

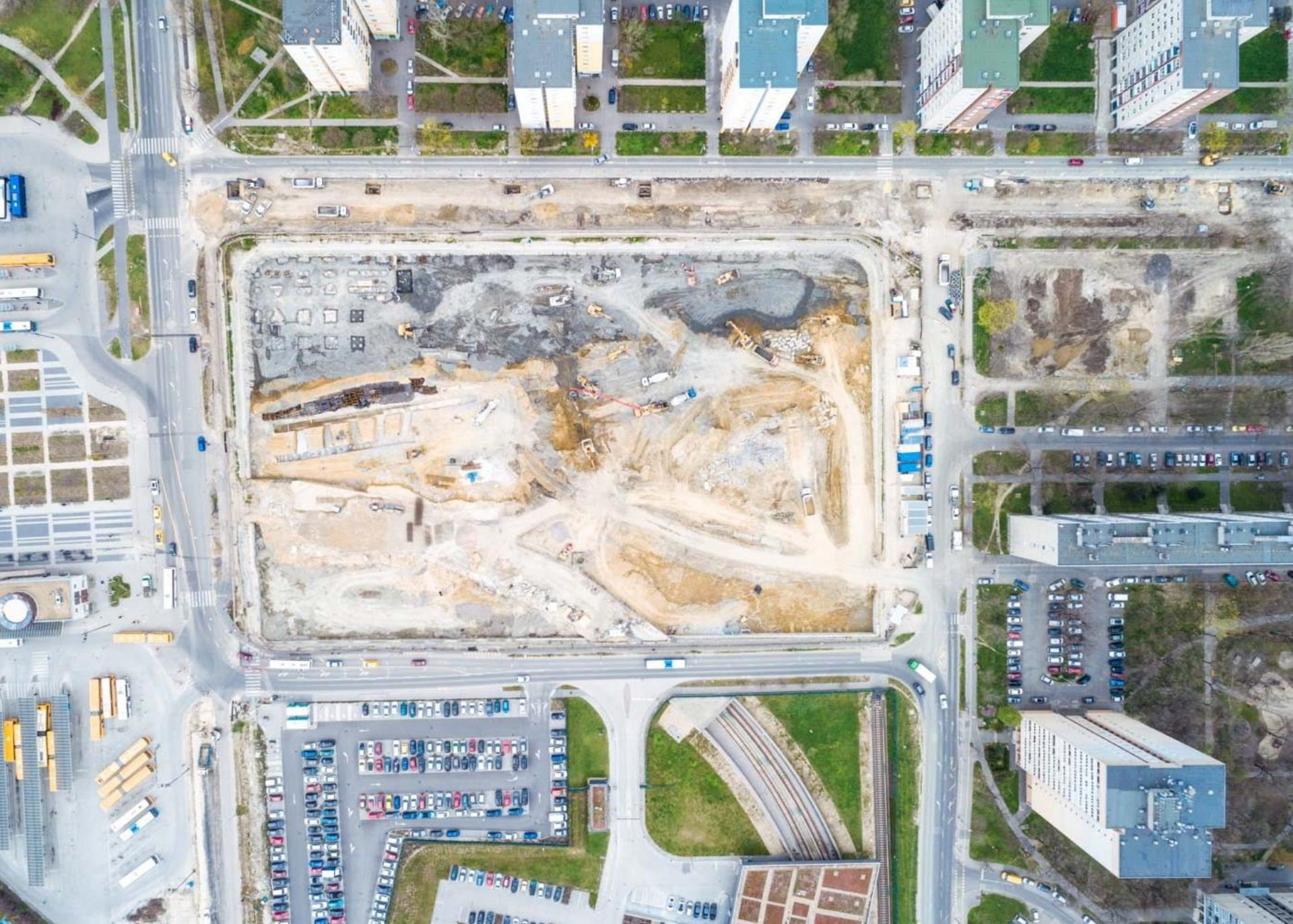
CONSTRUCTION WORKFLOW

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Szabolcs Patyi

Construction Management 3.

