Special Tasks in Work Planning for Construction Sites

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The triangle around the construction project

INVESTOR
OWNER

DESIGNER
ARCHITECT
ENGINEER

CONTRACTOR
BUILDER
The Construction Management Association of America (CMAA) states that the 120 most common responsibilities of a Construction Manager fall into the following 7 categories: Project Management Planning, Cost Management, Time Management, Quality Management, Contract Administration, Safety Management, and CM Professional Practice which includes specific activities like defining the responsibilities and management structure of the project management team, organizing and leading by implementing project controls, defining roles and responsibilities and developing communication protocols, and identifying elements of project design and construction likely to give rise to disputes and claims.
Main obligations for the client

... are those, which cannot be delegated

- Set up the project objectives
- Set up the project programme
- Set up the requirements list
- Set up the quality standards (and their changes)
- Acquire the financing
- Award contracts (project manager, architect, various engineers, authorities and checking engineers, some construction companies)
- Set up the cost budget
- Set up the master project schedule
- Approve the worked-out project documents
- Receive reports
- Make payments
- Declare the legal acceptance and approval of the work
The construction site is a **production plant**, which is installed and operated for a **limited time** (construction time).

Site layout planning covers all machinery, equipment and installations, which are necessary for running the site, and which must be **installed and** after completion, be **eliminated again** completely.
Site Management:

• *It is not firefighting*

• *It is about leading and managing a well organized operational unit*

As in other real operation there are many tasks to be controlled. Only one of them is the ad-hoc steering of critical deviations.

http://www.feuerwehr-baddoberan.de/_images2/eseiten/bild_gr/IS-Feuer9.jpg
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Tasks of site layout planning

- Housing and social care of workers
- Providing for all prerequisites for leadership by site manager
- Storing and overhauling of machinery etc.
- Taking over, handling and stocking of construction material and elements
- Doing prefabrication and assembling operations
- Supply with different media as electricity, communication etc.
- Reprocessing, recycling and disposal of all sorts of waste (and water)
- Protection of the site against unauthorized access
- Protection of uninvolved persons and of the environment
- Good and easy orientation on site
- Information about the building to be constructed (information post)
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Elements of site layout

Elements of construction site and site installation

- Building
  - Bauwerk

- Infrastructure
  - Infrastruktur
  - Spread out type -
  - Line type -
  - one point type - site
  - Punkt-Linien-Flächen - baustelle

- Construction area
  - Baufeld

- Work spaces
  - Arbeitsräume

- Social facilities for performing units
  - Sozial- und Leistungs-einrichtungen

- Surrounding area and existing buildings
  - Umfeld und Bestand

- Occupied and blocked areas
  - Bestandsflächen

- Construction pits, stocking areas, crane positions
  - Baugruben, Lagerflächen, Kranstandorte

- Site management offices, break room, accommodation, toilets
  - Bauleitung, Unterkünfte, WC...

- Supply lines and pipes, delivery areas, site roads
  - Versorgungsleitungen, Übergabeplatz, Baustraßen

- Home base, supplier
  - Bauhof, Lieferanten

- Stock, distance, operating strategies
  - Ausstattung, Entfernung Betriebsführungskonzept

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Concepts of traffic flow on site

1. dead-end road
   - public road
   - Construction site

2. dead-end road and turning area
   - public road
   - construction site

3. circuit
   - public road
   - construction site

4. separate entry and exit
   - public road
   - construction site

5. passage with one-way street
   - public road
Demands for site road construction

(even if it is a temporary facility and only for the site traffic, the wear on the road is considerable)

- Safe driving, also without danger for others
- Minimizing the need to maneuver
- Avoiding situations for trucks to reverse
- Minimize the handling operations
- Assure good grip and undisturbed traction (< 10 to 12 % slope)
- Built road as independent from weather conditions
Temporary site road, removable

Asphalt on textile mat
Safe access for crane driver
Access for crew members
Different types of construction projects

http://www.la-englisch.de/uploads/pics/westumgehung_2_01.jpg

http://www.massivbau.tu-darmstadt.de/media/massivbau_fgm/bilder_cag/bilder_03_lehre_cag/01_lehrveranstaltungen_fgm/mscmbr_1/150620121034.jpg
One point access sites
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Fast project

