HANOI UNIVERSITY OF CIVIL ENGINEERING
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DESIGN
CONSTRUCTION NORMS

MOUNTING THE PANEL WITH THE CKY101 TOWER CRANE

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I - INTRODUCTION OF CONSTRUCTION NORM SCHEMES

1. Purpose of making a project

1.1. Concept of norms

As a regulated level, it is determined by advanced averaging of many production factors within a defined range for each type of product, in each business, in each different locality. It represents the average cost of many factors working together.

Construction norms are a general concept that refers to the types of norms for construction activities, such as norms for construction surveying, equipment installation, experimental repair of construction materials, components and structures.

1.2. Role and effect of construction norms

Economic and technical norms in general and norms in construction in particular are of great importance.

First of all, it is a tool for the State to manage and organize production at the macro level, which is the first legal basis in terms of technical and economic aspects of the State.

Secondly, these norms are important tools for calculating technical standards, product use value, cost as well as socio-economic efficiency...

Thirdly, these norms are the basis for checking the technical quality of products, checking the costs and socio-economic efficiency of production processes.

Fourthly, these norms are also to ensure the necessary consistency in terms of national as well as internationally for products made to facilitate the production and consumption of products on the market.

Fifth, these norms are also used as a basic matching plan when analyzing and selecting optimal production options. The cost norms are also to represent the average social labor waste when calculating and selecting options.

Sixth, these norms are also the prerequisites for the application of modern electronic and informatics facilities.

Seventh, norms and standards also have a great effect in promoting scientific and technical progress, perfecting the level of production organization and economic management, implementing economic accounting and saving social costs.

* The normative work is a very important work as we have described above. Based on the norms, we will save living labor, other physical labor and the time of operation and exploitation of machinery and equipment during the construction process.

❄♒♏ ultimate purpose of normative work is to research and apply advanced production methods to promote labor productivity.

1.3. Tasks and requirements of the subject plan

a) Tasks of the subject plan

- Students understand and have the ability to formulate construction norms in accordance with practical conditions.
- Update new knowledge about construction techniques and technologies to be able to apply to normative work in order to establish appropriate normative values and save production costs.
- To study and improve norm formulation methods in order to provide reasonable norm values but save time and costs of norm makers.

b) Requirements

- Students can set normative values in accordance with specific conditions.
- Apply the knowledge learned to use the norms proficiently and effectively.
- It is possible to establish a set of construction standards and regulations in service of the State's macro management.

2. Implementation contents

Design of labor norms for panel assembly (Construction unit: Construction Company 479 – Ministry of National Defense)

* Initial data:

- Rated unit: 1 panel
- Jobs include:
  - Mixing, transferring, spreading mortar.
  - Hook the panel onto the crane.
  - Adjust the anchor.
  - Mortar vascular insertion
  - Waiting for the crane to move
  - Breaks
  - Benchmark time
  - Technical violations
  - Overdoing the movement
  - Taking a break because of the rain
  - Stop other work
- Tools, labor tools, materials, manpower, climatic and weather conditions all ensure the general requirements for production

3. Implementation order

- Adjusting Metrics
- Calculation of normative values
- Labor norm design
- Present as a table to apply

❖ This project presents the formulation of labor norms for panel production (320x250x500) and the calculation of salary unit prices, wage unit prices, design of components of the group of workers performing panel production, and presentation of the norm table.

The operating time is determined on the basis of data collected from the combined photo card

(CAKH) through five observations of the Non-Cycle Production Process:

- Mixing, transferring, spreading mortar.
- Mortar vascular insertion
- Waiting for the crane to move
- Breaks
- Benchmark time
- Technical violations
- Overdoing the movement
- Taking a break because of the rain
- Stop other work

Standards for TNGTC norms are taken according to the results of taking photos on working days:

Tngtc = 13%; 17%; 16%; 15,5%; (13,5%);

II. THEORETICAL BASIS FOR FORMULATION OF CONSTRUCTION TECHNICAL NORMS

2.1. Definition:

- Construction technical norms are detailed norms selected as a basis for establishing other construction norms.

* SE is a type of norm established on the basis of:

- Divide the manufacturing process into parts (Elements)
- Rationalize production in accordance with technical conditions, technology and product quality specifications.
- Collect actual data using the appropriate method.
- Processing data and determining construction norms.

Therefore, "construction technical norms" are detailed norms determined on the basis of science, technique and technology in normal working conditions (ensuring environmental sanitation and occupational safety).

* The methodology is expressed in 7 theses:

- Use critical facts.
- The subjects selected to obtain data to establish new norms must be representative.
- Survey the production processes in such a way that they are broken down into elements.
- Use the appropriate average formula.
- When setting new norms, it is necessary to consider the correlation between tasks to ensure science and fairness.
- Consistency between standard conditions and normative values
- Legal and mandatory nature of norms

2.2. Methods of setting norms:

There are commonly used methods in setting norms:

- Pure analytical and computational methods
- Actual observation method at the construction site.
- Expert methods and statistical methods.
- Mixed cannons.

In the project, the "*field observation method" is used* to establish a new norm: Labor norm for a construction work (Installing panels with CKY101 tower crane).

a. Method content:

It is a method of setting norms by ***"observing the reality at the scene"*** to collect data and set norms. According to this method, the norm maker will have to do both jobs: Collect data and calculate the norm value.

Procedure for implementation:
Step 1: Prepare the conditions for observing and collecting data.
Step 2: Observe the reality to collect data
Step 3: Process the data obtained according to appropriate methods.
Step 4: Calculate the norm value and present it in a document for application.
* *Determine the number of observations needed and the duration of observations:*

- Before starting to observe the production process, it is necessary to determine the number of observations and how much time it will take to do so. This not only saves effort, but also ensures accuracy and necessity.
- The number of observations depends on:
    - The number of types of variables in the production process;
    - Influencing factors expressed in words

- For the cycle production process, it is necessary to determine the number of cycles to be observed in 1 time, this number of cycles depends on the average length of each part.

b. Advantages and disadvantages:
**Advantage:*

- Gives very realistic results
- The data obtained is in accordance with the actual conditions at the construction site.

**Shortcoming:*

- This method is difficult for norm makers, takes a lot of time to observe and set norms, gives slow results, and high costs.
- It is difficult to choose the location of the observation site, the work may not take place continuously, depending on the construction process.

c. Scope of application:
Gathering information belonging to both groups A and B. High accuracy requirements
2.3. Methods of data collection:
* In the normative work, we have the following methods of data collection:

- Production process photography method:
    - Graph Photography Method (C.A.D.T)
    - Photography method using graphs combined with numerical recording (C.A.K.H)
    - Digital Imaging Method (C.A.S)
- Timekeeping Method:
    - Selective Timekeeping Method (B.G.C.L)

  - Continuous Timekeeping Method (B.G.L.T)
  - Timekeeping Method for Conjugated Elements (B.G.P.T.L.H)
- Working day photography method (C.A.N.L.V)
- Multi-time observation method
- Monte Carlo simulation method.

❖ In the above methods, we choose the selective timekeeping method because:
The selective timing method is highly selective: it is possible to monitor only individual elements of a production process (QTSX) and temporarily ignore the remaining elements. When observing a full element, immediately record the duration of its implementation in each working cycle. The accuracy of data recording can be achieved up to 0.01 seconds, usually only 0.1 seconds is required.

***Advantages and disadvantages of the selective timekeeping method:**

Advantage:

- Used when used for high-precision normation.
- The cost of performing each part is not affected by other elements.

Shortcoming:

- It takes a long time.
- Requires the skill of the observer to be well equipped.

Scope of use: the production process is fast-paced and requires high precision.

❖ In addition to the BGCL method, we also use the CANLV method.

Purpose of the CALV method:

- Obtain all types of time in shifts including: beneficial time and wasted time as a basis for normative calculations.
- There are solutions to reduce wasted time and increase useful time = > increase labor productivity.

Content of the CANLV method:

- The observation time is selected for one shift (8 hours).
- Each time an observation, the norm maker must be present at the scene for a full shift and collect all types of time in the working shift to set the norm.

** Advantages – disadvantages:*

Advantage:

- The way to observe and take notes is simple, very easy to do.
- Record all useful and wasted time = > solutions.

Shortcoming:

- Observing the selection of a single shift takes a lot of time to make norms

=> causes economic costs.

- Affecting the psychology of workers.

In this project, I chose the field observation method to establish a norm of machine use time for the soil exploitation process using an E2503 excavator combined with a self-dumping KPAZ256 car. Because this method is highly accurate.

This method is carried out as follows:

- Establish a norm study group, the number of team members depends on the volume to be observed, team members must have good norm skills.
- Conduct research on the production process (make lists of norms, study factors affecting the production process as well as labor productivity)
- Design standard conditions for the production process, then conduct observation, data collection and calculation.

2.4. Order of data adjustment.

- Data adjustment is to complete the collected documents and process the numbers according to the set standards in order to achieve the purpose: Determine the labor waste or waste of machine use time on average for a unit of product element of the production process.
- Adjusting the data is divided into 3 steps:
  - Step 1: Preliminary correction.
  - Step 2: Adjust for each observation.
  - Step 3: Adjust for multiple observations.

2.4.1. Preliminary adjustment:

Purpose:

- Complete the information on the feature sheet, such as the layout of the workplace; personal information: age, occupation, seniority; information about the weather, ...
- Completing the data on the number of component products obtained; Eliminate data obtained when production is not carried out in accordance with technical processes and regulations or machinery and equipment do not meet prescribed standards.

Content:

- It is carried out right on each characteristic sheet and observation sheet to complete the data collection and check for errors in the process of collecting data for correction.
  - Specification card: The characteristic card is a form used to record data, characteristics of the production process and production conditions when collecting data at the site to set norms.
  - Observation sheet: An observation sheet is a record of data on labor waste or waste of time using the machine obtained when observing at the site. (CADT, CAKH, CAS, BGLT, BGCL slips)

2.4.2. Adjustment for each observation:

Purpose:

- Systematize all data obtained when observing the field in the field.
- Eliminate data that are not suitable according to the prescribed method, select reasonable data to be included in the calculation of the Norm value

Content:

- Adjust the data for each observation for cycle production.
- Cycle manufacturing process: is the production process consisting of one, several cycle elements or all of the cycle elements.

* *Non-cyclic element*: is an element that takes place in a timeline (without repetition)

Adjusting the data for the non-cyclic element: Using a pair of table adjustments: each pair is a table used to adjust the data for a single observation: The first table is called the intermediate adjustment table (CLTG table); The second table is called the official correction slip (CLCT slip)

=> The adjustment of data is carried out in 2 steps:

Step 1: Intermediate adjustment

The data collected from the observation sheets in each observation hour are collected in order to systematize all the data collected. The results of data collection of 1 observation are recorded in 1 intermediate adjustment sheet.

When transferring the data from the photo slips to the intermediate adjustment slips, the data of any element that takes place at what hour of the shift must be written correctly for that element, exactly at the time of implementation stated in the photo slip.

* *Cycle element*: is an element that has repetition in the production process that at the end of a production cycle, the number of component products made is relatively uniform.

Adjust the metric for the cycle element: Adjust the random number sequence.

- Procedure for implementation:
    - Step 1: Arrange the number sequence (a_i) in ascending order from small to large. (a_{min} => a_{max}).

The purpose of making the number sequence scientific, avoiding confusion for the norm maker

- Step 2: Determine the scattering of the number sequence or calculate the stability coefficient of the number sequence (K_{Od})
  Od = $\frac{a_{max}}{a_{min}}$

Where: amax: the largest value in the number sequence.

amine: the smallest value in the number sequence.

There may be 3 cases for the case.

- Step 3: Adjust the number sequence according to the cases of K

❖ **Case 1: Odd ≤ 1.3**

- The stability of the range fluctuates within the permissible limits. Each number in the number sequence is usable, no adjustment is required.