2018-2019/2





Source: www.magyarpitok.hu / Budapest, Kelenföld – Etele plaza construction, 2018

MAIN TOPICS OF LECTURE

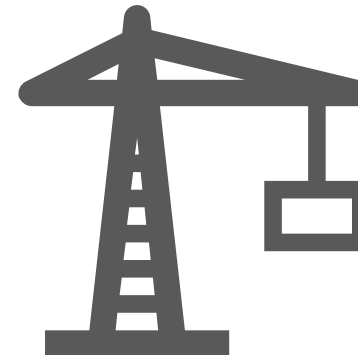
- Construction workflow
- The construction process
- Simple construction cost
- Manpower calculation
- Time planning



Source: www.magyarerepitok.hu / Budapest, Kelenföld – Etele plaza construction, 2018

THE CONSTRUCTION PROCESS – MAIN PHASES OF THE CONSTRUCTION

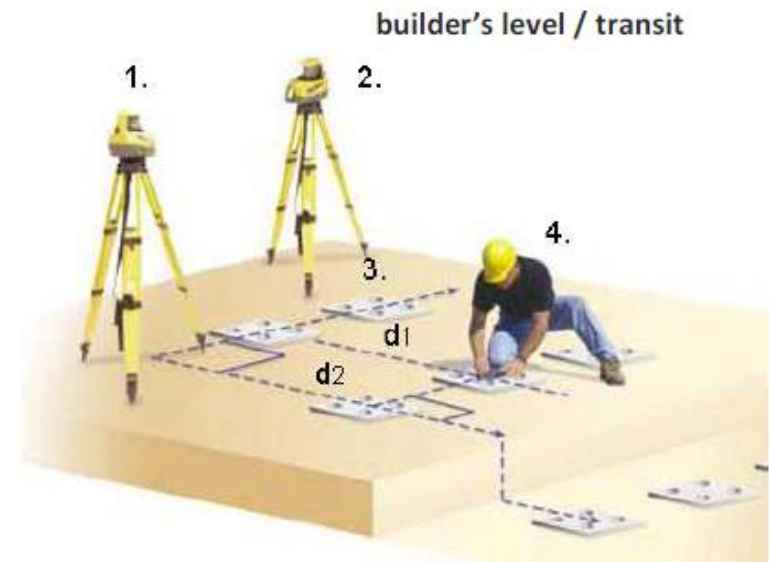
- Site preparation, procession, setting up
 - grading
 - marking of Layout
- Earthwork, excavation
- Foundation construction
 - Compacting the ground
 - Footing reinforcement
 - Shuttering
 - Footing concrete
- Substructure (basement)
 - in situ reinforced concrete
 - masonry
 - Insulations making
- Superstructure, loadbearing structure
 - in situ reinforced concrete
 - masonry
 - precast concrete
 - steel/timber structure
 - lintel
- Finishing works (+building services)
 - inner and outer
 - garden construction
 -
- Building electricity and building engineering
- Test run
- Handover produce



SITE LAYOUT, SETTING UP – IN THE MODEL, WITHOUT ELEMENT ACTIVITY

DEF.: Set out of the building = Fixing the characteristic points of the building on the site

1. set out the boundaries of the site – placing markers called „monuments”
2. mark out the right place of the building with stakes - the stakes should stay outside of the construction pit
3. assemble (with nail or screw) batter boards on the stakes, setting them to a proper level (with definitive relation to the level of the elevations)
4. marking the sides using a tape (holding by the batter boards)
5. plumbing the corners to the excavation floor (at the intersections of the lines)
6. sign the end of the work pit with further posts
7. start of the excavation of the work pit



