EUROPEAN COAL AND STEEL COMMUNITY

Community Ergonomic Research

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Technical Report n° 9

L I G H T E N I N G O F T A S K S

OF AUXILIARY HAULAGE UNDERGROUND

(EMMA/HENDRIK DSM MINE)

Source : Ergonomic team of the Netherlands coal mining industry
Project n° 5

Authors : L. RUWETTE, J.A. KOENE

Reference period : 1.12.1968 - 31.12.1970

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Financial assistance was provided for this study by the European Coal and Steel Community

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CONTENTS

Introduction

Successive pit closures led to a rapid rise in the average age of miners. It therefore became necessary to adapt workplaces to the diminished aptitude of older or relatively unfit miners.

Suitable workplaces had to be made available quickly.

A systematic study was made of workplaces in the supply gates to the various face sections. This study highlighted difficulties in the existing workplace layouts and also provided basic information for plans that led to improvements.

The method of describing workplaces is discussed in the report. Examples are given of workplace layouts adapted to the potential of older or relatively unfit miners.

CHAPTER I

The problem

The first Mines Report entitled "Memorandum on the mining industry and the industrial restructuring of Limburg" was published at the end of 1965.

Far-reaching changes in the utilization of different energy sources had made it necessary to close the South Limburg pits.

Alternative employment opportunities were the guiding factor in the official pit closure policy and determined the shape of the systematic policy for the reduction of the labour force.

This policy was based on tide-over measures for workers who still had five years to serve before their retirement in 1974-1975, while efforts were made to retain younger workers who were not likely to experience difficulty in adjusting to new jobs. For workers who were not eligible for tide-over arrangements pending retirement following pit closures, this policy amounted in fact to a selective redundancy scheme.

Fig. I-1 is a graph showing the reduction in the underground labour force of the DSM.

This clearly reflects implementation of the personnel reduction policy. It also shows the rapid rise in the age of workers.

This trend meant that the mine management was increasingly faced with the problem of employing persons who because of their greater age or accidents or illness could no longer perform the work they had previously done, generally at the face.

Special assistance for persons whose aptitudes have diminished or altered has been a problem for many years in the mines.

Some measures to overcome this situation have affected working conditions in general, while others have been tailor-made for individual cases by changing the nature of the duties performed to compensate for miners' diminished aptitudes.

Many factors may contribute to the need for miners to change to different work.

Individuals may experience difficulties because of a lessening of their powers of endurance. They will be unable to perform their work if it requires considerable effort even over a short period. Activities that have to be performed without interruption over longer periods are altogether beyond their capacity.

Their resistance to environmental influences such as high temperatures and humidity is reduced.

They will probably also be unable to perform any job that makes fairly heavy demands on the sense organs.

Sometimes intense concentration on a particular task becomes impossible for them.

Changes in postural and motor systems often cause many difficulties. They make it impossible to maintain an unnatural working posture or to work bending down, kneeling or crouching.

An attempt is generally made to overcome the snags arising from diminished aptitude by giving the personnel concerned new jobs to perform.

REDUCTION IN DSM UNDERGROUND LABOUR FORCE
BETWEEN 31-12-65 and 30-6-70, by category