Conclude:

- $P_{(i)}$: The number of usable numbers in the number sequence (Reflects the number of element products made in 1 observation i).
- $T_{(i)}$: The total value of the available numbers in the number sequence (reflecting the total number of employees who make up the product)

❖ **Case 2: 1.3 < Cod 2 ≤**

- The scattering of the number sequence is relatively large.

Adjust the number sequence according to ***the limited number method.***

** Upper Limit Test (Amax)*

Suppose you remove the largest numbers of the amax sequence (which has *i* numbers).

The sum of the remaining numbers in the range:

$$aTB1 = \frac{a_1 + a_2 + \dots + a'_{max}}{n - i}$$

- Upper limit calculation: Amax = aTB1 + k
  (a'_{max} – amine)

Where: a'_{max}: The largest value of the remaining numbers in the sequence.

k: Coefficients used in the limited number method (look up Table 3.1, page 63 of the textbook on Formulation of Construction Norms)

Number of numbers available in the range (*)	k	Number of numbers available in the sequence	k	Notes
4	1,4	9 ÷ 10	1	(*) Request the number of numbers available in the sequence (excluding hypothetical numbers) must not be less than 4 numbers
5	1,3	11 ÷ 15	0,9	
6	1,2	16 ÷ 30	0,8	
7 ÷ 8	1,1	31 ÷ 50	0,7	

- So sánh A_{max} với a_{max}

- If amax ≤ Amax (within the limit): retain the value of a_{max} in the number sequence, proceed to check the lower limit.
- If a_{max} > Amax: remove the value a_{max} from the number sequence. Continue to test the upper limit with the a'_{max} value in the above sequence until $anyone_{maxes}$ ≤ Amax stops.

**Lower Limit Test: (Amen)*

Suppose the amino value is excluded from the sequence (with i digits);

The sum of the remaining numbers in the range:

$$aTB2 = \frac{a_{min} + \dots + a_{max}}{n-i}$$

- Calculate the lower limit of the number sequence:

  Amin = a_{TB2} – k.(amax –a'_{min})

  Where: a'_{min}: the smallest value of the numbers remaining in the sequence.

  k: Coefficients used in the limited number method (look up Table 3.1, page 63 of the textbook on Formulation of Construction Norms)

- I'm going to take a $_{shower}$
  - If a_{min} < Amine => Type the value a_{min} out of the number sequence, continue to check the lower bound with the a'_{min} value in the above order.
  - If a_{min} ≥ Amine (within the limit) => retains the value of a_{min} in the number sequence.

  Conclusion $P_{(i)}$ = ?; $T_{(i)}$ = ?

Heed:

- The number of numbers eliminated is greater than 30% of the numbers in the original number.

- When assuming the removal of amax or amines, the number remaining in the sequence is less than 4 digits.

=> Do not continue to adjust the number sequence => Observe the addition of data to the initial number sequence.

❖ **Case 3: Kôd> 2**: Dispersion of a large number sequence.

Adjusting the number sequence according to ***the experimental Relative Military Deviation method.***

*Order:

- Calculate the military deviation of the number sequence according to the experimental values (etn) obtained:

$$e_{tn} = \pm \frac{100}{\sum_{i=1}^{n} a_i} \sqrt{\frac{n.\sum_{i=1}^{n} a_i{}^2 - (\sum_{i=1}^{n} a_i)^2}{n-1}}$$

Compare the empirical relative military deviation with the allowable relative military deviation [e]. (See Table 3.3, page 65 of the construction norm formulation textbook)

Number of Elements of QTSX Cycle	≤ 5	> 5
[e]	$\pm$7%	$\pm$10%

- TH1: If $e_{tn} \le$ [e], then the numbers in the sequence are fine.

Conclusion: The number of modifiable numbers in the range is P_i

The total value of the numbers available in the sequence is T_i

- TH2: If $e_{tn} >$ [e], the number sequence must be adjusted according to the instructions of the orientation coefficients and according to the formula: $K_1 K_n$

K_1= ; $= \frac{\sum_{i=1}^{n} a_i - a_1}{\sum_{i=1}^{n} a_i - a_n} K_n \frac{\sum_{i=1}^{n} a_i{}^2 - a_1 \sum_{i=1}^{n} a_i}{a_n \sum_{i=1}^{n} a_i - \sum_{i=1}^{n} a_i{}^2}$

+ K1 < Kn: the type of amine value out of the number sequence.

+ K1 K≥n: type the amax value out of the number sequence.

After removing the amine or amax from the number sequence, the coefficient of the new sequence is recalculated.

In which case does the code continue to adjust the number sequence according to that case.

Heed:

- For the limited number method, the coordinates are not recalculated (unless additional data are added to the initial sequence).
- For the relatively experimental military deviation method, after the amax value or the amine value, the coordinates must be recalculated.

2.4.3. Correction for multiple observations:

*Purpose:

- Determine the labor cost calculated for a unit of product after n observations.

$$(\text{sec})T_{tb} = \frac{n}{\sum_{i=1}^{n}\frac{P_i}{T_i}}$$

n: Number of observations.

Pi: The total number of products of each element at the ith observation.

Ti: Total time wasted labor

2.4.4. Check the results of taking photos on working days.

❖Determine the number of observations needed.

$$n = \frac{4\delta^2}{\varepsilon^2} + 3$$

In which:

n: Number of times CANLV is needed

δ2: Experimental variance

$$\delta^2 = \frac{\sum_{i=1}^{n}(x_i - x_{tb})^2}{n-1}; \qquad x_{tb} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

Xi: Observation results obtained at the first photo shoot

X̄: The simple average of the experimental values Xi:

The error between the experimental value of Xi compared to the mean, the maximum is 3%.

In this method, we usually use the error intervals: 1%; 1,5%; 2% ; 2.5% and 3%

Procedure for implementation:

Step 1: Draw 5 graph lines of n according to δ2 or according to the formula corresponding to the value = 1%; 1.5%; 2%; 2.5% and 3% respectively to 1 perpendicular coordinate system with the vertical axis representing δ2 and the horizontal axis representing n.

- ε = 1% → $n = \frac{4\delta^2}{\varepsilon^2} + 3$

  σ = 0 → n = 3 → A (3; 0)

  σ = 0 → n = 7 → A (7; 1)

- ε = 1.5 % → $n = \frac{4\delta^2}{\varepsilon^2} + 3$

  σ = 0 → n = 3 → A (3; 0)

  σ = 1.5 → n = 7 → A (7; 2.25)

- ε = 2% → $n = \frac{4\delta^2}{\varepsilon^2} + 3$

  σ = 0 → n = 3 → A (3; 0)

  σ = 2 → n = 7 → A (7; 4)

- ε = 2.5% → $n = \frac{4\delta^2}{\varepsilon^2} + 3$

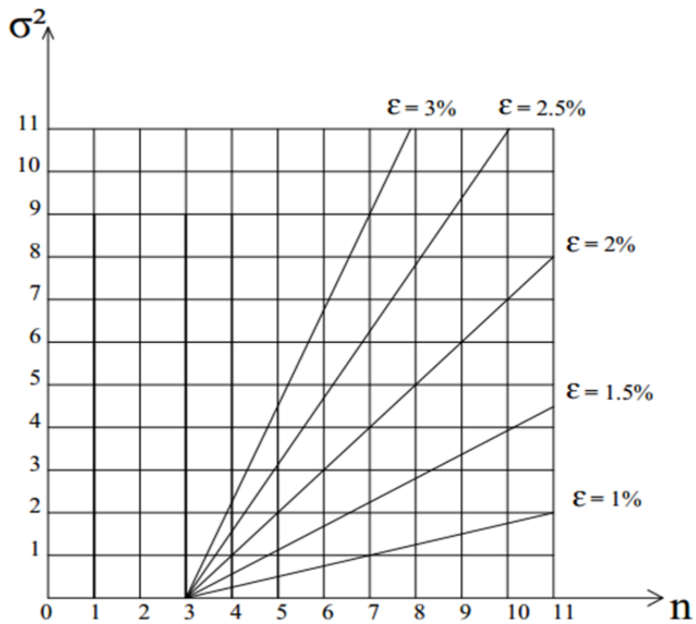
  σ = 0 → n = 3 → A (3; 0)
  σ = 2.5 → n = 7 → A (7; 6.25)

- ε = 3% → $n = \frac{4\delta^2}{\varepsilon^2} + 3$

  σ = 0 → n = 3 → A (3; 0)

  σ = 3 → n = 7 → A (7; 9)

⇨ We can draw a graph system to determine the number of times CALV is needed (n)



Step 2: Perform field observations a minimum number of times (n1, n1min = 4 times) to determine the point A1 (n_1; δ21)

Step 3: Represent the point A1 on the coordinate axis system just drawn.

- If point A_1 is to the right of the graph line = 3%, then the conclusion: The number of CANLV times is sufficient. The error of the observation is less than the allowable error and will be taken by the value of which line is closest to point A_1
- If point A_1 is to the left of the graph line = 3%, the error of the observation is greater than the allowable error => The number of observations n_1 is not enough, additional observations must be made to supplement the data.

2.5. Design of standard conditions for new norms

Standard Condition Concept:

- Standard conditions are relatively standard regulations to well implement the established norms as stated in the methodology.
- What are the production conditions, there must be corresponding norms; When working conditions change, the norm value also changes.
- Standard conditions regulations are often factors that affect labor productivity.

Standard Condition Design:

- Workplace: Arrange the workplace reasonably, ensure the prescribed standards (ensuring safety and environmental sanitation) Weather and climate conditions.
- Quality of labor tools: Tools and tools for the production process must be suitable for the product, sufficient in quantity and quality assurance.
- Specification and quality of materials: Materials of origin, design and quality ensure the quality of the product meets the requirements.
- Composition of the worker group, level of worker qualifications: the right occupation and the right level of workers required in each working position, form of salary payment (product contracting or from time to time)

Design of worker team components: (there are 3 ways)

- **Method 1**: Observing the reality at some construction sites, seeing that the payroll of the team to carry out a type of construction and installation work is smooth, stopping the work locally with few high employers, it is possible to immediately select that team member as a payroll and calculate the average worker rank for the new norm.

$$C_{bq} = \frac{\sum_{i=1}^{n} n_i * C_i}{\sum_{i=1}^{n} n_i} \quad => \quad K_{cb} \quad => \quad TL = LTT.K_{cb}$$

- **Option 2**: Rely on the actual team payroll (recorded in the dry characteristics sheet to observe and waste the operational time of each element to adjust and complete the team payroll.
  - *Content:*
    - Offering 2 options for staffing the worker team to compare and choose a more reasonable option
    - Calculate the average worker rank of each worker to determine the worker who works the most.
    - Determine the local suspension of each option.
  - *Commenting and evaluating the selection of options based on:*
    - Smaller local downtime means higher employers.
    - Local downtime: This is the time difference between the person who works the most and other workers.
    - The average worker rank of the options.
    - If there are many high-level workers on the payroll to have higher employers, more salaries must be spent, so the following conditions must be ensured: Employer growth rate > Salary growth rate.

- **Option 3**: Design team components in accordance with the regulations of the work hierarchy. The payroll of the team is based on the following principles:
  - Make the most of the capacity of high-level workers.
  - Distribute the workload relatively evenly to all members so that local downtime due to waiting for each other is the least.

Knowing that the workers who install the panels are determined according to the unit price of construction workers in Thach That district.

❖ **Determination of labor** norms.

Formulas are used to determine labor norms.