the placement of the studs are allocated by geodesic methods

SITE PREPARATION AND EARTHWORK



FOUNDATION CONSTRUCTION



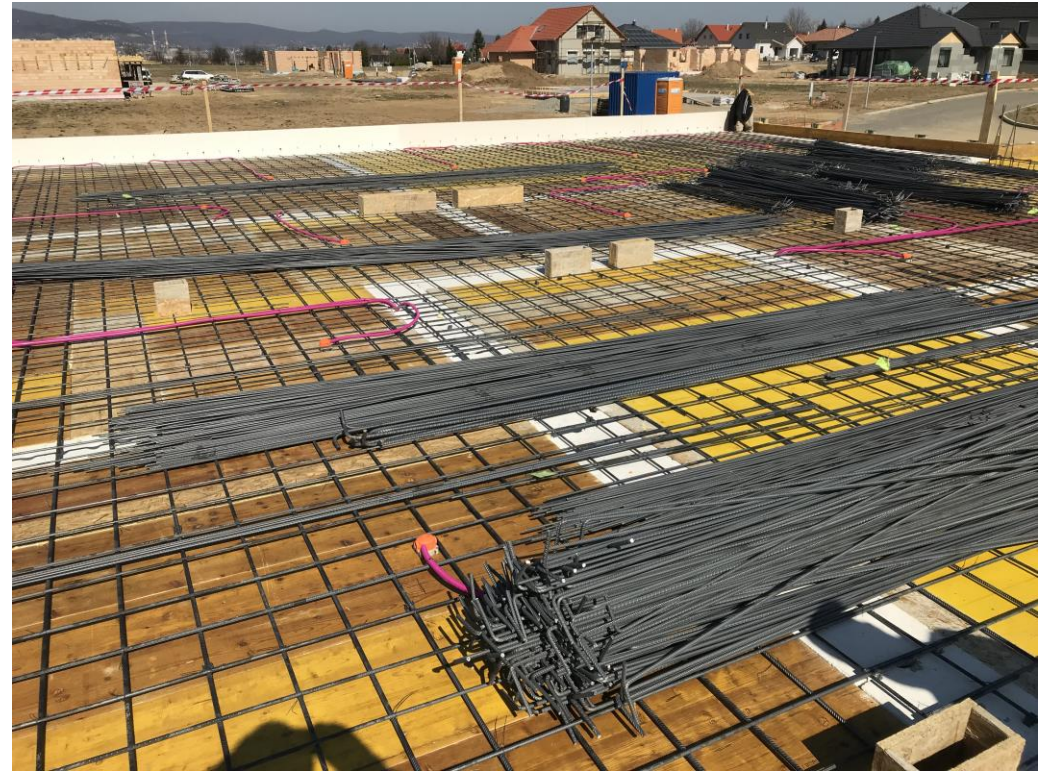
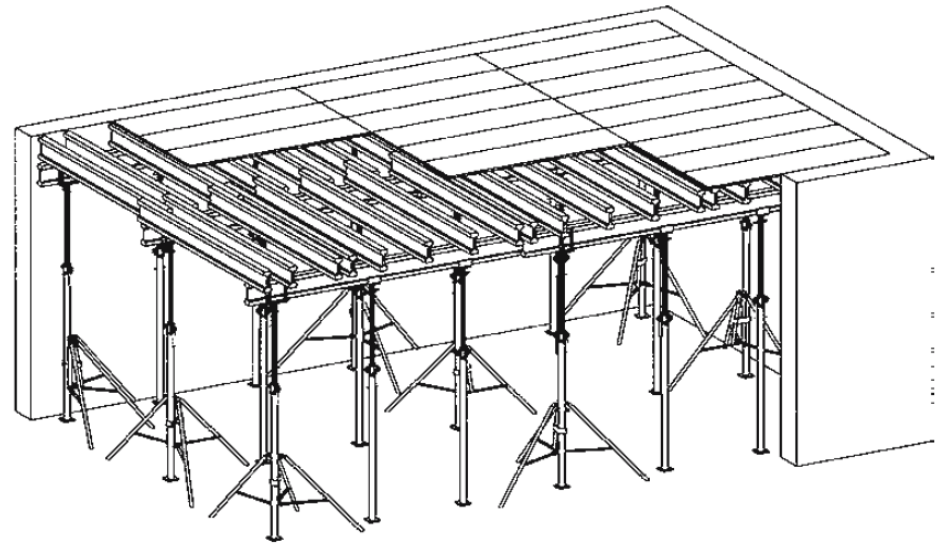
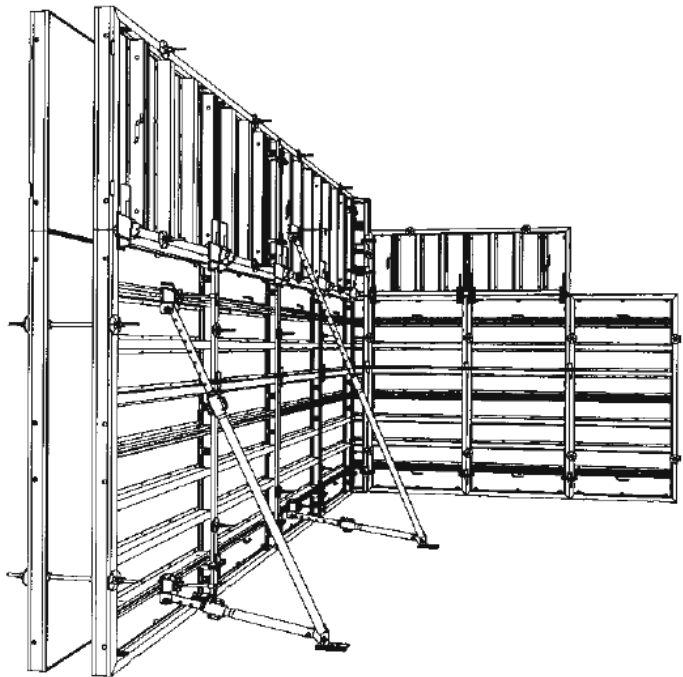
SUBSTRUCTURE