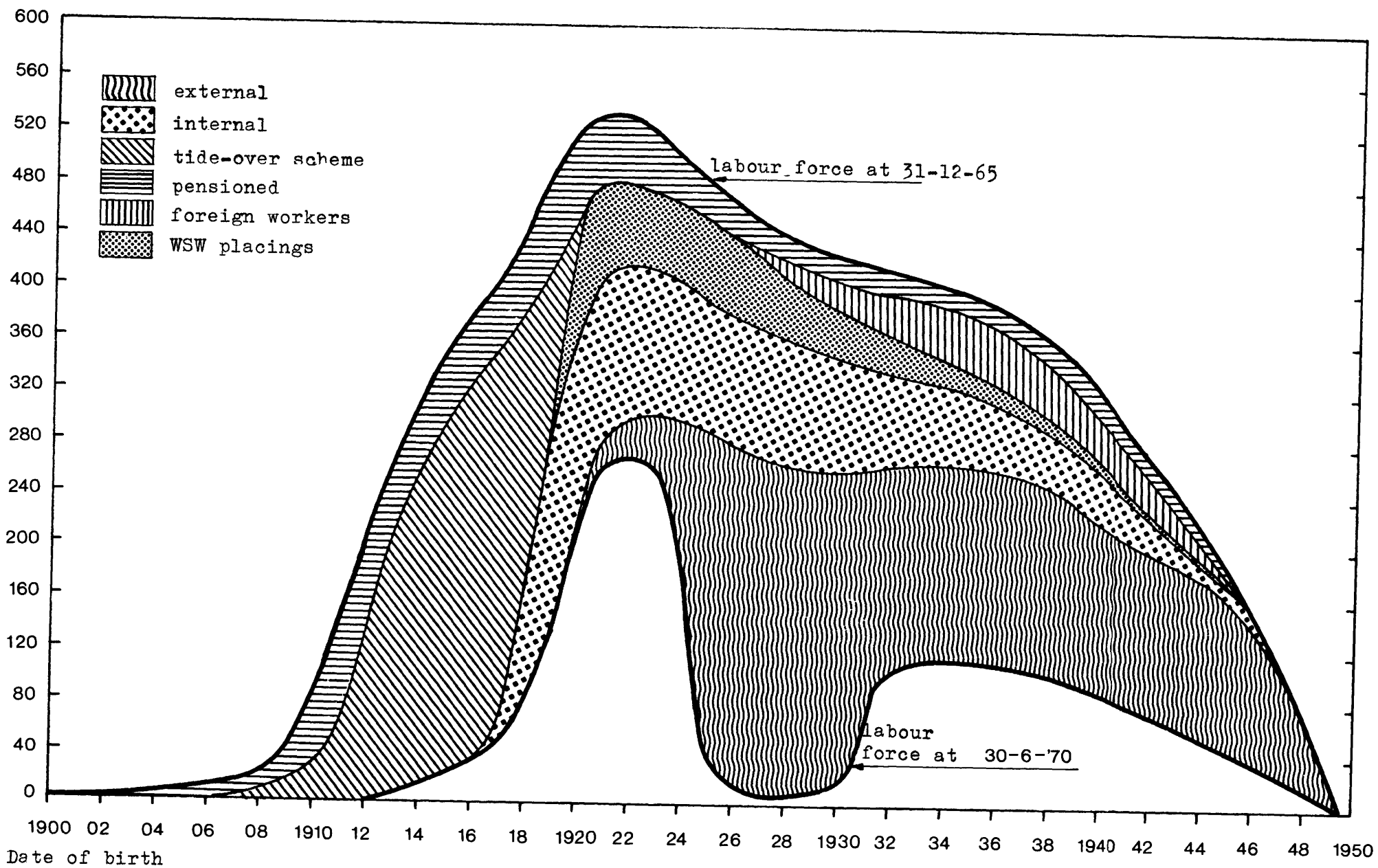

Fig. I-1: Reduction in DSM underground labour force

Generally accepted concepts of the stress caused by work performed underground were decisive in assigning new jobs to miners.

The rapid rise in average age during the pit closure programme was obviously likely to make the problem of employing persons of relatively advanced age or limited aptitude even more acute. Not only was it necessary to provide sufficient jobs for persons of diminished potential; performance of essential tasks by persons of above average age or below average potential was also bound to be particularly difficult.

Adaptation of workplaces to the aptitudes of such workers necessarily led to a broader range of available jobs, certain tasks being reserved for miners in this special category.

At the request of the management of the Emma/Hendrik pit, the ergonomics research team studied the adaptation of workplaces in the auxiliary underground haulage sector of that mine.

CHAPTER II

Reassignment to auxiliary haulage duties

1. General

Some of the older miners or miners no longer able to perform their previous activities because of illness or accident have been assigned to auxiliary haulage operations.

Auxiliary haulage includes all transport operations other than main road haulage with mine cars. The carriage of materials to a large number of workplaces throughout the mine is a particularly important form of auxiliary haulage.

In general the activities at these points were adapted to take account of the limited potential of older miners or those of diminished aptitude.

Ventilation in the supply gates, in which material is transported, is generally satisfactory because of the air drawn in through the downcast shaft.

Dust concentration is also low.

Moreover, work in haulage roads of this kind makes fewer demands on the postural and motor system because of the greater freedom of movement enjoyed by comparison with work at the face.

Finally, auxiliary haulage does not form part of the direct production activities: this supports the general assumption that work of this kind can be performed by persons of diminished potential.

The specific tasks of persons employed in the materials haulage sector can be described concisely.

Materials for the face arrives by tub at points in the cross cuts from which the haulage roads run to the faces. Belt conveyors are installed in the haulage roads. At loading points in the cross cuts material must be transferred from the tubs to the belt conveyor. Depending on the exact position of the face, material must be carried to it on several conveyors in succession. These may meet at an angle, at which point the material must be removed from one conveyor and placed or pushed onto the next.

Fig. II-1 shows a typical materials haulage road. There are a number of angles on the route from the cross-cut to the face. The workplaces in the auxiliary haulage sector, i.e. loading points and conveyor junctions, are manned by older or relatively unfit miners. They were offered a chance to work here in familiar surroundings when they became unfit to work at the face.