(1) Formula 1:

If the data of Ttn, Tck, Tngtc and Tnggl are obtained in absolute numbers, the labor norms are calculated according to the formula:

$$TD = TTN + Tck + Tngtc + Tnggl$$

(2) Formula 2

If only the operating time is collected according to the absolute number (Ttn – working hours/DVSP) and other quantities (tck, TNGTC, tnggl) are collected according to the relative number (%), the **MLD** is calculated according to the formula:

$$\text{Labor union (working hours/union)} = \frac{T_{tn} * 100}{100 - (t_{ck} + t_{nggl} + t_{ngtc})}$$

(3) Formula 3

If there is an operation time collected in absolute numbers (ttn – working hours/HVSP) and other quantities (tck, tngtc, tnggl) collected by relative numbers (%), in which tngtc > 10% of working shifts and tnggl > and = 6.25% of shifts, it is recommended to take advantage of part of the construction stoppage time to give workers a break. $t_{nggl}^{min} t_{nggl}^{min}$**MLA** is calculated according to the formula calculated according to the formula:

$$\text{Labor union (working hours/union)} = \frac{T_{tn} * 100}{100 - (t_{ck} + t_{nggl}^{tt} + t_{ngtc}^{tt})}$$

In this case, the construction stop time () and the break time () must be recalculated.$t_{ngtc}^{tt} t_{nggl}^{tt}$

Call part of the construction time to take advantage of to give workers a break is x (x = where n is a positive integer) $\frac{1}{n}$

We have: t_{nggl}^{tt} =tnggl - x.tngtc ≥ t_{nggl}^{min}

We choose the value of x that satisfies the condition of the expression: t_{nggl}

$$x \leq \frac{t_{nggl} - t_{nggl}^{min}}{t_{ngtc}}$$

Determination t_{nggl}^{tt}:

$$t_{ngtc}^{tt} = \frac{T_{ngtc}}{T_{tn} + T_{ngtc}} \{100 - [t_{ck} + (t_{nggl} - x.t_{ngtc})]\}$$

After condensing we have:

$$t_{ngtc}^{tt} = \frac{T_{ngtc}}{T_{tn} + (1 - x)T_{ngtc}} [100 - (t_{ck} - x.t_{ngtc})]$$

In which:

The net worth needs to be calculated as the absolute number (working hours/DVSP) from the value of the known net worth (%):

Tngtc = 100 − (tckTtn +×tngtctngtc+ tnggl) **(working hours/VNSP)**

(4) Formula 4

If the value x takes advantage of the construction stop time to give workers too little rest (x <), the labor norm is$\frac{1}{6}$calculated according to the formula:

$$\text{Labor union (working hours/union)} = \frac{T_{tn}*100}{100-(t_{ck}+t_{nggl}^{min}+t_{ngtc}^{tt})}$$

At that time, the calculated break time: = $t_{ngtc}^{tt}t_{nggl}^{min}$ **= 6.25%.**

And the calculation of the construction stop time () is calculated according to the formula: t_{nggl}^{tt}

$$t_{ngtc}^{tt} = \frac{T_{ngtc}}{T_{tn}+T_{ngtc}}[100-\left(t_{ck}+t_{nggl}^{min}\right)]$$

❖ **Determination of the unit price of labor to produce a unit of product (DGN)**

The labor unit price is the amount of wages paid to workers to complete a unit of product.

$$\text{EIA} = (\text{VND/ĐVSP})\frac{ĐM_{lđ}*G_{NC}}{8}$$

In which:

DMD_ Average number of working hours to complete a unit of construction work volume (working hours/HVSP)

GNC_ Unit price of working days of workers directly engaged in construction production (VND/working day)

8_ An 8-hour workday

The unit price of working days of workers directly engaged in construction is the level of remuneration paid to workers working in a shift determined according to the market price at the time of determining the unit price. This unit price includes the allowances that construction workers are entitled to according to regulations.

Currently, the method of determining the unit price of construction labor is guided by Circular 15/2019/TT-BXD dated 26/12/2019 of the Ministry of Construction.

$$G_{NC}^{i} = \frac{G_{NC}^{j}.H_{CB}^{j}}{H_{CB}^{j}}$$

In which:

HCBi _Hệ the rank number of workers performing work I with the rank announced in the system of norms for construction estimates.

HCBj _ The average rank coefficient of the jth construction worker group, specified in Appendix 6 of Circular 15/2019/TT-BXD. If the average construction worker rank is an odd number, it is necessary to refine the interpolation to determine the worker rank coefficient.

GNCi _ Unit price of working days of construction workers performing the first construction work with the norm waste published in the system of norms for construction estimates (VND/working day)
GNCj _The unit price of a construction worker's working day of a worker in the jth construction working group is announced by the People's Committees of provinces and centrally-run cities.

2.6. Present in a table of norms.

- Job Composition
- Composition of the workers' group, salaries and wages
- Normative Units of Calculation
- Norm Value Table

Unit of Calculation:

Symbol DM	Work	Wasted ingredients	Unit	Values	Notes
(1)	(2)	(3)	(4)	(5)	(6)

III. DATA ADJUSTMENT

- Data adjustment is to complete the collected documents and process the numbers according to predetermined standards in order to achieve the purpose: to determine the labor waste or waste of time using construction machinery calculated on average for 1 unit of component product of the production process. When the above goal is achieved, that is, the period of data correction is ended.
- It consists of 3 basic steps:
  - Preliminary Correction
  - Adjustment for each observation
  - Adjust the data for observations.

The process of mounting PANEL with the CKY 101 tower crane is a production process with cyclic and non-cyclic elements.
Production cycle process:

- Hook the panel onto the crane.
- Adjust, set anchors.

The rest of the processes are non-cyclic elements.
Adjust metrics for cyclical manufacturing: Cyclical manufacturing processes are continuous processes that have no product limits. The production process does not cycle, the adjustment of data in each observation is carried out in 2 steps:

- Step 1: Intermediate adjustment.
- Step 2: Formal correction.

Adjust the data for the cycle production process: It is a process that consists of cycle elements or several cycle elements together, the cycle elements are repeated after each production with a relatively equal amount of waste. Adjusting the data to the cyclic process is essentially correcting the sequence of numbers with each observation of a cyclic element that will result in a sequence of numbers. Each number in the sequence represents the execution time of that element in the cycle. The adjustment of the number sequence uses the mathematical method in the following sequence:

- Step 1: Arrange the numbers in the range from small to large.
- Step 2: Calculate the stability factor of the number sequence. \
- Step 3: Adjust the number sequence according to the cases of the stability coefficient.

1. **Preliminary adjustments with combined photo slips**

- Purpose: to complete the recording and collection of information when observing data collection
- Calculate the labor cost for each element individually in each observation hour and write it to the available column in the CA tickets.
- Notice that the columns and items on the observation sheet are fully recorded without additional information.

2. **Adjustment for each observation**

2.1. Objectives:

- Complete and systematize the data obtained in each observation to serve as a basis for calculating the norm value.
- Remove inappropriate metrics to select the appropriate ones when calculating the norm value.

<u>a. Preliminary Correction</u>

- Edit on feature and observation sheets.

✞ For the characteristic sheet: the information on the characteristic sheet such as: name of the normative group, name of the

QTSX, team composition, personal information, age, occupation, seniority, photo salary, weather conditions...) fully recorded information, no need to supplement or edit.

✞ For the combined photo observation card:

- Check the number of people participating in each part of the work at each time in the hour to see if it matches the actual number of workers working recorded in the characteristic sheet:

After checking, it was found that:

▪ There are errors in the observation of actual data: the time to end the observation is 11 o'clock, the observation sheet is recorded at 14 hours => is incorrect

▪ Observations:

**** Observation 1:***

- *Observation time of the elements from 7:00 – 11:00 => END: 11:00 PM*
- At the time of 9:59 a.m. – 10:00 a.m., add the number of workers 1 to the Excess Movement element.
- *Added Labor Cost (ng.ph) for all elements.*

**** Observation 2:***

- *Observation time of the elements from 7:00 – 11:00 => END: 11:00 PM*
- At the time of 7:49 a.m. - 7:50 a.m., the number of workers is 5 people => Add 1 more worker to the Excess Movement element.
- At the time of 9:38 a.m. - 9:43 a.m., the number of workers is 5 people => Add 1 worker to the Excess Movement element.
- At the time of 10:13 a.m. - 10:17 a.m., the number of workers is 7 people => Eliminate 1 worker in the other Stop work element.
- At 10:26 a.m. – 10:27 a.m., the number of workers is 5 people => Add 1 more worker to the Break element.
- At the time of 10:30 a.m. – 10:33 a.m., the number of workers is 5 people => Adding 1 more worker to the Disciplinary Violation element.
- *Added Labor Cost (ng.ph) for all elements.*

**** Observation 3:***

- *Observation time of the elements from 7:00 – 11:00 => END: 11:00 PM*
- At the time of 7:59 a.m. – 8:00 a.m., the number of workers is 7 people => Remove 1 worker from the Disciplinary Violation element.
- At the time of 9:00 a.m. - 9:05 a.m., the number of workers is 4 people => Add 2 more workers to the Excess Movement element.
- At the time of 10:25 a.m. - 10:32 a.m., the number of workers is 4 people => Add 2 more workers to the Redundancy element.
- At the time of 10:52 a.m. - 10:55 a.m., the number of workers is 5 people => Add 1 more worker to the Disciplinary Violation element.

- *Added Labor Cost (ng.ph) for all elements.*

**** Observation 4:***

- *Observation time of the elements from 7:00 – 11:00 => END: 11:00 PM*
- At the time of 9:41 a.m. - 9:42 a.m., the number of workers is 7 people => Eliminate 1 worker in the Break element.
- At the time of 10:11 - 10:12 p.m., the number of workers is 7 people => Remove 1 worker from the Panel element to the crane.
- *Added Labor Cost (ng.ph) for all elements.*

**** Observation 5:***

- *Observation time of the elements from 7:00 – 11:00 => END: 11:00 PM*
- At the time of 7:38 a.m. - 7:40 p.m., the number of workers is 7 people => Eliminate 1 worker in the Waiting element of the crane to move.
- At the time of 8:00 a.m. - 8:02 a.m., the number of workers is 5 people => Add 1 more worker to the Disciplinary Violation element.
- *Added Labor Cost (ng.ph) for all elements.*

b. Adjustment for each observation

The production process has cyclic and non-cyclic elements:

- Cycle elements:
  - Hook the panel onto the crane.
  - Adjust, anchor.

- Non-cyclic elements:
  - Mix, transfer, spread mortar.
  - Plug the mortar pulse.
  - Wait for the axis to move
  - Take a break.
  - Standard time.
  - Disciplinary violations
  - Do extra movement.
  - Take a break because of the rain.