SUPERSTRUCTURE



ADDITIONAL WORKS

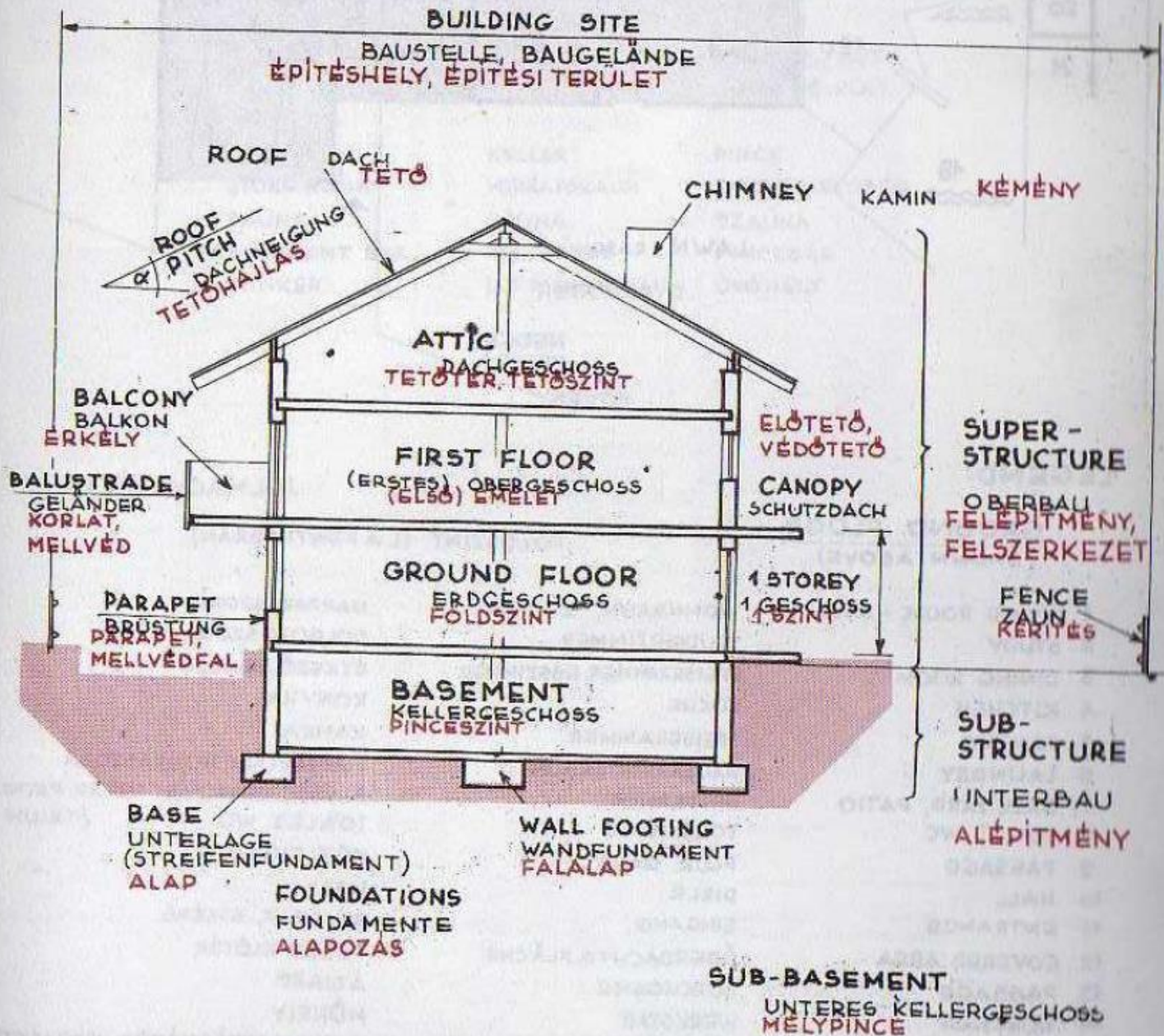


FINISHING WORKS



HANDOVER PRODUCE





DETAILED EXAMPLE

SINGLE FAMILY HOUSE, 2 FLOOR (BASEMENT, GROUND FLOOR, ATTIC)

„1. TASK”

- procession
- setting up
- excavation work in basement
- trench fund excavation
- foundation construction (flat foundation, gravel, concrete for slab)
- plumbing work
- floor water proofing work
- basement walls construction
- basement slab construction from reinforced concrete (formwork, steel bars, concreting)
- basement vertical waterproof insulation
- ground floor masonry works
- ground floor slab construction from reinforced concrete (formwork, steel bars, concreting)
- carpentry work
- chimney construction