It is worth noting that the haulage roads are also fitted with monorail and towed tub installations to carry heavy material or items of equipment not transportable by conveyor.

Finally, workers employed on materials haulage are also responsible for controlling the conveyors.

2. Views on the difficulty of auxiliary haulage work

It was generally felt that workplaces in auxiliary haulage could be manned by older or relatively unfit miners. Whenever complaints were voiced, an attempt was made to find a solution through direct contact with the person concerned. Discussions between members of the personnel department and supervisory staff played an important part in overcoming difficulties. To evaluate workplaces in this sector, it was important to know the views of these members of the staff on each workplace.

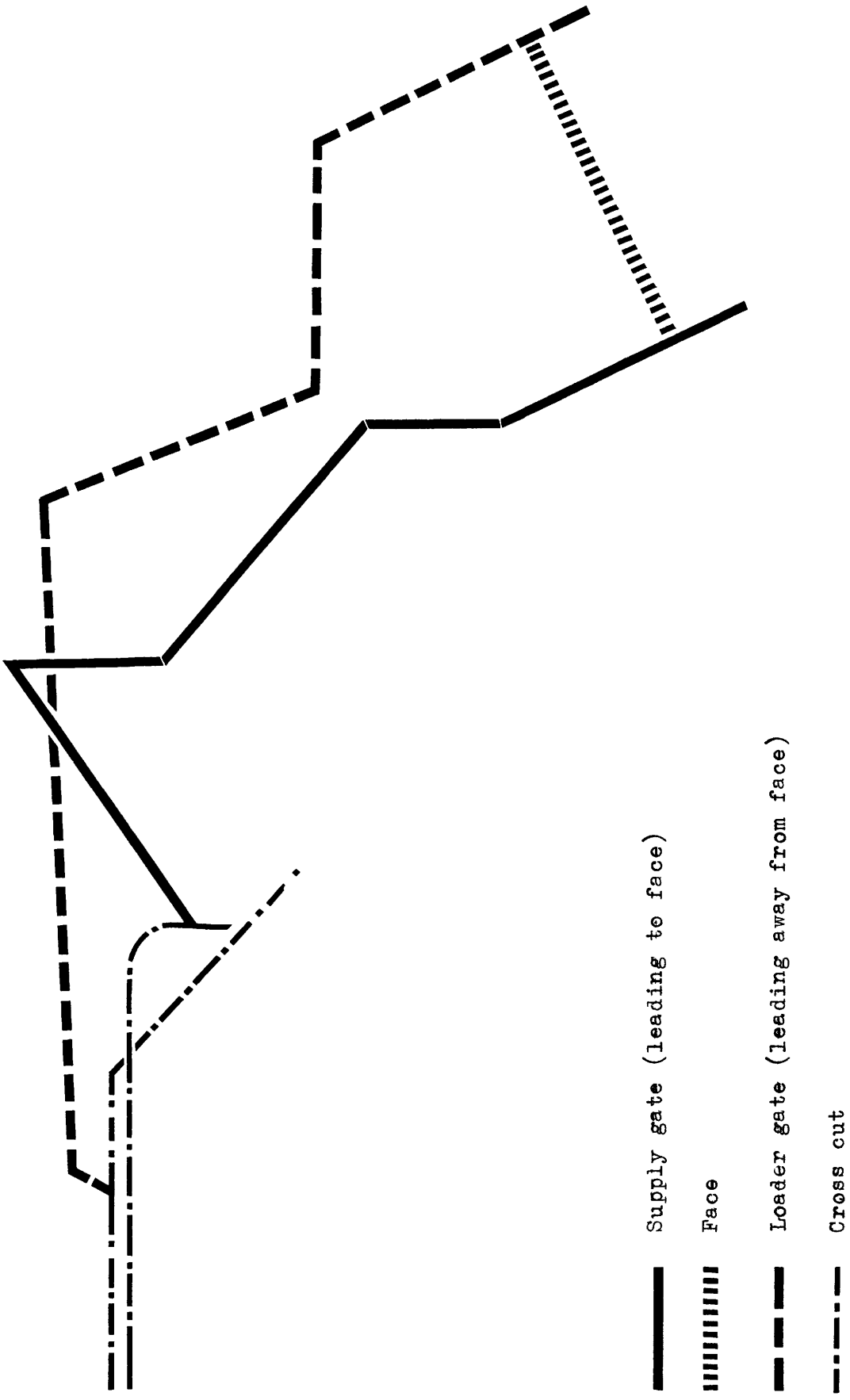

Fig. II-1: Example of a materials haulage road

They were asked to grade auxiliary haulage activities into heavy, fairly heavy and light work. These activities involved:

1. Operation of haulage equipment in supply and loader gates.
2. Activities at face loading points.
3. Clearing loader gates with chain conveyors.
4. Haulage of materials in supply and loader gates.