2.2. Adjustment of data obtained by PPCA for non-cyclical QTSX.

*** Observation 1:**

- **Intermediate Correction (CLTG):**

QTSX NAME: PANEL ASSEMBLY BY CKY101 TOWER CRANE							**Times QS 1**
TT	**SHPT**	**Element Name**	**Labor waste (h.min)**				**Total (ng.min)**
			1	**2**	**3**	**4**	
1	1	Mixing, transferring, spreading mortar	53	72	53	80	258
2	4	Mortar vascular insertion	34	45	46	62	187
3	5	Waiting for the crane to move	41	13	15	21	90
4	6	Breaks	12	46	21	12	91
5	7	Benchmark time	29	0	40	19	88
6	8	Disciplinary violations	7	7	8	0	21

7	9	Overdoing the movement	0	7	0	6	13
8	10	Taking a break because of the rain	0	0	2	40	43
9	11	Stop other work	0	3	0	0	3
10	2	Panel to the crane	33	30	25	19	107
11	3	Adjustable anchor fastening	151	137	150	101	539

- **Official Correction (CLCT):**

QTSX NAME: PANEL ASSEMBLY WITH CKY101 TOWER CRANE							**QS Times 1**
TT	**SHPT**	**Element Name**	**Labor waste**		**Obstetrics and Gynecology**	**Amount**	**Quantity of aggregate products**
			Person.min	**%**	**Product Element**	**SPPT**	
1	1	Mixing, transferring, spreading mortar	258	17.92	m^3	0,8	Mountable 12 Panels panel
2	4	Mortar vascular insertion	187	12.99	m^2	84	
3	5	Waiting for the crane to move	90	6.25			

4	6	Breaks	91	6.32			
5	7	Benchmark time	88	6.11			
6	8	Disciplinary violations	21	1.46			
7	9	Overdoing the movement	13	0.90			
8	10	Taking a break because of the rain	43	2.99			
9	11	Stop other work	3	0.21			
10	2	Panel to the crane	107	7.43	12	plate	
11	3	Adjustable anchor fastening	539	37.43	13	plate	

<u>* Observation 2:</u>

- **Intermediate Correction (CLTG):**

QTSX NAME: PANEL ASSEMBLY BY CKY101 TOWER CRANE							Times QS 2
TT	**SHPT**	**Element Name**	**Labor waste (h.min)**				**Total (ng.min)**
			1	**2**	**3**	**4**	
1	1	Mixing, transferring, spreading mortar	69	57	70	47	243
2	4	Mortar vascular insertion	29	49	32	29	139

3	5	Waiting for the crane to move	13	29	27	19	88
4	6	Breaks	48	10	31	7	96
5	7	Benchmark time	30	0	0	27	57
6	8	Disciplinary violations	7	0	5	11	23
7	9	Overdoing the movement	6	8	3	10	27
8	10	Taking a break because of the rain	0	0	0	55	55
9	11	Stop other work	0	0	0	0	0
10	2	Panel to the crane	33	37	35	38	143
11	3	Adjustable anchor fastening	125	170	157	117	569

- **Official Correction (CLCT):**

QTSX NAME: PANEL ASSEMBLY WITH CKY101 TOWER CRANE							**QS Times 2**
TT	**SHPT**	**Element Name**	**Labor waste**		**Obstetrics and Gynecology**	**Amount**	**Quantity of aggregate products**
			Person.min	**%**	**Product Element**	**SPPT**	
1	1	Mixing, transferring, spreading mortar	243	16.88	m ^{3}	1,3	Mountable 14 sheets panel

2	4	Mortar vascular insertion	139	9.65	m ²	73	
3	5	Waiting for the crane to move	88	6.11			
4	6	Breaks	96	6.67			
5	7	Benchmark time	57	3.96			
6	8	Disciplinary violations	23	1.60			
7	9	Overdoing the movement	27	1.88			
8	10	Taking a break because of the rain	55	3.82			
9	11	Stop other work	0	0.00			
10	2	Panel to the crane	143	9.93	14	plate	
11	3	Adjustable anchor fastening	569	39.51	13	plate	

*** Observation 3:**

- **Intermediate Correction (CLTG):**

QTSX NAME: PANEL ASSEMBLY BY CKY101 TOWER CRANE	**Times QS 3**

TT	SHPT	Element Name	Labor waste (h.min)				Total (ng.min)
			1	2	3	4	
1	1	Mixing, transferring, spreading mortar	69	45	75	82	271
2	4	Mortar vascular insertion	35	40	56	70	201
3	5	Waiting for the crane to move	14	16	13	10	53
4	6	Breaks	12	38	9	9	68
5	7	Benchmark time	42	7	10	18	77
6	8	Disciplinary violations	4	14	5	8	31
7	9	Overdoing the movement	4	10	0	0	14
8	10	Taking a break because of the rain	0	0	10	14	24
9	11	Stop other work	0	0	5	0	5
10	2	Panel to the crane	30	29	21	37	117
11	3	Adjustable anchor fastening	150	161	156	112	579

- **Official Correction (CLCT):**

QTSX NAME: PANEL ASSEMBLY BY CKY101 TOWER CRANE	Times QS 3

TT	SHPT	Element Name	Labor waste		Obstetrics and Gynecology	Amount	Quantity of aggregate products
			Person.min	%	Product Element	SPPT	
1	1	Mixing, transferring, spreading mortar	271	18.82	m^3	1,25	Mounts 11 panels
2	4	Mortar vascular insertion	201	13.96	m^2	84	
3	5	Waiting for the crane to move	53	3.68			
4	6	Breaks	68	4.72			
5	7	Benchmark time	77	5.35			
6	8	Disciplinary violations	31	2.15			
7	9	Overdoing the movement	14	0.97			
8	10	Taking a break because of the rain	24	1.67			
9	11	Stop other work	5	0.35			
10	2	Panel to the crane	117	8.13	11	plate	
11	3	Adjustable anchor fastening	579	40.21	13	plate	

<u>* Observation 4:</u>

- **Intermediate Correction (CLTG):**

QTSX NAME: PANEL ASSEMBLY WITH CKY101 TOWER CRANE							QS Times 4
TT	SHPT	Element Name	Labor waste (h.min)				Total (ng.min)
			1	2	3	4	
1	1	Mixing, transferring, spreading mortar	75	55	60	70	260
2	4	Mortar vascular insertion	19	44	40	64	167
3	5	Waiting for the crane to move	18	47	22	18	105
4	6	Breaks	22	14	41	20	97
5	7	Benchmark time	65	0	10	27	102
6	8	Disciplinary violations	1	8	0	0	9
7	9	Overdoing the movement	0	5	2	8	15
8	10	Taking a break because of the rain	0	0	0	0	0
9	11	Stop other work	10	0	0	0	10
10	2	Panel to the crane	30	29	30	32	121
11	3	Adjustable anchor fastening	120	158	155	121	554

- **Official Correction (CLCT):**

QTSX NAME: PANEL ASSEMBLY BY CKY101 TOWER CRANE							**Times QS 4**
TT	**SHPT**	**Element Name**	**Labor waste**		**Obstetrics and Gynecology**	**Amount**	**Quantity of aggregate products**
			Person.min	**%**	**Product Element**	**SPPT**	
1	1	Mixing, transferring, spreading mortar	260	18.06	m^3	1,24	Mounts 12 panels
2	4	Mortar vascular insertion	167	8.40	m^2	80	
3	5	Waiting for the crane to move	105	38.47			
4	6	Breaks	97	11.60			
5	7	Benchmark time	102	7.29			
6	8	Disciplinary violations	9	6.74			
7	9	Overdoing the movement	15	7.08			
8	10	Taking a break because of the rain	0	0.63			

9	11	Stop other work	10	1.04			
10	2	Panel to the crane	121	8.40	12	plate	
11	3	Adjustable anchor fastening	554	38.47	12	plate	

<u>* Observation 5:</u>

- **Official Correction (CLCT):**

QTSX NAME: PANEL ASSEMBLY BY CKY101 TOWER CRANE							Times QS 5
TT	SHPT	Element Name	Labor waste (h.min)				Total (ng.min)
			1	2	3	4	
1	1	Mixing, transferring, spreading mortar	80	58	75	60	273
2	4	Mortar vascular insertion	52	56	44	24	176
3	5	Waiting for the crane to move	20	27	20	5	72
4	6	Breaks	37	18	21	0	76
5	7	Benchmark time	10	0	5	0	15
6	8	Disciplinary violations	4	6	0	22	32
7	9	Overdoing the movement	7	3	4	3	17

8	10	Taking a break because of the rain	0	0	0	35	35
9	11	Stop other work	0	15	0	0	15
10	2	Panel to the crane	30	33	31	31	125
11	3	Adjustable anchor fastening	120	144	160	180	604

- **Intermediate Correction (CLTG):**

QTSX NAME: PANEL ASSEMBLY BY CKY101 TOWER CRANE							**Times QS 5**
TT	**SHPT**	**Element Name**	**Labor waste**		**Obstetrics and Gynecology**	**Amount**	**Quantity of aggregate products**
			Person.min	**%**	**Product Element**	**SPPT**	
1	1	Mixing, transferring, spreading mortar	273	18.96	m^3	1,24	Mounts 12 panels
2	4	Mortar vascular insertion	176	12.22	m^2	67	
3	5	Waiting for the crane to move	72	5.00			
4	6	Breaks	76	5.28			
5	7	Benchmark time	15	1.04			

6	8	Disciplinary violations	32	2.22			
7	9	Overdoing the movement	17	1.18			
8	10	Taking a break because of the rain	35	2.43			
9	11	Stop other work	15	1.04			
10	2	Panel to the crane	125	8.68	12	plate	
11	3	Adjustable anchor fastening	604	41.94	14	plate	

2.3. Adjust the data obtained by the CA method for the cycle element.

First Observation

❖ **Element: Panel hook to the crane.**

- The sequence of numbers obtained by the combined photographic method of the panel hook element to the crane during the observation of 1 production process has 2 cycle elements as follows:

7; 11; 10; 10; 9; 8; 8; 9; 8; 8; 11; 8

Sort the numbers in the sequence in order from smallest to largest:

7; 8; 8; 8; 8; 8; 9; 9; 10; 10; 11; 11

Dispersion of the Köd number sequence:

a_{max} = 11; = 7a_{min}

Kôđ = $\frac{11}{7}$= 1,57

1.3 < ≤ 2, the dispersion of the number sequence is relatively large.

Adjust the number sequence according to the 'limited number method':

Check the limit of the number sequence

Check the upper limit:

+ Let's say the value type amax = 11 out of the number sequence (there are 2 numbers)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB1 = \frac{7 + 8*5 + 9*2 + 10*2}{12 - 2} = 8.50$$

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 10 numbers, looking up table 3.1 we get k = 1

Amax = 8.50 + 1. (10 - 7) = 11.5

Comparison of Amax and amax values

Notice: amax = 11 < A_{max} = 11.5, so we keep the amax value in the number sequence

Check the lower limit:

+ Suppose the type of amine value = 7 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB2 = \frac{8*5 + 9*2 + 10*2 + 11*2}{12 - 1} = 9.09$$

+ Calculate the lower limit of the number sequence (A_{min})

Amin = aTB2 - k.(amax – a'$_{min}$)

The remaining sequence has 11 numbers, looking up table 3.1 we get k = 0.9

Amine = 9.09 - 0.9. (11 - 8) = 6.39

Comparison of Amine and Amine Values

Notice: amine = 7 > amine = 6.39 should retain the value of a_{min} in the number sequence

Conclusion: The adjusted number sequence is within the allowable limit, we have:

Pi = 12 numbers

Ti = 107 ngmin

❖ **Element: Adjustable anchor**

The sequence of numbers obtained by the combined photographic method of the anchor adjustment element in the observation of 1 production process has 2 cycle elements as follows:

52; 60; 42; 53; 39; 42; 42; 42; 36; 24; 24; 50; 33

Sort the numbers in the sequence in order from smallest to largest:

24; 24; 33; 36; 39; 42; 42; 42; 42; 50; 52; 53; 60

Dispersion of the Köd number sequence:

amax = 60; amin = 24

$$Kôđ = \frac{60}{24} = 2,5$$

Cod > 2, the scattering of the number sequence is large

Adjusting the number sequence according to the method of 'experimental relative military deviation - e_{tn}'

ETN Spreadsheet:

STT	1	2	3	4	5	6	7	8	9	10	11	12	13	Sum
To	24	24	33	36	39	42	42	42	42	50	52	53	60	539
AI2	576	576	1089	1296	1521	1764	1764	1764	1764	2500	2704	2809	3600	23727

etn = = $\pm\frac{100}{\sum_{i=1}^{n} ai} * \sqrt{\frac{n*\sum_{i=1}^{n}(ai)^2-(\sum_{i=1}^{n} ai\ )^2}{n-1}} \pm \frac{100}{536}\sqrt{\frac{13*23727-539^2}{13-1}} =$ 7,17 %$\pm$

This is the sequence of numbers of an element in a QTSX consisting of 2 periodic elements (< 5). Looking up the table, we have a relatively permissible military deviation [e] = ±7%.

- For comparison, we see: etn = ± 7.16 % > [e] = ±7%.