Structural work (24 months) = 8 quarters

Finishing (20 months) = 7 2/3 quarters

Structural work to finishing work = 24/20 = 1.2 (1.0 – 1.5)
The impact on the design phase
Horizontal sequence of assembling

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Vertical sequence of assembling

Combined sequence of assembling

Quelle:
Lehrter Bahnhof, Berlin

Haupteingang, Südfassade
Lehrter Bahnhof, Berlin
Main railway station, Berlin

Assembling the hanger building
More and more
the site planning is
shifting to the
designers and
consultants
in the early phases of
a project

http://upload.wikimedia.org/wikipedia/commons/8/89/Berlin_Hauptbahnhof_(Lerter_Bahnhof)_Absenkung_Bügelbau_-_Detail.jpg
Bahrebachmühlen Viadukt – A4
Bahrebachmühlen Viadukt – A4
Prefabrication of tubbings
Prefabrication of tubbings
Prefabication of concrete shafts for wind mills
Prefabrication of concrete shafts for wind mills
Prefabrication of concrete shafts for wind mills
Safety for other partners
Safety for other partners
The subcontractor paradigm

Subcontracting work is often practised in the form of

• I solved my tasks by finding a subcontractor who does the work for a fixed price
• I do not care how the subcontractor does the job
• I do not know (exactly) how to do the job
• I hope the subcontractor will find a solution, it is his responsibility
• Therefore I will check the quality of the sub-work only at the end

http://upload.wikimedia.org/wikipedia/commons/8/89/Berlin_Hauptbahnhof_(Lehrtter_Bahnhof)_Absenkung_Bügelbau_-_Detail.jpg
What do you have to organize, if you operate with more than one crane?
What do you have to organize, if you operate with more than one crane?

- Overall coverage
- Tower cranes within building?
- Free turning in idle position
- Highly charged areas reachable with tower cranes
- Minimize maximum reach in limits
- Look for minimum distance to the building
- Look for positions close to inner buildings corners, this is automatically out of the way
- Considerable overlap between any two cranes
- Rotating speed is the highest, moreover at the end of reach
- Next is trolley, then with distance the railtrack driving
- Access for disassembly
- Safe founding area
- Rules for crane traffic
Operation of concrete pump in difficult conditions
Telescope crane reaching far into the building
Concrete pump tumbled over

http://www.blaulicht-reporter.de/mediapool/13/136745/images/02_Unfalleinsaetze_2/IMG_5645.JPG
Telescope crane operating almost up to the third floor
Telescope platform in a hall
Concrete pouring in the mountains assisted by helicopter
Cabe crane operation for concrete
Cabe based crane on a large concrete dam
Site management units

- Office for site manager
  - Communication equipment
- Meeting room
- Room for foremen
- Office for site supervisor
- Break rooms for the workers
Delivery and positioning of office containers
Office for site manager and general foreman
Accommodation on site in Taipei
Facilities on site in Hanoi
Site offices in containers at Potsdam Place, Berlin
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Customs control on site in Germany

Break rooms, storage

- Break rooms for the day
- **Overnight accommodation**
- toilets
- lavatory
- canteen
- Emergency room (if more than 50 persons)

- Small parts storage
- Repair shop
- Laboratory for concrete and other quality control
Insufficient site housing for workers in Istanbul

11 workers killed off site in a fire in March 2012
warning: “don’t enter, parents are responsible for their children“
Safety measures at an entrance to the site
Safety tunnel for pedestrians
Plastic mesh to protect passengers and workers
Site fencing in Taipei
Site fence in Taipei
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Official site information posts
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Views to Site Operations for the Public

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http://www.das-gerber.de/fileadmin/user_upload/Bilder/News/2012-03/gerber-stuttgart-bauzaun-guckloch-02.jpg
Information for citizens
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Arts Installation for Site Fencing

http://www.google.de/imgres?um=1&hl=de&safe=off&gl=de&biw=1522&bih=863&tbnid=C5LPQALrx62z0oM:&imgrefurl=http://www.huexl.de/&docid=7N_xWU4BzAeM&imgurl=http://www.huexl.de/h-bilder/bauzaun/bauzaun_bunt.jpg&w=426&h=312&ei=Yj6jUJ7jHInMmAXiSoG&w=426&h=312&ei=Yj6jUJ7jHInMmAXiSoG
Site layout plan
In virtual construction sites we can exercise, control and improve complex situations longtime before they become reality