- sheetmetal work
- roof tiling work
- plumbing work and electrical installation
- plaster work (first the ceilings, then the walls)
- stair
- horizontal heating insulation
- base concrete
- drywall construction
- painting work
- tiling work
- installation of windows and doors, glazing work
- exterior plaster work
- exterior heating insulation and final plaster
- sheetmetal work for windows or parapet walls
- joinery work
- test run and
- handover produce

SIMPLE CONSTRUCTION COST CALCULATION

„2. TASK”

Why it is important to know about costs for an architect and an civil engineers?

- Usually costs play key rule in an investment
- Must know,
 - where
 - why and
 - how do arise costs
- To give advises to the investor or owner

SIMPLE CONSTRUCTION COST CALCULATION

„2. TASK”

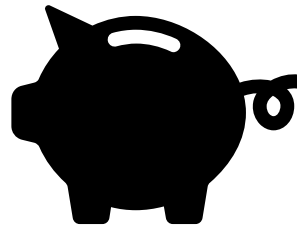
$$C=A*p$$

where,

C: construction cost of building

A: floor area, in the building

p: unit construction cost, euro per square meter (in 2019, Hungary – 1300-1600 euro/m²)



TIME OF THE CONSTRUCTION PROCESS

- The technology of construction, the scheduling of individual construction works and their connection to each other are different ways of building

Building construction is also important in the case of the simplest buildings because it is not

- unnecessary extra work
- (boundary) time offset, ie
- additional costs

WHAT IS THE NORM / STANDARD?

- the amount of time required to complete a given workload, or the amount of work that you must complete in a time unit
- the performance of an average skilled, trained worker working under the best technical and organizational conditions

Earthworks							
Activity	Unit	Soil consistency				Skill	Item number
		I-II.	III.	IV.	V.		
		Time-standard (hour)					
Topsoil excavation, depth less than 10 cm, (and for each 10 cms on)	10m ²	0.79	1,2	-	-	labourer	0.008
Excavation, from trench without timbering, depth less than 1,5 m vertical or sloped earthwall	m ³	1,17	1.71	2.76	3.98	labourer	0.009
Excavation, from ditch without timbering	m ³	1.46	2.49	3.76	4.64	labourer	0.010
Excavation, from trench with timbered vertical earthwall	m ³	1.47	2.67	4,07	4.79	labourer	0.011
Excavation, from ditch with timbered vertical earthwall	m ³	1.46	2.66	4,08	4.87	labourer	0.012
Refill and spread in trench	m ³	0.61	0.85	1,08	-	labourer	0.013
Refinery earthwork after rough excavation by equipment, depth 10-20 cm	10m ²	2,16	3.81	5.58	-	labourer	0.014
Levelling the ground, without compacting, depth below 10 cm	10m ²	0.50	0.72	0.97	-	labourer	0.015
Levelling the ground, without compacting, depth 10-20 cm	10m ²	0.96	1.35	1.81	-	labourer	0.016
Sloping in a hollow or on embankment, mean thickness 10 cm	10m ²	0.72	1,02	1.43	-	labourer	0.017
Sloping in a hollow or on embankment, mean thickness 10-15 cm	10m ²	0.92	1.32	2,02	-	labourer	0.018
Subgrading, excavated earth deposited, depth below 10 cm (and for each 10 cms on)	10m ²	1,11	1.54	2,03	-	labourer	0.019
Loading earth or building rubbish to truck, or moving it within an arm reach distance	m ³	0.73	0.92	1,08	1,27	labourer	0.020
Spreading earth or building rubbish, mean depth below 20 cm, after rough spreading by equipment	m ³	0.17	0.25	0.33	-	labourer	0.021

PROJECT TIME PLANNING
„3. TASK”



Activity/Milestone	Duration
Project start	0 – Date
Preparation phase	
Project preparation	1-3 months
Analyses	1-6 months
Feasibility study	1-3 months
Financing	1 week-6 months
Planning phase	
Choosing architect	2 weeks-6 months
Concept plan	2 weeks-
Documentation for building consent	2 weeks-
Building consent (permit)	0 – Date 2 months after finishing the plan
Preparation of implementation	
Documentation for tendering	1 week-
Construction plan	1 month-
Tendering, contracting	2-5 months