⇨ Adjust the number sequence according to the instructions of the "directional" coefficients of and K_1 K_n

K_1= = = 1,07 = = = 1,25$\frac{\sum_{i=1}^{n} a_i-a_1}{\sum_{i=1}^{n} a_i-a_n}$ $\frac{539-24}{539-60}$ K_n $\frac{\sum_{i=1}^{n} {a_i}^2-a_1\sum_{i=1}^{n} a_i}{a_n\sum_{i=1}^{n} a_i-\sum_{i=1}^{n} {a_i}^2}$ $\frac{23727-24*539}{60*539-23727}$

- Comparison we see: K_1 = 1.07 < K_n= 1.25

⇨ Discard the smallest value of the number sequence (value = 24)a_1

etn' spreadsheet:

STT	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**sum**
To	33	36	39	42	42	42	42	50	52	53	60	491
AI2	1089	1296	1521	1764	1764	1764	1764	2500	2704	2809	3600	22575

etn = = $\pm\frac{100}{\sum_{i=1}^{n} a_i} * \sqrt{\frac{n*\sum_{i=1}^{n}(a_i)^2-(\sum_{i=1}^{n} a_i\ )^2}{n-1}} \pm \frac{100}{515}\sqrt{\frac{11*22575-491^2}{11-1}} =$ 5,48 %$\pm$

This is the sequence of numbers of an element in a QTSX consisting of 2 periodic elements (<5). Looking up the table, we have a relatively permissible military deviation [e] = ±7%.

For comparison, we see: etn = ± 5.48 % < [e] = ±7%.

Conclusion: The numbers in the number sequence are all usable, we have:

Pi = 11 numbers

Ti = 491 ngmin

**** Observation 2:***

❖ **Element: Hook the panel to the crane.**

- The sequence of numbers obtained by the combined photographic method of the panel hook element to the crane during the observation of 1 production process has 2 cycle elements as follows:
11; 10; 12; 8; 10; 9; 10; 10; 9; 16; 11; 10; 8 ; 9

Sort the numbers in the sequence in order from small to large:
8; 8; 9; 9; 9; 10; 10; 10; 10; 10; 11; 11; 12; 16
Dispersion of the Köd number sequence:
amax = 16; amin = 8
Kôđ = $\frac{16}{8}$ = 2
1.3 < ≤ 2, the dispersion of the number sequence is relatively large.
Adjust the number sequence according to the 'limited number method':

Check the limit of the number sequence
Check the upper limit:
+ Suppose the value type amax = 16 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

aTB1 = $\frac{8*2\ +\ 9*3\ +10*5 +\ 11*2+12*1}{14\ -\ 1}$ = 9.77

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 13 numbers, looking up table 3.1 we get k = 0.9

Amax = 9.77 + 0.9. (12 - 8) = 13.37

Comparison of Amax and amax values

Notice: amax = 16 > A_{max} = 13, 37, so we remove amax from the number sequence.
It is the turn of a'max = 12 to be suspected

+ Let's say the type of value amax = 12 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

aTB1 = $\frac{8*2\ +\ 9*3\ +10*5 +\ 11*2}{13\ -\ 1}$ = 9.58

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a’$_{max}$ – amin)
The remaining sequence has 13 numbers, looking up table 3.1 we get k = 0.9
Amax = 9.58 + 0.9. (11 - 8) = 12.28
Comparison of Amax and amax values
Notice: amax = 12 < A_{max} = 12.28, so we keep the amax value in the number sequence
At this time, the remaining number: 8; 8; 9; 9; 9; 10; 10; 10; 10; 10; 11; 11; 12

Check the lower limit:
+ Suppose the type of amine value = 8 out of the sequence (there are 2 numbers)
+ Calculate the simple average of the remaining numbers in the number sequence:
aTB2 = $\frac{9*3\ +10*5\ +11*2+12*1}{13-2}$ = 10.09
+ Calculate the lower limit of the number sequence (A_{min})
Amin = aTB2 - k.(amax – a’$_{min}$)
The remaining sequence has 11 numbers, looking up table 3.1 we get k = 0.9
Amines = 10.17 - 0.9. (12 - 8) = 3.79
Comparison of Amine and Amine Values
Notice: amine = 8 > A_{min} = 3.79, so we retain the amine value in the number sequence

Conclusion: The adjusted number sequence is within the allowable limit, we have:
Pi = 13 numbers
Ti = 127 ngmin

❖ **Element: Adjustable anchor**
- The sequence of numbers obtained by the combined photographic method of the panel hook element to the crane during the observation of 1 production process has 2 cycle elements as follows:
33; 44; 45; 48; 42; 59; 30; 36; 45; 46; 54; 48; 39

Sort the numbers in the sequence in order from smallest to largest:
30; 33; 36; 39; 42; 44; 45; 45; 46; 48; 48; 54; 59
Dispersion of the Köd number sequence:
amax = 59; amin = 30
Kôđ = $\frac{59}{30}$ = 1,9
Adjust the number sequence according to the 'limited number method':

Check the limit of the number sequence
Check the upper limit:

+ Suppose the value type amax = 59 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB1 = \frac{30*1 + 33*1 + 36*1 + 39*1 + 42*1 + 44*1 + 45*2 + 46*1 + 48*2 + 54*1}{13-1} = 42.50$$

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 12 numbers, looking up table 3.1 we get k = 0.9

Amax = 942.50 + 0.9. (54 - 30) = 64.10

Comparison of Amax and amax values

Notice: amax = 59 < A_{max} = 64.10, so we keep the amax value in the number sequence

Check the lower limit:

+ Let's say the type of amino value = 30 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB2 = \frac{33*1 + 36*1 + 39*1 + 42*1 + 44*1 + 45*2 + 46*1 + 48*2 + 54*1 + 59*1}{13-1} = 44.92$$

+ Calculate the lower limit of the number sequence (A_{min})

Amin = aTB2 - k.(amax – a'$_{min}$)

The remaining sequence has 12 numbers, looking up table 3.1 we get k = 0.9

Amines = 44.92 - 0.9. (59 - 33) = 21.51

Comparison of Amine and Amine Values

Notice: amine = 30 > A_{min} = 21.51, so we retain the amine value in the number sequence

Conclusion: The adjusted number sequence is within the allowable limit, we have:

Pi = 13 numbers

Ti = 569 ngmin

**** Observation 3:***

- The sequence of numbers obtained by the combined photographic method of the panel hook element to the crane during the observation of 1 production process has 2 cycle elements as follows:

9; 11; 10; 10; 10; 9; 12; 9; 9; 13; 15

Sort the numbers in the sequence in order from small to large:

9; 9; 9; 9; 10; 10; 10; 11; 12; 13; 15

Dispersion of the Köd number sequence:

amax = 15; ana = 9

Kôđ = $\frac{15}{9}$ = 1,67

1.3 < ≤ 2, the dispersion of the number sequence is relatively large.

Adjust the number sequence according to the 'limited number method':

Check the limit of the number sequence

Check the upper limit:

+ Let's say the type of value amax = 15 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

aTB1 = $\frac{9*4 + 10*3 + 11*1 + 12*1 + 13*1}{11 - 1}$ = 10.20

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 10 numbers, looking up table 3.1 we get k = 1

Amax = 10.20 + 1. (13 - 9) = 14.20

Comparison of Amax and amax values

Notice: amax = 15 > A_{max} = 14.20, so we remove amax from the number sequence.

It is the turn of a'max = 13 to be suspected

+ Let's say the type of value amax = 13 out of the number sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

aTB1 = $\frac{8*2 + 9*3 + 10*5 + 11*1 + 12*1}{10 - 1}$ = 9.89

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 9 numbers, looking up table 3.1 we get k = 1

Amax = 9.89 + 1. (12 - 9) = 12.88

Comparison of Amax and amax values

Notice: amax = 13 > A_{max} = 12.88, so we remove amax from the number sequence.

It is the turn of a'max = 12 to be suspected

+ Let's say the type of value amax = 12 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

aTB1 = $\frac{9*4 + 10*3 + 11*1}{9 - 1}$ = 9.63

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 8 numbers, looking up table 3.1 we get k = 1.1

Amax = 9.63 + 1.1. (11 - 9) = 11,825

Comparison of Amax and amax values

Notice: amax = 12 > A_{max} = 11.825, so we remove amax from the number sequence.
It is the turn of a'max = 11 to be suspected

+ Let's say the type of value amax = 11 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB1 = \frac{8*2 + 9*3 + 10*5}{8 - 1} = 9.43$$

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 19 numbers, looking up table 3.1 we get k = 1

Amax = 9.43 + 1. (10 - 9) = 10.53

Comparison of Amax and amax values

Notice: amax = 11 > A_{max} = 10.53, so we remove amax from the number sequence.

Comments: The initial sequence of 11 numbers has eliminated 4 digits, accounting for 36% > 30% of the sequence without identifying Amax, proving that the data obtained is not enough for research.
Assuming that 3 additional cycles are observed with the results obtained respectively are 12; 13 and 14 (minutes). At that time, the new sequence of numbers is arranged in ascending order (11 numbers):
9; 9; 9; 9; 10; 10; 10; 11; 12; 13; 14

+ Let's say the amax = 14 value type out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB1 = \frac{9*4 + 10*3 + 11*1 + 12*1 + 13*1}{11 - 1} = 10.20$$

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 10 numbers, looking up table 3.1 we get k = 1

Amax = 10.20 + 1. (13 - 9) = 14.20

Comparison of Amax and amax values

Notice: amax = 14 < A_{max} = 14.20, so we keep the amax value in the number sequence

At this time, the number sequence is: 9; 9; 9; 9; 10; 10; 10; 11; 12; 13; 14

Check the lower limit:

+ Let's say the type of amine value = 9 out of the sequence (there are 4 numbers)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB2 = \frac{10*3 + 11*1 + 12*1 + 13*1 + 14*1}{11 - 4} = 11.43$$

+ Calculate the lower limit of the number sequence (A_{min})

Amin = aTB2 - k.(amax – a'$_{min}$)

The remaining sequence has 7 numbers, looking up table 3.1 we get k = 1.1

Amines = 11.43 - 1.1. (14 - 10) = 5.93

Comparison of Amine and Amine Values

Notice: amine = 9 > A_{min} = 5.93, so we retain the amine value in the number sequence

Conclusion: The adjusted number sequence is within the allowable limit, we have:

Pi = 11 numbers

Ti = 116 ngmin

❖ **Element: Adjustable anchor**

- The sequence of numbers obtained by the combined photographic method of the panel hook element to the crane during the observation of 1 production process has 2 cycle elements as follows:

51; 48; 51; 28; 45; 43; 45; 48; 45; 48; 49; 30; 48

Sort the numbers in the sequence in order from smallest to largest:

28; 30; 43; 45; 45; 45; 48; 48; 48; 48; 49; 51; 51

Dispersion of the Köd number sequence:

amax = 51; amin = 28

Kôđ = $\frac{51}{28}$ = 1,82

Adjust the number sequence according to the 'limited number method':

Check the limit of the number sequence

Check the upper limit:

+ Let's say the type of value amax = 51 out of the sequence (there are 2 numbers)

+ Calculate the simple average of the remaining numbers in the number sequence:

aTB1 = $\frac{28*1 + 30*1 + 43*1 + 45*3 + 48*4 + 49*1}{13 - 1}$ = 43.36

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 12 numbers, looking up table 3.1 we get k = 0.9

Amax = 43.36 + 0.9. (49 - 28) = 64.36

Comparison of Amax and amax values

Notice: amax = 51 < A_{max} = 64.36, so we retain the amax value in the number sequence

Check the lower limit:
+ Let's say the type of amine value = 28 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB2 = \frac{30*1 + 43*1 + 45*3 + 48*4 + 49*1 + 51*2}{13 - 1} = 45.92$$

+ Calculate the lower limit of the number sequence (A_{min})

Amin = aTB2 - k.(amax – a'_{min})

The remaining sequence has 12 numbers, looking up table 3.1 we get k = 0.9

Amines = 45.92 - 0.9. (51 - 30) = 45.92

Comparison of Amine and Amine Values

Notice: amine = 28 > A_{min} = 45, 92, so we retain the amine value in the number sequence

Conclusion: The adjusted number sequence is within the allowable limit, we have:
Pi = 13 numbers
Ti = 579 ngmin

**** Observation 4:***

❖ Element: Hook the panel to the crane.