See: www.conworld.biz
Communication

- said is not equal to heard
- heard is not equal to understood
- understood is not equal to accepted
- accepted is not equal to executed
- executed is not equal to maintained

In analogy to Konrad Lorenz’s, eight stages of communication
Power wall

Single-user head tracking

Multi-user head tracking

4D site installation planning in virtual reality for multi-user
**Perspective projection in combination with head tracking**

Single-user head tracking perspective projection

![Diagram showing perspective projection with head tracking for different viewpoints: second person, head-tracked person, and third person.](Diagram)
Perspective projections for multi-users

Multi-user head-tracking perspective projection

Head-tracked person 1

Head-tracked person 2

Head-tracked person 3
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Perspective projection for different users

Multi-user head-tracking perspective projection for different users

Client  Worker  Crane Operator
BIM for Construction Processes

BIM is a modeling technology and associated set of processes to produce, communicate and analyze virtual building models. BIM yields the basis to further develop dynamic models with the ability to simulate the construction project in advance.

With it’s adoption, BIM will be the main basis for
- Project quality
- Accurate schedules
- Quantity take-off
- and many other beneficial aspects.

BIM – Beneficial for Low-skilled workforce – **Why Not?**

BIM can provide
- Basic functional literacy
- Possibility to overcome communication barriers
- Skills of basic construction tasks
BIM for construction planning

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First step: focusing on visualization
Second step: instructional videos
Third step:
Test the understanding of the instructions:
• Questions and answers in a multiple choice format
• Direct online feedback
• Admission to work only after corresponding tests have been passed

Improve target quality of workers
Site installation planning

- Traditional drawings for site installation
Catalogues of parameters for equipment and manpower

Work range parameters of an excavator – Source: KOMATSU

<table>
<thead>
<tr>
<th>MODEL</th>
<th>PC800LC-8</th>
<th>PC800-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom length</td>
<td>8,0 m</td>
<td>7,1 m</td>
</tr>
<tr>
<td>Arm length</td>
<td>3,6 m</td>
<td>2,9 m</td>
</tr>
<tr>
<td>A Max. digging height</td>
<td>11.955 mm</td>
<td>11.330 mm</td>
</tr>
<tr>
<td>B Max. dumping height</td>
<td>8.235 mm</td>
<td>7.525 mm</td>
</tr>
<tr>
<td>C Max. digging depth</td>
<td>8.445 mm</td>
<td>7.130 mm</td>
</tr>
<tr>
<td>D Max. vertical wall digging depth</td>
<td>5.230 mm</td>
<td>4.080 mm</td>
</tr>
<tr>
<td>E Max. digging depth of cut for 2,44 m level</td>
<td>8.310 mm</td>
<td>6.980 mm</td>
</tr>
<tr>
<td>F Max. digging reach</td>
<td>13.660 mm</td>
<td>12.265 mm</td>
</tr>
<tr>
<td>G Max. digging reach at ground level</td>
<td>13.400 mm</td>
<td>11.945 mm</td>
</tr>
<tr>
<td>H Min. swing radius</td>
<td>5.985 mm</td>
<td>5.645 mm</td>
</tr>
<tr>
<td>Bucket digging force (ISO)</td>
<td>40.500 kg</td>
<td>48.000 kg</td>
</tr>
<tr>
<td>Arm crowd force (ISO)</td>
<td>33.300 kg</td>
<td>38.100 kg</td>
</tr>
</tbody>
</table>
Object oriented site installation planning

Visualization of site installation elements

- Dimension
- Geometry
- Mobility
- Working range
- Bearing load
- Safety areas
- Foundation
- Access
Different detailing of a window in Revit

- coarse
- average
- fine
Agglomeration of information for construction processes

Research report Mefisto ErgB_B-5[1].1, 2011
Object oriented site installation planning

Visualization of site installation elements in a construction process model

construction
+ time schedule
+ site installation
4D site installation

Construction sequence
4D site installation – using a construction dashboard
Advantages of 4D site installation planning

Application and advantages of different elements on the dashboard:

- Positioning of site installation elements
- Dimensioning of site installation elements
- Optimisation of site installation elements
- Prevent clashes between site installation elements and construction
- Prevent clashes between site installation elements
- Work instruction, job description, method statement
- Information management (structured data)
- Communication (client, neighbourhood)
- Process visualisation (5D, nD)
- Coordination (contractors, suppliers)
- Job safety analysis