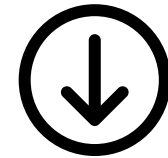
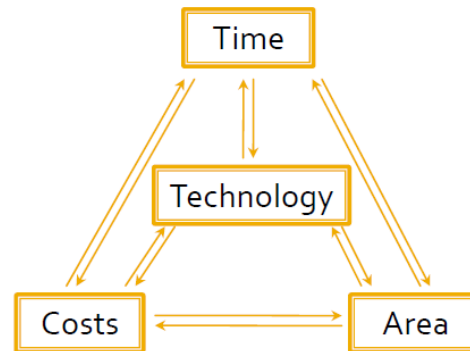
Implementation	
Construction start	0 – Date 1 (or more) months after contract
Earthwork	Depends on the size/structure of the building
Foundation	Depends on the size/structure of the building
Loadbearing structures	Depends on the size/structure of the building
Exterior finishing works	Depends on the size/structure of the building
Interior finishing works	Depends on the size/structure of the building
Handover-takeover procedure	1 week-
Fulfilment plans	1 week-
Construction finish	0 – Date
Project end	
Permission of use	0 – Date 2 months after finishing construction
Project closing	1 year

WHAT IS THE TIME SCHEDULE?

- Why?
 - There are **lots of processes** during a construction project
 - Some **hundreds of people** are involved
 - These have to be **harmonised in space** and in **time**
- Types of processes
 - Design processes
 - Realisation processes (purchase/preparation of materials)
 - Authority procedures
 - Handover-takeover procedure, permission of use...

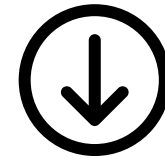
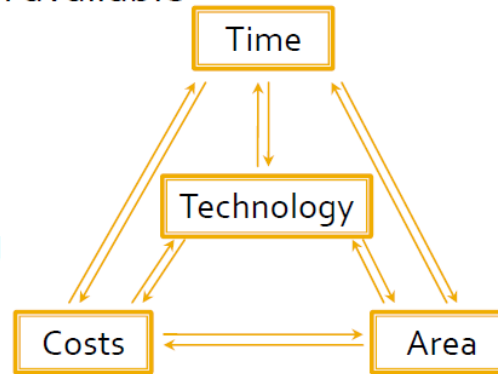
Information needed

- What to do?
 - Operations, activities;
 - Events;
 - Quality and quantity.
- How to do it?
 - Technology;
 - Type of labour (trades);
 - Type of machine, equipment;
 - Subcontractors.
- Costs?



- Information incorporated:

- Duration of activities or time span available
- Contents on technology (how?)
- Time-Space correspondence
- Sequence based on technologies
- Milestones: starting and finishing dates → whole duration
- Partial payments, cash-flow



Standards: tools for estimating time required for the processes

- Performance standard [time/unit] (h/m^3 , h/m^2 ...)
- Standard output [unit/time] (m^3/h , pcs/h)
- The standards are determined by statistical/technical analysis, by measuring and comparing former performance.
- The standards have to be adjusted to the actual circumstances (location, resources, ...)

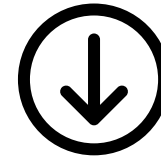
Estimating time: the duration of the processes

$$\text{Work [time]} = \frac{\text{Volume [unit]}}{\text{Standard output [unit/time]}}$$

$$\text{Work [time]} = \text{Volume [unit]} \times \text{Performance standard [time/unit]}$$

$$\text{Duration [time]} = \frac{\text{Work [time]}}{\text{Allocated resource [unit]}}$$

- Work: time of process for one unit of resource
- Duration: time of process for the allocated units of resource



Example: partition making (ceramic blocks) 27m²

$$\begin{array}{l}
 \text{Volume [unit]} \times \text{Performance standard [time/unit]} = \text{Work [time]} \\
 27\text{m}^2 \quad \times \quad 0,56\text{h/m}^2 \quad = \quad 15,12 \text{ h} \quad \text{Work: time of process for one unit of resource} \\
 \\
 \frac{\text{Work [time]}}{\text{Allocated resource [unit]}} = \text{Duration [time]} \\
 \frac{15,12\text{h}}{3 \text{ workers}} = 5,04 \text{ h} \rightarrow 1 \text{ day (8h/day)} \quad \text{Duration: time of process for the allocated units of resource}
 \end{array}$$

Result information:

- Operation (task), Quantity
- Labour / equipment, quantity
- Duration

WHAT IS THE TIME OF CONSTRUCTION?