Table II-1 shows how the difficulty of the work was evaluated by supervisory staff and members of the personnel department.

Job description	Number of workplaces	Opinion as to difficulty of work					
		Supervisory staff			Personnel department		
		heavy	fairly heavy	light	heavy	fairly heavy	light
1. Operation of:							
Monorail	5	5				5	
Supply gate conveyors	5			5			5
Loader gate conveyors	59	2	19	38			59
2. Loading:							
Loading coal	26		26			26	
Help in loading	2		2				2
Loading dirt	19	1	3	15			19
3. Clearing loader gates with chain conveyors	33		11	22			33
4. Carriage of material in supply and loader gates	105	79	26			105	
Total	254	87	87	80		136	118

Table II-1: Evaluation of difficulty of work by supervisory staff and mambers of personnel department

This evaluation of the difficulty of particular activities revealed a difference of opinion between the persons actually responsible for the performance of the work and those responsible for allocating jobs. This was easy to understand: in evaluating activities, the supervisory staff were directly aware of the actual situation in their departments while the members of the personnel department based the allocation of jobs underground on general concepts relating to the workload of underground activities.

It may also be assumed that supervisory staff would prefer to have completely fit workers at their disposal and might therefore exaggerate slightly in assessing job requirements. Conversely, job requirements at less critical points may be underestimated.

3. Opinion survey to determine job stress

The results of the evaluation of job stress by supervisory staff and members of the personnel department led on to a more systematic study of subjective impressions of the difficulty of particular jobs.

An opinion survey was carried out among a group of supervisory officials and a group of workers engaged in laterials haulage to dtermine job stress.

This questionnaire was in two parts. In the first part, interviewees were asked to state their opinion on the difficulty of jobs on a scale ranging from "hard" to "light". They were asked not only for their general impression of the work but also for their views on a number of individual operations and working postures.

In the second part of the questionnaire, the method of comparison by pairs was adopted. In addition to haulage activities, coal face and operating duties were also included.

Figs II-1 to II-10 show the opinions of supervisory staff and workers in the materials haulage sector - designated non-supervisory - classified according to the same scale.

Fig. II-11 shows the result of a comparison by pairs of job stress for a number of underground activities.

This comparison enabled these underground activities to be classified on a job stress scale.

Activities were shown on a scale of five levels ranging from "heavy" to "light". Surprisingly enough, the two extremes, i.e. "heavy" and "light", were not encountered. This may be due to the inclusion of different opinions regarding the job stress associated with the various activities on a single scale, so that heavy and light work tended to merge.

This suggests overestimation of heavy and an underestimation of light activities.

It follows that evaluation of the difficulty of jobs on the basis of generally accepted concepts must be treated with caution. The differences in opinion are too wide and concepts such as "heavy", "fairly heavy" and "light" work are not clear enough.