- The sequence of numbers obtained by the combined photographic method of the panel hook element to the crane during the observation of 1 production process has 2 cycle elements as follows:

10; 9; 11; 10; 10; 8; 10; 12; 10; 11; 10; 10

Sort the numbers in the sequence in order from smallest to largest:
8; 9; 10; 10; 10; 10; 10; 10; 10; 11; 11; 12
Dispersion of the Köd number sequence:
a_{max} = 12; = 8a_{min}

Kôđ = $\frac{12}{8}$ = 1,5

1.3 < Cod ≤ 2, the dispersion of the number sequence is relatively large
Adjust the number sequence according to the 'limited number method':

Check the limit of the number sequence

Check the upper limit:
+ Let's say the type of value amax = 12 out of the number sequence (there are 2 numbers)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB1= \frac{8*1+ 9*1 + 10*7 + 11*2}{12 - 1} =9.91$$

+ Calculate the upper limit of the number sequence (Amax)

$Amax = aTB1 + k.(a'_{max} – amin)$

The remaining sequence has 10 numbers, looking up table 3.1 we get k = 1

Amax = 9.91 + 1. (11 - 8) = 12.60

Comparison of Amax and amax values

Notice: amax = 12 < A_{max} = 12.60, so we keep the amax value in the number sequence

Check the lower limit:
+ Suppose the type of amine value = 8 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB2 =\frac{9*1 + 10*7 + 11*2 + 12*1}{12 - 1} = 10.27$$

+ Calculate the lower limit of the number sequence (A_{min})

$Amin = aTB2 - k.(amax – a'_{min})$

The remaining sequence has 11 numbers, looking up table 3.1 we get k = 0.9

Amines = 10.27 - 0.9. (12 - 9) = 7.57

Comparison of Amine and Amine Values

Notice: amine = 8 > amine = 7.57 should retain the value a_{min} in the number sequence

Conclusion: The adjusted number sequence is within the allowable limit, we have:
Pi = 12 numbers
Ti = 121 ngmin

❖ **Element: Adjustable anchor**

- The sequence of numbers obtained by the combined photographic method of the panel hook element to the crane during the observation of 1 production process has 2 cycle elements as follows:

48; 42; 42; 56; 48; 42; 41; 51; 47; 50; 48; 39

Sort the numbers in the sequence in order from smallest to largest:
39; 41; 42; 42; 42; 47; 48; 48; 48; 50; 51; 56
Dispersion of the Köd number sequence:
amax = 56; amin = 39

Kôđ = $\frac{56}{39}$ = 1,44

Adjust the number sequence according to the 'limited number method':

Check the limit of the number sequence

Check the upper limit:

+ Let's say the type of value amax = 56 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB1 = \frac{39*2 + 41*1 + 42*3 + 47*1 + 48*3 + 50*1 + 51*1}{12 - 1} = 45.27$$

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 12 numbers, looking up table 3.1 we get k = 0.9

Amax = 45.27 + 0.9. (51 - 39) = 56.07

Comparison of Amax and amax values

Notice: amax = 56 < A_{max} = 56.07, so we keep the amax value in the number sequence

Check the lower limit:

+ Suppose the type of amine value = 39 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB2 = \frac{41*1 + 42*3 + 47*1 + 48*3 + 50*1 + 51*1 + 56*1}{12 - 1} = 46.82$$

+ Calculate the lower limit of the number sequence (A_{min})

Amin = aTB2 - k.(amax – a'$_{min}$)

The remaining sequence has 12 numbers, looking up table 3.1 we get k = 0.9

Amine = 46.82 - 0.9. (41 - 39) = 33.32

Comparison of Amine and Amine Values

Notice: amine = 39 > A_{min} = 33.32, so we retain the amine value in the number sequence

Conclusion: The adjusted number sequence is within the allowable limit, we have:

Pi = 12 numbers

Ti = 554 ngmin

**** Observation 5:***

❖ **Element: Hook the panel to the crane.**

- The sequence of numbers obtained by the combined photographic method of the panel hook element to the crane during the observation of 1 production process has 2 cycle elements as follows:

10; 10; 10; 11; 11; 11; 10; 10; 11; 10; 10; 11

Sort the numbers in the sequence in order from smallest to largest:
10; 10; 10; 10; 10; 10; 10; 11; 11; 11; 11; 11
Dispersion of the Köd number sequence:
amax = 11; amin = 10
Kôđ = $\frac{11}{10}$ = 1,1
A ≤ 1.3 degrees of dispersion of the number sequence is allowed

Conclude:
Pi = 12 numbers
Ti = 125 persons.min

❖ **Element: Adjustable anchor**
- The sequence of numbers obtained by the combined photographic method of the panel hook element to the crane during the observation of 1 production process has 2 cycle elements as follows:
54; 45; 39; 42; 45; 39; 40; 45; 42; 39; 39; 45; 48; 42

Sort the numbers in the sequence in order from smallest to largest:
39; 39; 39; 39; 40; 42; 42; 42; 45; 45; 45; 45; 48; 54
Dispersion of the Köd number sequence:
amax = 54; amin = 39
Kôđ = $\frac{54}{39}$ = 1,38
1.3 < ≤ 2, the dispersion of the number sequence is relatively large.
Adjust the number sequence according to the 'limited number method':

Check the limit of the number sequence
Check the upper limit:
+ Let's say the value type amax = 54 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

$$aTB1 = \frac{39*4 + 40*1 + 42*3 + 45*4 + 48*1}{14 - 1} = 42.31$$

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 13 numbers, looking up table 3.1 we get k = 0.9

Amax = 42.31 + 0.9. (48 - 39) = 50.41

Comparison of Amax and amax values

Notice: amax = 54 > A_{max} = 50.41, so we remove amax from the number sequence.

It is the turn of a'max = 48 to be suspected

+ Let's say the type of value amax = 48 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

aTB1= $\frac{39*4 + 40*1 + 42*3 + 45*4}{13 - 1}$ =41.83

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 12 numbers, looking up table 3.1 we get k = 0.9

Amax = 41.83 + 0.9. (45 - 39) = 47.23

Comparison of Amax and amax values

Notice: amax = 48 > A_{max} = 47.23, so we remove amax from the number sequence.

It is the turn of a'max = 45 to be suspected

+ Let's say the type of value amax = 45 out of the sequence (there are 4 numbers)
+ Calculate the simple average of the remaining numbers in the number sequence:

aTB1 = $\frac{39*4 + 40*1 + 42*3}{12 - 4}$ = 40.25

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 8 numbers, looking up table 3.1 we get k = 1.1

Amax = 40.25 + 1.1. (42 - 39) = 43.55

Comparison of Amax and amax values

Notice: amax = 45 > A_{max} = 43.55, so we remove amax from the number sequence.

It is the turn of a'max = 42 to be suspected

+ Let's say the value type amax = 42 out of the sequence of numbers (there are 2 numbers)
+ Calculate the simple average of the remaining numbers in the number sequence:

aTB1 = $\frac{39*4 + 40*1}{8 - 3}$ = 39.20

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 5 numbers, looking up table 3.1 we get k = 1.3

Amax = 39.20 + 1.3. (40 - 39) = 40.5

Comparison of Amax and amax values

Notice: amax = 42 > A_{max} = 40.5, so we remove amax from the number sequence.

Comments: The initial sequence of 14 numbers has eliminated 9 digits, accounting for 64% > 30% of the sequence without identifying Amax, proving that the data obtained is not enough for research.
Suppose an additional observation cycle is performed with a result of 43 (minutes). At that time, the new number sequence is arranged in ascending order (9 numbers):
39; 39; 39; 39; 40; 42; 42; 42; 43

+ Let's say the type of value amax = 43 out of the sequence (there is 1 number)
+ Calculate the simple average of the remaining numbers in the number sequence:

aTB1 = $\frac{39*4 + 40*1 + 42*3}{9 - 1}$ = 40.25

+ Calculate the upper limit of the number sequence (Amax)

Amax = aTB1 + k.(a'$_{max}$ – amin)

The remaining sequence has 8 numbers, looking up table 3.1 we get k = 1.1

Amax = 40.25 + 1.1. (42 - 39) = 43.55

Comparison of Amax and amax values

Notice: amax = 43 < A_{max} = 43.55, so we retain the amax value in the number sequence

At this time, the number sequence is: 39; 39; 39; 39; 40; 42; 42; 42; 43

Check the lower limit:
+ Let's say the type of amine value = 39 out of the sequence (there are 4 numbers)
+ Calculate the simple average of the remaining numbers in the number sequence:

aTB2 = $\frac{3\ 40*1 + 42*3 + 43*1}{9 - 4}$ = 41.80

+ Calculate the lower limit of the number sequence (A_{min})

Amin = aTB2 - k.(amax – a'$_{min}$)

The remaining sequence has 5 numbers, looking up table 3.1 we get k = 1.3

Amine = 41.80 - 1.3. (43 - 40) = 37.90

Comparison of Amine and Amine Values

Notice: amine = 39 > A_{min} = 37.90, so we retain the amine value in the number sequence

Conclusion: The adjusted number sequence is within the allowable limit, we have:
Pi = 9 numbers
Ti = 365 ngmin

Adjustment results after 5 observations of the panel hook to the crane and anchor adjustment:

Pi and Ti value summary table for 5 observations with the panel hook element to the crane:

Observations	Pi (number)	Ti (Minute Person)
1	12	107
2	13	127
3	11	116
4	12	121
5	12	125

Summary table of Pi and Ti values for 5 observations with anchor adjustment element:

Observations	Pi (number)	Ti (Minute Person)
1	11	491
2	13	569
3	13	579
4	12	554
5	9	365

3. Correction for multiple observations

The task of this adjustment step is: to determine the labor waste or waste of computer time for 1 unit of component product after n observations.