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WHAT IS THE TIME OF CONSTRUCTION?

insulator	drywall worker	welder	proof worker	glazier	labourer	
					6	6
0,00	0,00	0,00	0,00	0,00	257,65	257,65
					2,49	
					0,92	
					3	3
0,00	0,00	0,00	0,00	0,00	49,50	49,5
					0,70	
					0,50	

Item number	Item description (short)	Quantity	Unit	Period (hour)	labourer	
1 Earthworks				manpower:	6	6
				42,94	257,65	257,65
0.009	Excavation, from ditch without timbering	85	m3		2,49	
0.019	Loading earth or building rubbish to truck, or moving it within an arm reach distance	50	m3		0,92	
2 Flat foundation				manpower:	3	3
				16,50	49,50	49,5
	Concreting plain concrete or RC strip foundation, footings, slab- (mat-) or beam-grid foundation applying concrete pump	35	m3		0,70	
	Recovering gravel bed	50	10m2		0,50	

Timetable (tabular or alpha-numerical schedule)

- Data given with numbers - dates
- Exact, but difficult to see the current status

Example: a retaining wall

Item number	Item description (short)	Quantity	Unit	Period (hour)
1 Earthworks				manpower:
				42,94
0.009	Excavation, from ditch without timbering	85	m3	
0.019	Loading earth or building rubbish to truck, or moving it within an arm reach distance	50	m3	
2 Flat foundation				manpower:
				16,50
	Concreting plain concrete or RC strip foundation, footings, slab- (mat-) or beam-grid foundation applying concrete pump	35	m3	
	Recovering gravel bed	50	10m2	

From these results

- the time-plan,
- the labour schedule,
- the equipment (plant) schedule,
- the material schedule,
- and the payment schedule can be made.

Connections between operations:

- Consecutive
 - Parallel
 - Overlapping
- Activities



BASIC GANTT CHART LAYOUT

WORKFLOW BREAKDOWN

- ▼ Phase of Construction (Group of Tasks)
 - Task 1
 - Task 2
 - Task 3
 - Task 4

- ▼ Phase of Construction (Group of Task)
 - Task 1
 - Task 2
 - Milestone 1 - (Significant Event)
 - Task 3

% Complete

30%

36%

100

60

10

0

23%

50

25

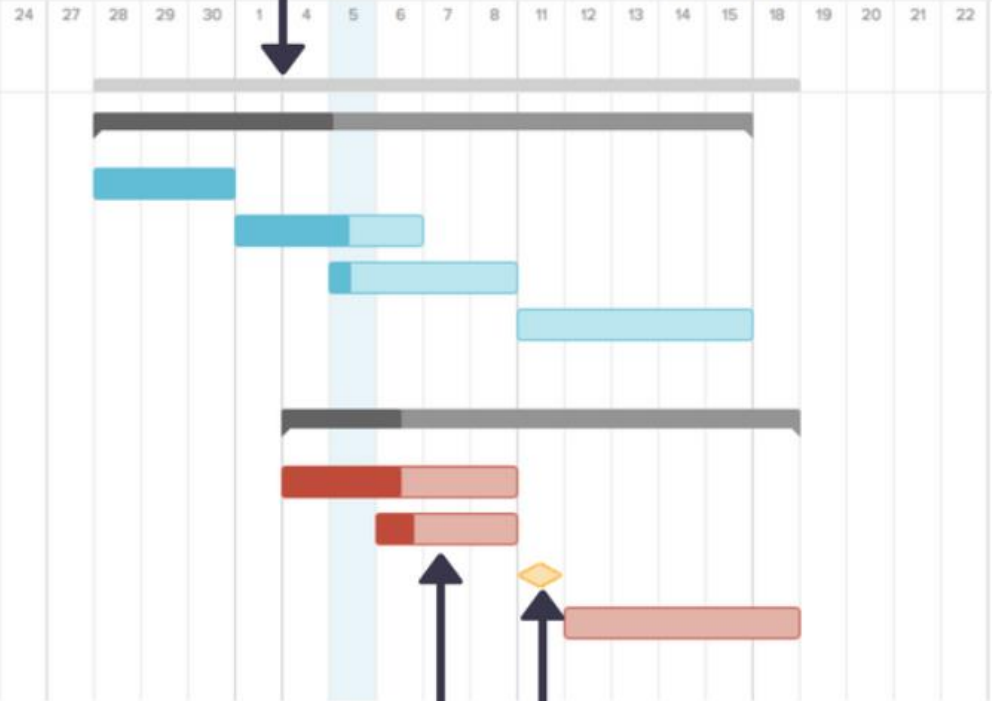
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0