Job stress in materials haulage

Supervisory staff

N = 31

A. Supply gate loading point (tub - belt conveyor)

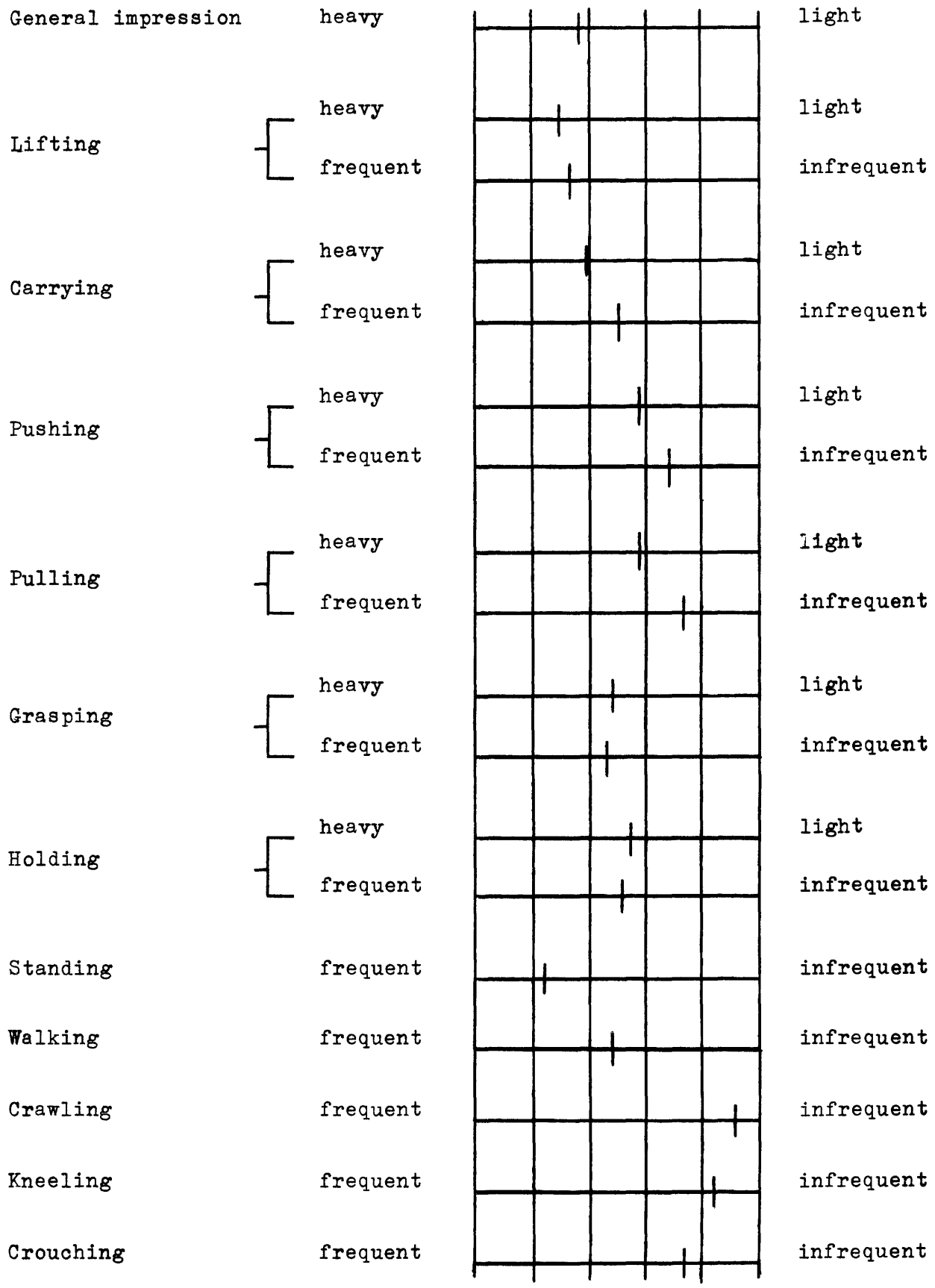

Fig. II-1: Opinion of supervisory staff on job stress in the materials haulage sector