- The content of this step is to systematize the documents that have been adjusted at each observation and then apply the formula "average of the harmonizing" to calculate the "normative standards" for each element of the QTSX.
- Calculation of labor waste for 1 unit of elements:

Calculation Formula: Tj = $\frac{n}{\sum_{i=1}^{n}\frac{Pi}{Ti}}$

In which:

- Tj: HPLD uses the average machine after n observations of element j
- Pi: number of products at the first observation after adjustment for each observation
- Ti: total HPLD used at the first observation
- n: number of observations
- J: Element order number during production

3.1. For element: mixing, transferring, spreading mortar

Adjust the data for mixing, transferring, and mortar elements

Observations	Product element (m3)	Time wasted (people minutes)
1	0.8	258
2	1.3	243
3	1.25	271
4	1.24	260
5	1.24	273
Sum	5.83	1305

T1 = $\frac{5}{\frac{0,8}{258}+\frac{1,3}{243}+\frac{1,25}{271}+\frac{1,24}{260}+\frac{1,24}{273}}$ = 223.47 (person.min/m3)

3.2. For element: hook the panel to the crane

Adjust the figures for the panel hook element to the crane

Observations	Element Products (Plates)	Time wasted (people minutes)
1	12	107
2	14	127
3	11	116
4	12	121
5	12	125
Sum	61	596

T2 = = 9.67 (person.min/plate)$\frac{5}{\frac{12}{107}+\frac{14}{127}+\frac{11}{116}+\frac{12}{121}+\frac{12}{125}}$

3.3. For element: adjustable, anchored

Adjusting the figures for the adjustment element, anchoring

Observations	Element Products (Plates)	Time wasted (people minutes)
1	13	491
2	13	569
3	13	579
4	12	554
5	14	365
Sum	65	2558

T3 = $\frac{5}{\frac{13}{491}+\frac{13}{569}+\frac{13}{579}+\frac{12}{554}+\frac{14}{365}}$ = 37.94 (person.min/plate)

3.4 For element: mortar circuit insertion

Adjusting the data for the mortar insertion element

Observations	Product Element (m2)	Waste of time(minutes)
1	84	187
2	73	139
3	84	201
4	80	167
5	67	176
Sum	388	870

T4 = $\frac{5}{\frac{84}{187}+\frac{73}{139}+\frac{84}{201}+\frac{80}{167}+\frac{67}{176}}$ = 2.22 (person.min/m2)

Summary Table:

STT	Element Name	Labor waste	Unit
1	Mixing, transferring, spreading mortar	223,47	People min/m3
2	Panel to the crane	9,76	Man min/sheet
3	Adjustable anchor fastening	37,94	Man min/sheet
4	Mortar vascular insertion	2,22	People/m2

IV. LABOR NORM DESIGN

1. Determination of types of time as a basis for calculation of labor norms.

a. Determination of operating time norm standards (Ttn)

- Working time is the time that the worker directly makes the product and it accounts for a large proportion of 1 shift.

$$\textbf{Ttn} = \sum_{j=1}^{m} \boldsymbol{T_j} \times \boldsymbol{K_j} \text{ (Working Hours / Element Mission)}$$

In which:

m: number of operating elements in the production process

Tj: wasted time of j-element operation

Kj: unit transfer coefficient or structural coefficient of element j

After 5 observations of the process of installing panels with CKY 101 tower cranes, the adjustment results obtained are as follows:

STT	Element Name	Labor waste	Unit

1	Mixing, transferring, spreading mortar	223,47	people/m3
2	Hook the panel to the crane	9,76	Man Minutes/Plate
3	Adjustable anchor fastening	37,94	Man Minutes/Plate
4	Mortar vascular insertion	2,22	people/m2

In all observations, the total results obtained:

- Mixing and transferring mortar: 5.83 m3;
- Hook panel to crane: 61 panels;
- Adjustment, anchoring: 65 plates;
- Mortar insertion: 388 m2.

The unit of calculation of the norm is 1 average panel of all types.

The total number of assembled panels is: 65 (panels)

Since the manufacturing process is *Panel Mounting* , we chose the "Adjust, anchor set" element as the root.

➢ Determine the unit transfer factor:

K1 = $\frac{5,83}{65}$ = 0,09 (m^3 vữa/ tấm panel)

K2 = $\frac{61}{65}$ = 0.94

K3 = $\frac{65}{65}$ = 1

K4 = $\frac{388}{65}$ = 5,97 (m^2 vữa/ tấm panel)

Operating time:

Ttn = 223,47.0,09 + 9,76.0,94 + 36,94.1 + 388.5,97

= 80.39 (persons/panel).

Or Ttn = 1.34 (man-hours/panel).

b. Determination of normative standards for remaining time waste

Observations	Time Benchmark (%)	Time Break (%)	Time Stop construction (%)
1	6,11	6,32	13
2	3,96	6,67	17
3	5,35	4,72	16
4	7,08	6,74	15,5
5	1,04	5,28	
Sum	23,54	29,72	61,50
GTTB	4,71	5,94	15,375

2. Checking the quality of data obtained by the working day photography method (CANLV)

The time of downtime for technology reasons (tngtc) obtained by the CANLV method showed the following results: 13%; 17%; 15,5%; 16%

Procedure for implementation:

The number of required weekday photoshoots is determined by the formula:

$$n = \frac{4\delta^2}{\varepsilon^2} + 3$$

Step 1: Draw 5 graph lines of n according to δ2 or according to the formula corresponding to the value = 1% ; 1.5% ; 2% ; 2.5% and 3% respectively to 1 perpendicular coordinate system with the vertical axis representing δ2 and the horizontal axis representing n.

Step 2 : Perform a minimum number of practical observations (n1; n1min=4 times), determine the coordinates of point A1 (n1; δ2)

- Average value for 4 observations: $\bar{x} = \frac{13 + 17 + 15,5 + 16}{4} = 15.375\%$
- Spreadsheet to calculate variance:

xi	13	17	15,5	16
xi - xtb	-2,375	1,625	0,125	0,625
$(\text{ha-xtb})^2$	5,640	2,640625	0,016	0,391

$$S = = = 2,896\delta^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1} \frac{11,375}{4-1}$$

Thus, the experimental score determined is A_1 (4; 2.896).

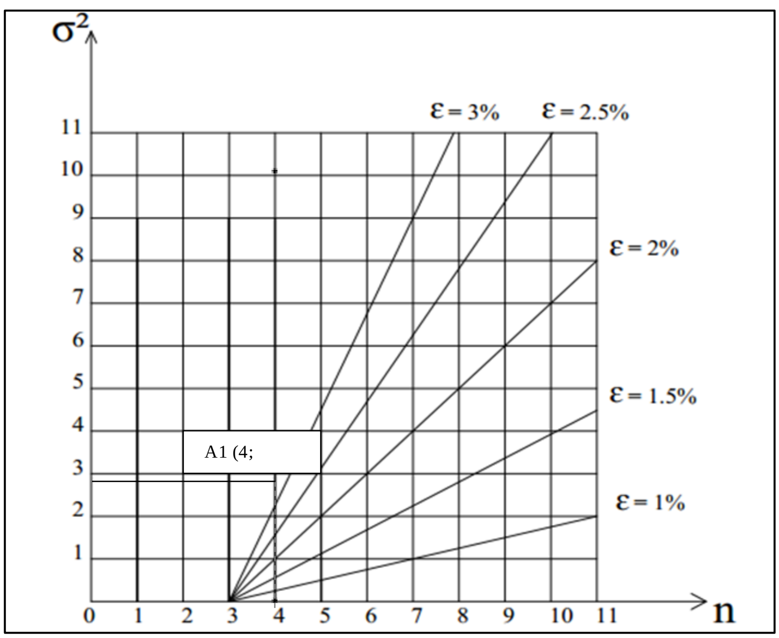
Determine the number of weekday shots needed: $n = \frac{4\delta^2}{\varepsilon^2} + 3$

Where: σ^2: the experimental variance of the observation.

ε : the error between the experimental value xi compared to the mean.

Maximum allowable error: ε = 1% ; 1.5% ; 2% ; 2.5% ; 3%.

- Represent the point A1 (4; 2.896) on the coordinate plane with the following graph lines.



We see that on the graph point A_1 (4; 2.896) is located to the left of the graph line corresponding to the error = 3%, which means that the error of the experimental result is greater than the permissible error value. Therefore, it is necessary to observe an additional number of weekday photo shoots.

Downtime due to technology outages:

tngtc: 13%; 17%; 15,5%; 16% 13,5%

Determine the coordinates of point A2 (n_2; δ2)

$$\bar{x} = \frac{13 + 17 + 15,5 + 16 + 13,5}{5} = 15\%$$

Spreadsheet Making:

xi	13	17	15,5	16	13,5
xi - xtb	-2	2	0,5	1	-1,5
(xi - xtb)^2	4	4	0,25	1	2,25

$$\delta^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1} ==2,875\frac{11,5}{5-1}$$

⇨ Thus, the determined experimental score is A_2 (5; 2,875).

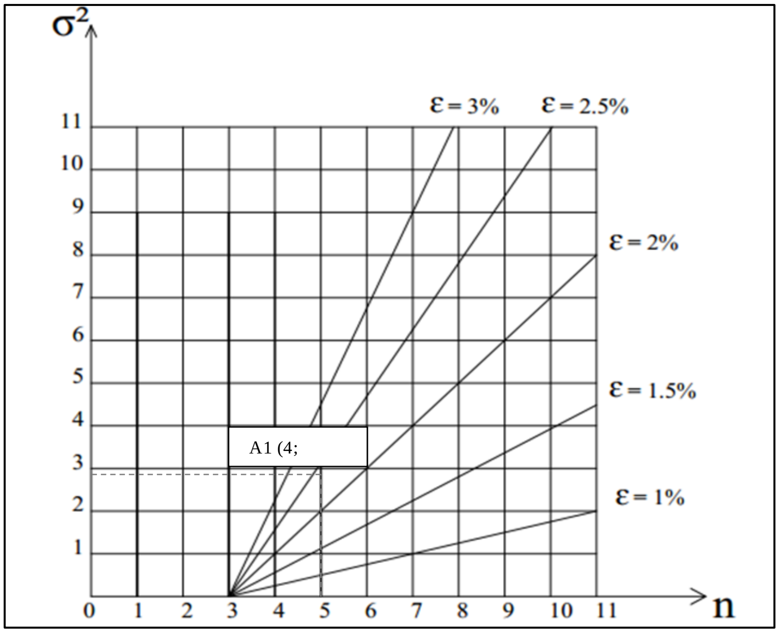
- Determine the number of weekday shots needed: $n = \frac{4\delta^2}{\varepsilon^2} + 3$

In which: σ^2: the experimental variance of observation.

ε: the error between the experimental value x_i compared to the mean.

Maximum allowable error: ε = 1%; 1,5% ; 2% ; 2,5% ; 3%.

- Representing point A(5; 2.875) on the coordinate plane with the following graph lines.



- Comment: Looking at the graph, we see that the point A2 (5; 2.875) is close to the graph line corresponding to the allowable error = 2.5%. This means that the error of the experimental results is less than the permissible limit.

  Therefore, the conclusion :

  - The number of weekday photos taken is sufficient. So n = 5 (times).
  - The error is equal to the allowable error value = 2.5%.
  - The approximate approximation of the quantity x is: x = x_{tb} ±0.025.xtb,

    i.e. x = 15%*(10,025)±

  - The average downtime ranges from (14.625%; 15.375%)
  - The average construction stop time used as a basis for calculating labor norms for construction work is t_{ngtc} = 15%.
  - Average benchmark time is: 4.47%
  - Average recess time was: 5.94%

3. Standard condition design.

- Standard conditions are relatively standard regulations to well implement the norms set up in accordance with the stated methodology.

- What are the production conditions, there must be corresponding norms; When working conditions change, the norm value also changes.

a. Standard conditions of panel mounting process by CKY101 tower crane.

- Weather conditions: 22oC - 23oC; There is light rain.
- Production organization: Choose CKY 101 tower crane with 3-10T lifting capacity: reach 13-30m; lifting height 20.8m. The panel is stacked against a specialized rack, arranged within the working range of the crane. Cars transport components from the place of manufacture to the building.
- Tools: masonry, flying, crowbar, stiffener.
- Arrangement of worker teams:
  - Put forward 2 options for team payroll (the actual payroll is 1 option). Based on the work rank of each element to choose the level of work, based on the waste of time on the element wall to select the number of people to perform. The division of labor is relatively uniform for each person, each level of worker, taking advantage of the working time of high-level workers.
  - Compare 2 options for staffing workers and choose the best option that satisfies the conditions:

- There is a smaller local stop than the other option (higher employer).
- If the payroll of many high-level workers is organized to have a higher employer, more salaries must be spent, so the following conditions must be ensured: Employer growth rate > Salary growth rate.

b. Design of team components

Payroll plan for the workers' team:

Option I: Payroll of 6 workers, including: 1 worker at level 2, 2 workers at level 3, 3 workers at level 4.

Option II: Payroll of 6 workers, including: 2 level 2 workers, 1 level 3 worker, 3 level 4 workers

Applying the formula for calculating the average worker rank:

$$C_{bq} = \frac{\sum_{i=1}^{n} C_i.n_i}{\sum_{i=1}^{n} n_i}$$

In which:
Cbq: the average worker rank of the team.
Ci: the ith rank of the worker.
Ni: the first number of workers in the team.