% COMPLETE

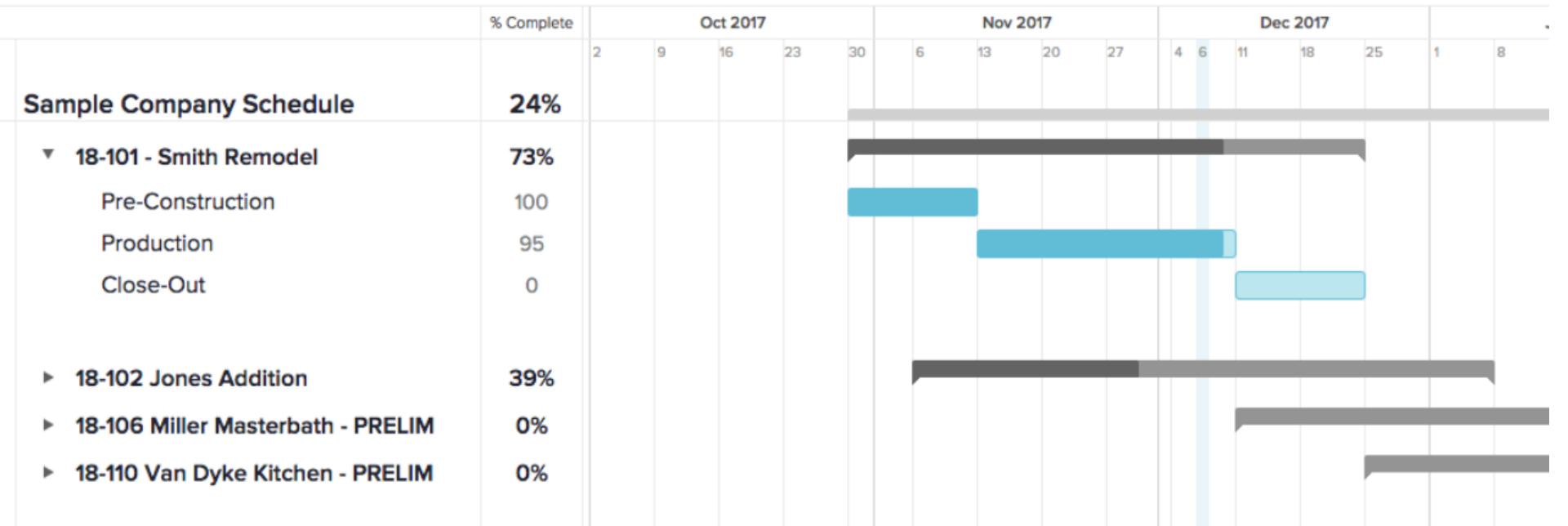
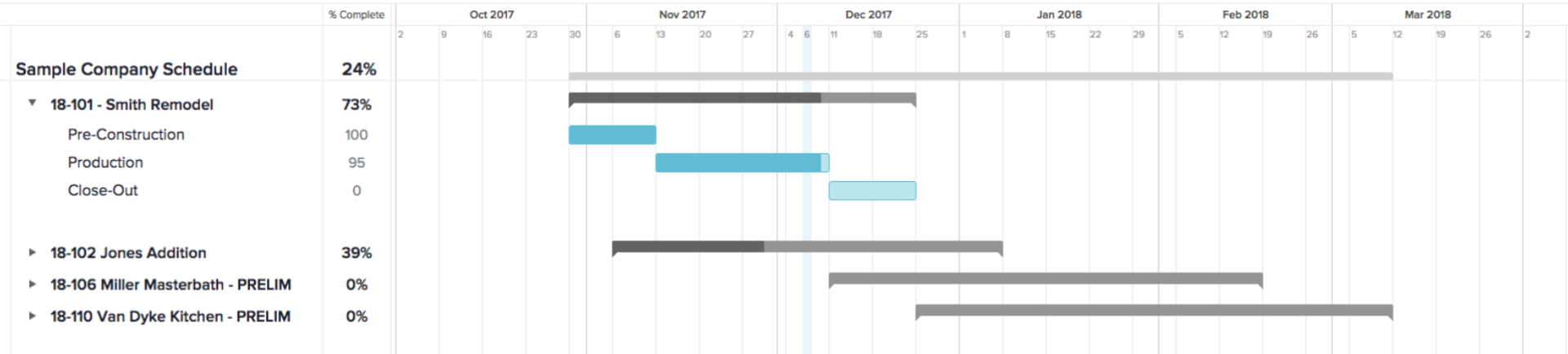
PROJECT DURATION

December 2017



MILESTONE
TASK DURATION





Please check the Guide in the Facebook group or the witch server



Source: www.magyarépitok.hu / Budapest, Kelenföld – Etele plaza construction, 2018