Job stress in materials haulage

Supervisory staff

N = 31

B. Supply gate loading point (tub - monorail)

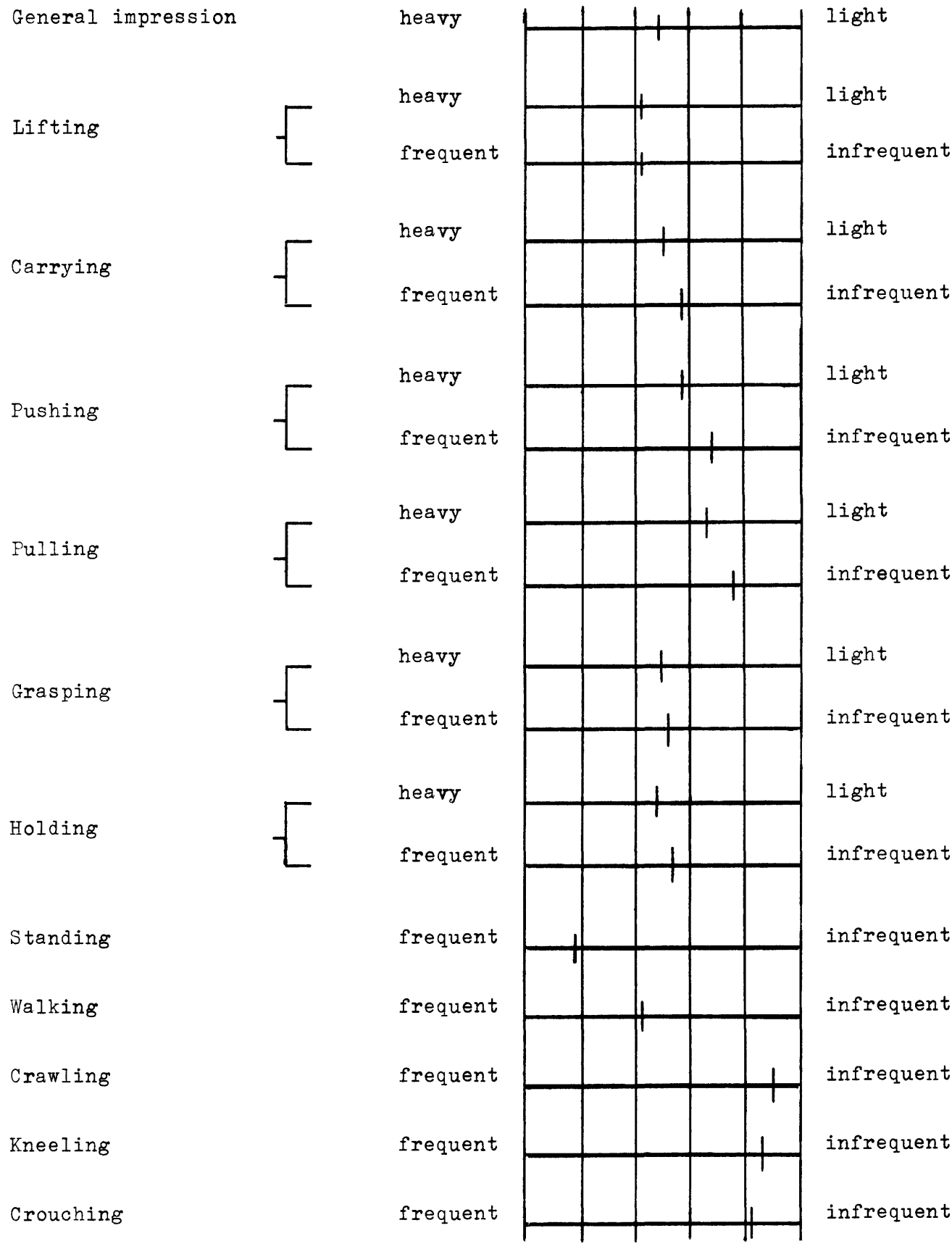

Fig. II-2: Opinion of supervisory staff on job stress in the materials haulage sector