Ttn= 80.39 (people/panel).
We have the labor waste calculated for 1 panel as follows:
- Mixing transfer of grouting = T1 x K1 = 223.47 x 0.09 = 20.04 persons.min
- Hook the panel to the crane = T2 x K2 = 9.76 x 0.94 = 9.16 people.min
- Adjusting, anchoring = T3 x K3 = 37.94 x 1 = 37.94 people.min
- Mortar infusion = T4 x K4 = 2.22 x 5.97 = 13.25 persons.min

We rely on the photo board combined with 5 observations to make a design plan for the composition of the workers' group as follows:

TT	**Operation element name**	**Occupational labor union calculated for 1 tấm panel**		**Ranks business**	**Option 1**			**Option 2**		
					Tier 2	**Tier 3**	**Tier 4**	**Tier 2**	**Tier 3**	**Tier 4**
		e-ph	**%**		**1**	**2**	**3**	**2**	**1**	**3**
1	Mixing, transferring, spreading mortar	20,04	24,93	2 – 3	-	20,04	-	16	4,06	-
2	Hook the panel to the crane	9,16	11,39	2 – 4	9,16	-	-	5	4,16	1
3	Adjustable, anchored	37,94	47,19	4	-	-	37,94	-	-	37,94
4	Mortar vascular insertion	13,25	16,49	2 – 3	4,25	9	-	6,25	7	-
Total		**80,39**	100		13,41	29,04	37,94	27,25	15,22	37,94
Average labor cost for 1 worker					**13,41**	**14,52**	**12,64**	**13,625**	**15,22**	**12,64**

Comment on the selection of the team plan.

- *Option 1:* Payroll of 6 workers including 1 worker of level 2, 2 workers of level 3, 3 workers of level 4.
  - Average worker rank:

$$Cbq = \quad = \quad = 3{,}33/7\frac{\sum_{i=1}^{n} n_i * C_i}{\sum_{i=1}^{n} n_i}\frac{1*2+2*3+3*4}{1+2+3}$$

- Partial work stoppage due to the manipulation of at least 12.64 people.min (level 4) compared to the most people in the group 14.52 people.min (level 3 workers) $\frac{14{,}52 - 12{,}64}{14{,}52}$.100% = 12.95%
- Partial work stoppage between level 2 workers (1 person) compared to the most workers at level 3

$$\frac{14{,}52 - 13{,}41}{14{,}52}.100\% = 7.64\%$$

⇨ The total number of local work stoppages of option 1 is: 3 x 12.95% + 1 x 7.64% = 46.49%

- *Option 2:* Payroll of 6 workers including 2 level 2 workers, 1 level 3 worker, 3 level 4 workers.
  - Average worker rank:

$$\text{Cbq} = = = 3.17/7 \frac{\sum_{i=1}^{n} n_i * C_i}{\sum_{i=1}^{n} n_i} \frac{2*2 + 1*3 + 3*4}{2+ 1 + 3}$$

  - The local work stoppage due to the manipulation of at least 12.64 people.min (level 4) compared to the most people in the group of 15.22 people.min (level 3 workers) are: $\frac{15{,}22 - 12{,}64}{15{,}22}$.100% = 16.95%
  - Partial work stoppage between level 2 workers (2 people) compared to the person who does the most in the group is level 3 (1 person).

$$.100\% = 11.7\% \frac{15{,}22 - 14}{15{,}22}$$

⇨ The total number of partial work stoppages of option 2 is: 3 x 16.95% + 1 x 11.7% = 78.1%

Observe:

- Option 2 has a greater local work stop than option 1, that is, option 1 has higher labor productivity than option 2.
- Option 1 has a higher average worker rank than option 2, that is, it has to pay higher wages than option 2.

=> Therefore, it is necessary to compare the remuneration of the 2 options.

- Calculation of remuneration of 2 options:

From the average worker rank (Cbq) of the plan to calculate the average rank coefficient (Kcb) of the options. The coefficient of worker ranks is specified in Appendix 4, Circular 13/2021/TT-BXD on Guidelines for determining unit prices for construction workers. The average worker rank is 3.5/7, the rules of the corresponding rank coefficient:

$$Hcb = 1.39 + \frac{1,65 - 1,39}{4 - 3} . (3.5-3) = 1.52$$

Option 1: Cbq1 = 3.33/7 => $H_{cb1} = 1.39 + \frac{1,65 - 1,39}{4 - 3} . (3.33 - 3) = 1.48$

Option 2: Cbq2 = 3.17/7 => $H_{cb2} = 1.39 + \frac{1,65 - 1,39}{4 - 3} . (3.17 - 3) = 1.43$

PHỤ LỤC:

BẢNG GIÁ NHÂN CÔNG XÂY DỰNGTHÀNH PHỐ HÀ NỘI

(Kèm theo Quyết định số 1265/QĐ-SXD ngày 21/12/2021

của Sở Xây dựng Hà Nội)

Đơn vị: Đồng/ ngày

STT	Nhóm	Đơn giá nhân công xây dựng bình quân theo khu vực (đ/ngc)		
		Vùng I		Vùng II
		Khu vực I	Khu vực II	
		Quận: Hoàn Kiếm, Ba Đình, Đống Đa, Hai Bà Trưng, Bắc Từ Liêm, Nam Từ Liêm, Cầu Giấy, Hoàng Mai, Thanh Xuân, Long Biên, Tây Hồ, Hà Đông; Huyện: Thanh Trì, Gia Lâm	Huyện: Chương Mỹ, Thường Tín, Đông Anh, Sóc Sơn, Thanh Oai, Hoài Đức Quốc Oai, Thạch Thất, Mê Linh, thị xã Sơn Tây	Huyện: Đan Phượng, Phú Xuyên, Phúc Thọ, Ứng Hòa, Mỹ Đức, Ba Vì
A	**Danh mục nhóm nhân công xây dựng**			
I	**Nhóm nhân công xây dựng**			
1	Nhóm 1	241.510	219.165	210.206
2	Nhóm 2	243.318	221.114	211.276
3	Nhóm 3	244.279	221.784	216.538
4	Nhóm 4	251.777	227.652	217.544
II	**Kỹ sư** (Kỹ sư khảo sát, thí nghiệm)	350.000	350.000	325.000
III	**Nghệ nhân**	590.000	590.000	540.000
IV	**Vận hành tàu, thuyền** (Thuyền trưởng, thuyền phó, thủ thủ, thợ máy, thợ điện, kỹ thuật viên)	348.000	348.000	319.000
V	**Thợ lặn**	620.000	620.000	570.000

The average wage of workers corresponding to the 3.5/7 rank in Thach That district, Hanoi according to Decision 820/QD-UBND on the announcement of construction labor prices in Hanoi city is:

$$TC3.5/7 = \frac{4\ 657\ 625 + 5\ 842\ 003 + 7\ 333\ 945}{3} = 5\ 944\ 524 (VND/month)$$

The average wages of workers corresponding to rank 3.5/7 in Thach That district, Hanoi according to Decision 1265/QD-SXD on announcing construction labor prices in Hanoi city are:

TC3.5/7 = 221 114(VND/day)

Wages of workers installing panels option 1:

TC1 = = 5 788 089 (VND/month)$\frac{5\ 944\ 524 * 1{,}48}{1{,}52}$

Wages of workers installing panels in option 2:

TC2 = = 5 592 546 (VND/month)$\frac{5\ 944\ 524 * 1{,}43}{1{,}52}$

The rate of increase in labor productivity and the rate of increase in wages of PA1 compared to PA2:
Employer growth rate:

=: = 1,216$\frac{NS_1}{NS_2}\frac{1}{1 + 0{,}4649}\ \frac{1}{1 + 0{,}781}$

Average wage growth rate:

==1,035$\frac{TC_1}{TC_2}\ \frac{5\ 788\ 089}{5\ 592\ 546}$

It is found that the rate of increase in employers of option 1 compared to option 2 is greater than the rate of increase in wages of option 1 compared to option 2. Thus, option 1 is chosen as the payroll plan for the workers' team.

So choose option 2

4. Calculation of labor norms.

- Operating time: Ttn = 1.34 (working hours/panel)
- Standard time, construction stop time, average break time:

tck = 4.7% ; t_{nggl} = 5.94% ; tngtc = 15.375%.

Realizing that tngtc = 15.375% > 10% of working shifts and = 5.94% < 6.25%, it is necessary to take advantage of a part of the construction stop time for workers to take breaks.t_{nggl}^{mib}

Select ==6.25%.$t_{nggl}^{min} t_{nggl}^{tt}$

Calculate the tax rate according to the formula, $t_{ngtc}^{tt} = \frac{T_{ngtc}}{T_{tn} + T_{ngtc}}\left[100 - \left(t_{ck} + t_{nggl}^{min}\right)\right]$

With Tngtc = = $\frac{T_{tn} \cdot t_{ngtc}}{100 - (t_{ck} + t_{nggl} + t_{ngtc})}\ \frac{1{,}34 * 15}{100 - (4{,}7 + 6{,}25 + 15)}$ = 0.27 (man-hours/panel)

t_{ngtc}^{tt}= . [100 - (4.7 + 6.25)] = 15%$\frac{0{,}27}{1{,}34 + 0{,}27}$

Labor = = = 1.81 (working hours/panel)$\frac{T_{tn} * 100}{100 - (t_{ck} + t_{nggl}^{tt} + t_{ngtc}^{tt})}\ \frac{1{,}34 * 100}{100 - (4{,}7 + 6{,}25 + 15)}$

Check:

tnggl + tngtc = 5.94% + 15% = 21.315%

The total break time of workers and the time of construction stoppage after calculation

The math is:
t_{ngtc}^{tt} + = 15% + 6.25% = 21.25%t_{nggl}^{tt}
⇨ (t_{nggl} + t_{ngtc}) - (t^{ttngtc} + t^{ttnggl}) = 21.315% - 21.25% = 0.065%
So the construction stop time is taken advantage of will contribute to increasing labor productivity.

5. Determination of labor unit cost for the production of a unit of product

The average working day unit price corresponds to the worker rank of 3.5/7 in Thach That area

GNC = 221 114 (VND/working day)

Worker rank 3.17/7, we have Hcb = 1.48

Worker rank 3.5/7, interpolation we have HCB = 1.39 +. (3.5 - 3) = 1.52$\frac{1,65-1,39}{4-3}$

The unit price of working days of panel production workers is:

GNC = = $\frac{221\ 114*1,48}{1,52}$215.295,21 (VND/working day)

The unit price of labor of construction workers in Thach That district, Hanoi to produce 1 panel is:

Electricity = = = = 48 710.54 (VND/panel)$\frac{ĐM_{lđ}*G_{NC}}{8}$ $\frac{1,81*215.295,2}{8}$

V. PRESENTED IN A TABLE OF NORMS.

1. Job composition

- Panel mounting with CKY101 tower crane
  - Mix the transfer and spread the mortar.
  - Install the panel on the crane.
  - Adjust the anchor.
  - Plug the mortar pulse.

2. Composition of workers and salaries and wages

- Composition of workers:
  - Tier 2 worker: 2 people
  - Tier 3 worker: 1 person
  - Tier 4 worker: 3 people

Average worker rank

Cbq = 3.17/7

- Unit price of working days:

GNC = 215.097,91 (VND/working day)

- Labor unit price:

Electricity = 5 0.279.13 (VND/panel)

3. Normative Units of Calculation

Calculate the labor norm for assembling 1 panel.

4. Norm Value Table

Unit: 1 panel

Code	Work	Wasted ingredients	Unit	Values	Notes
(1)	(2)	(3)	(4)	(5)	(6)

AG.41511	Assembling Panel Dimensions 3.2x0.25x0.5 (m) Weight: 0.42 T	Labor 3.17/7	Office Hours	1,81	DLD
			Copper	50 367,51	Alumni