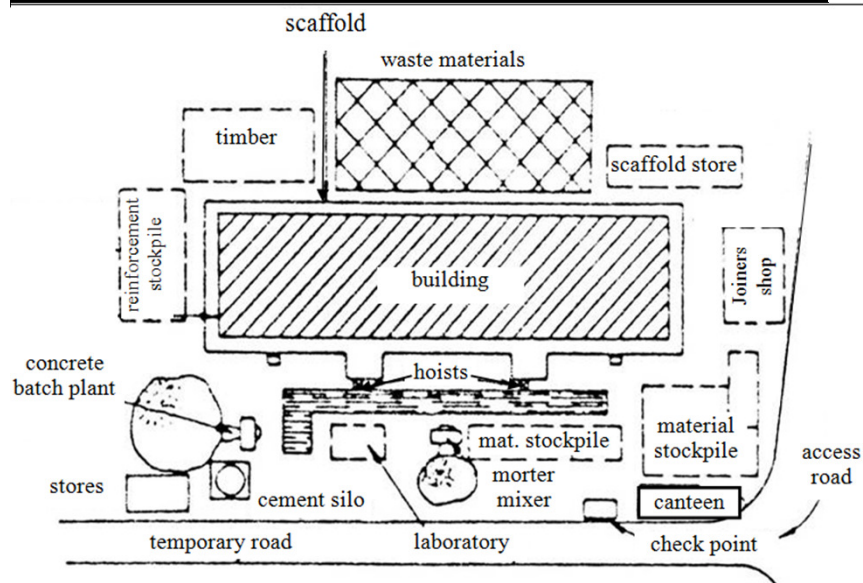
Temporary Facilities Sizing

Rules of thumb

Description	Equations for Calculations		
	Variable	Unit	Use Rate%
1. Job office	peak number of Staff/Eng.	80.73 sf**/pp	70
2. Dormitory for Staff / Eng.	variable 1 - variable 3	86.11 sf/pp	80
3. Dormitory for Staff / Eng. Family	number of Staff/Eng. With family	322.92 sf/pp	-
4. Dormitory for labor	peak number of labors	48.44 sf/pp***	75
5. Dormitory for labor family	peak number of labors with family	269.1 sf/pp	-
6. Bathroom for Staff / Eng.	variable 2 x Use Rate	43.06 sf/pp	20
7. Bathroom for staff / Eng. Family	variable 3	21.53 sf/pp	-
8. Toilet (job office)	variable 1 x Use Rate	32.29 sf/pp	10
9. Toilet (staff / Eng. Dormitory)	variable 2 x Use Rate	32.29 sf/pp	10
10. Dining room for labor	variable 4 x Use Rate - variable 5	21.53 sf/pp	60
11. Bathroom for labor	variable 4 x Use Rate	32.29 sf/pp	10
12. Toilet for labor Dormitory	variable 4 x Use Rate	26.91 sf/pp	10
13. Parking lot	number of cars	215.28 sf/car	-
14. Canteen	variable 1 x (1 - Use Rate)	64.58 sf/pp	80
15. Owner's representative office	the number of representatives	86.11 sf/pp	-
16. Toilet on site	variables (14 + 15 + 17) / 15	32.29 sf/toilet	-
17. Rest area for labor	variable 4	16.15 sf/pp	30
18. Equipment maintenance shop	number of <u>mechanicians</u>	322.92 sf/pp	-
19. Parking lot for <u>mechanician</u>	number of <u>mechanicians</u>	322.92 sf/pp	-
20. Material warehouse	project cost	150-266 sf/m*	-
21. Rebar fabrication yard	peak number of iron workers	75.35 sf/pp	-
22. Rebar storage yard (prefab.)	(peak number of usage/day)x days	16.15 sf/ton	-
23. Rebar storage yard (straight)	(peak number of usage/day)x days	10.76 sf/ton	-
24. Carpentry shop	peak number of carpenters	53.82 sf/pp	-
25. Form storage yard	(peak number of usage/day)x days	0.72 sf	-

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Example



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