Job stress in materials haulage

Supervisory staff

N = 31

C. Conveyor junction

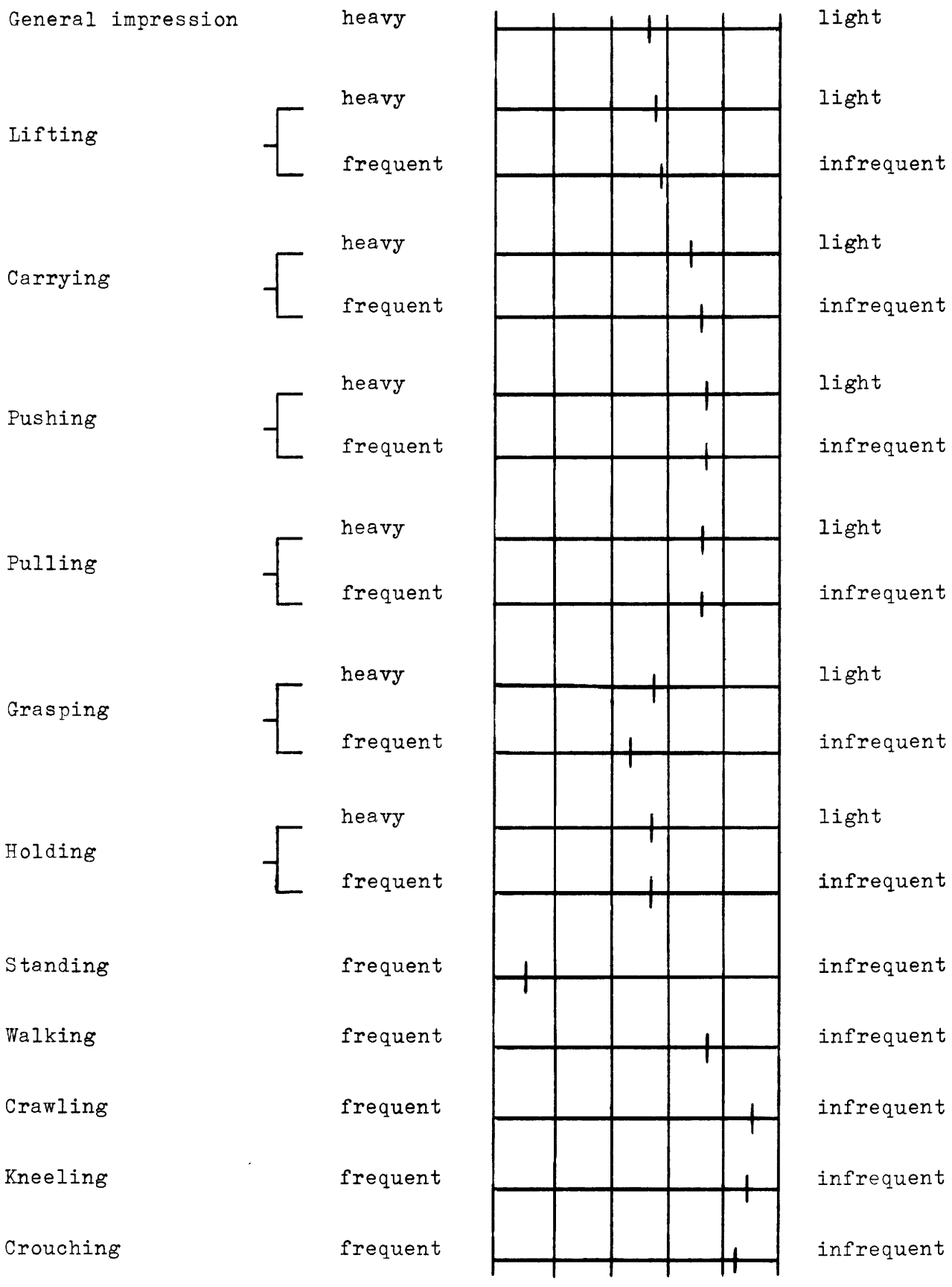

Fig. II-3: Opinion of supervisory staff on job stress in the materials haulage sector

Job stress in materials haulage

Supervisory staff

N = 31

D. Removing materials from conveyor and stacking

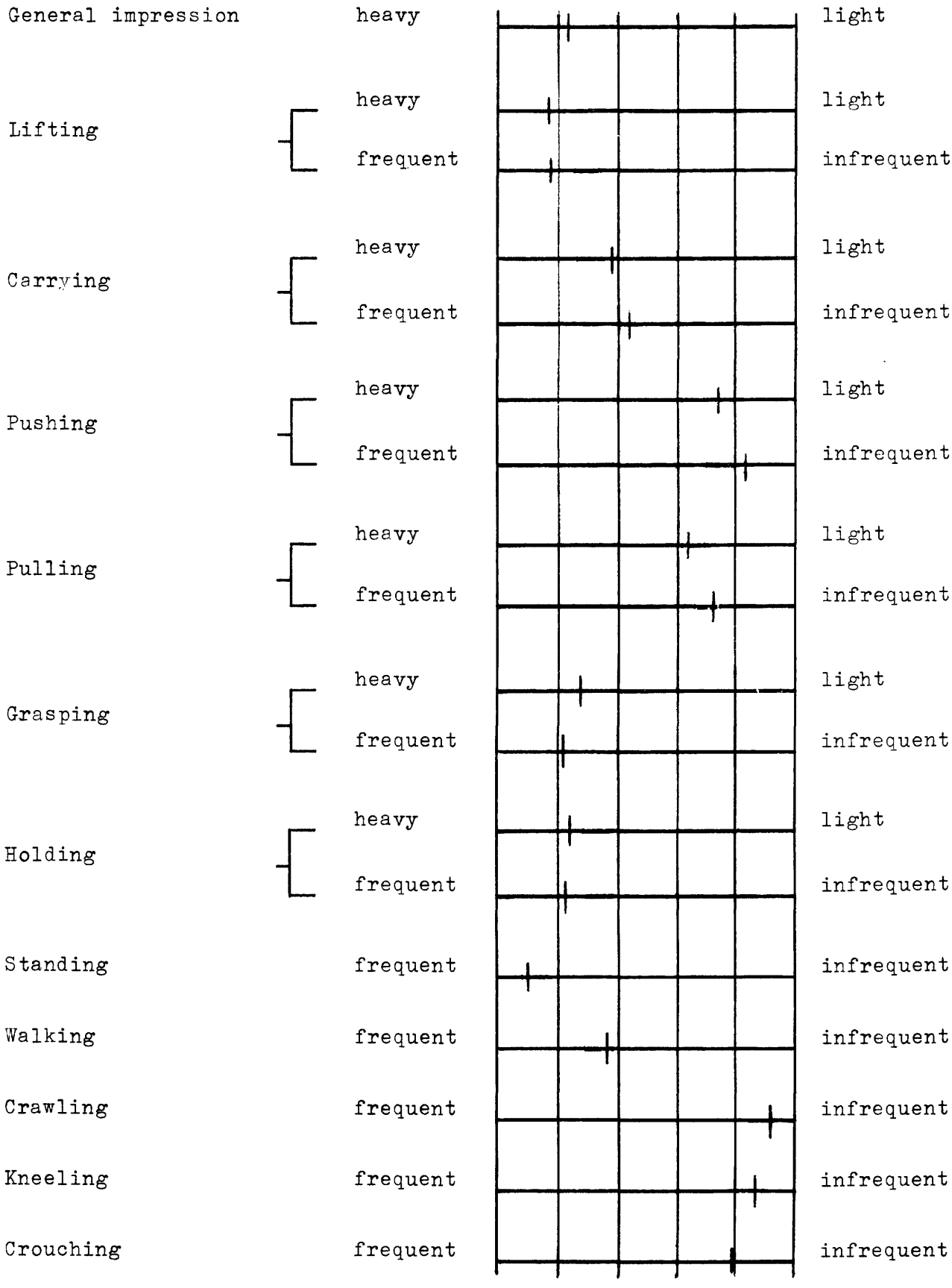

Fig. II-4: Opinion of supervisory staff on job stress in the materials haulage sector

Job stress in materials haulage

Supervisory staff

N = 31

E. Monorail
Removing materials from container and stacking

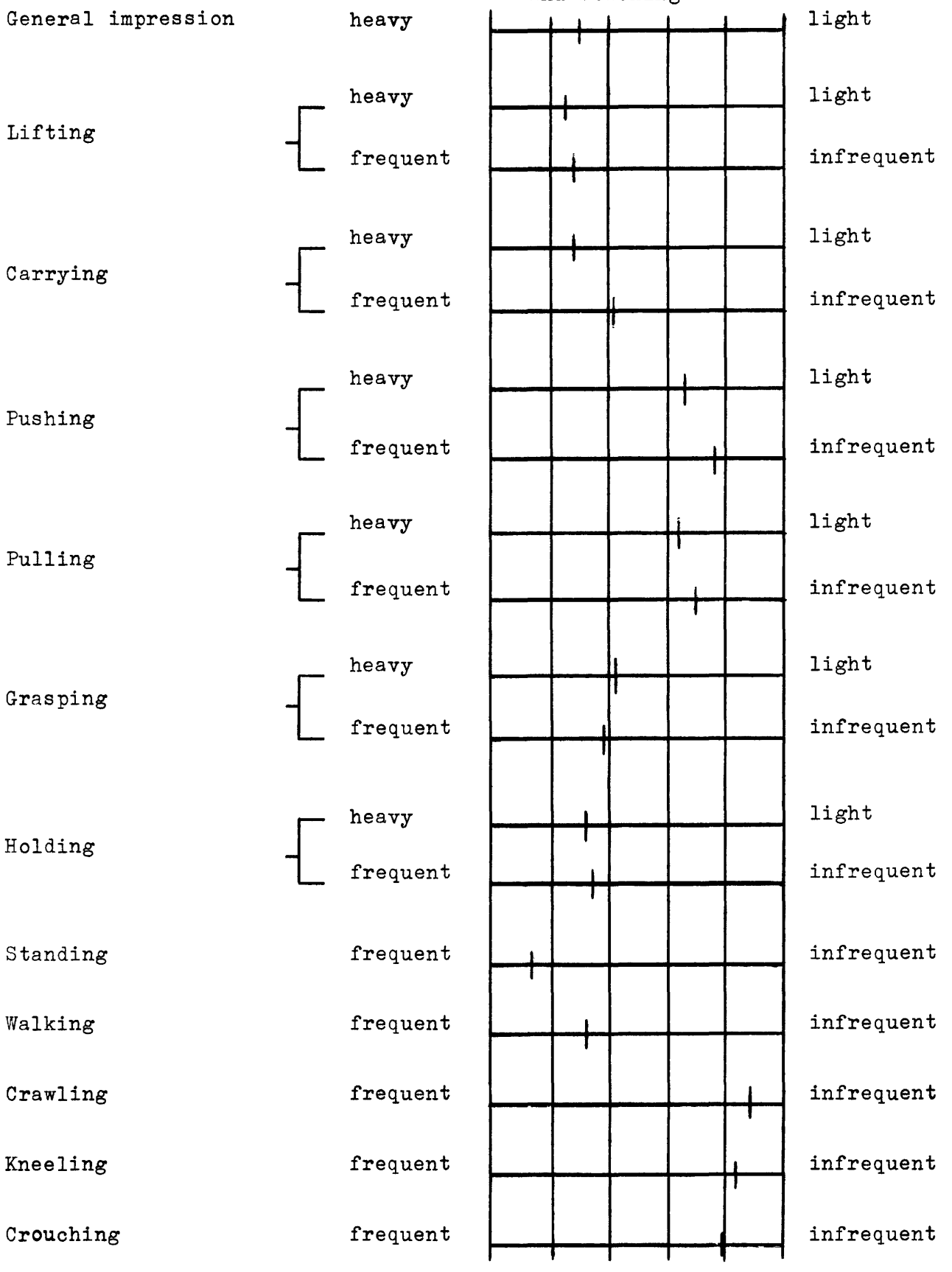

Fig. II-5: Opinion of supervisory staff on job stress in the materials haulage sector

Job stress in materials haulage

Non-supervisory personnel

N = 31

A. Supply gate loading point (tub - belt conveyor)

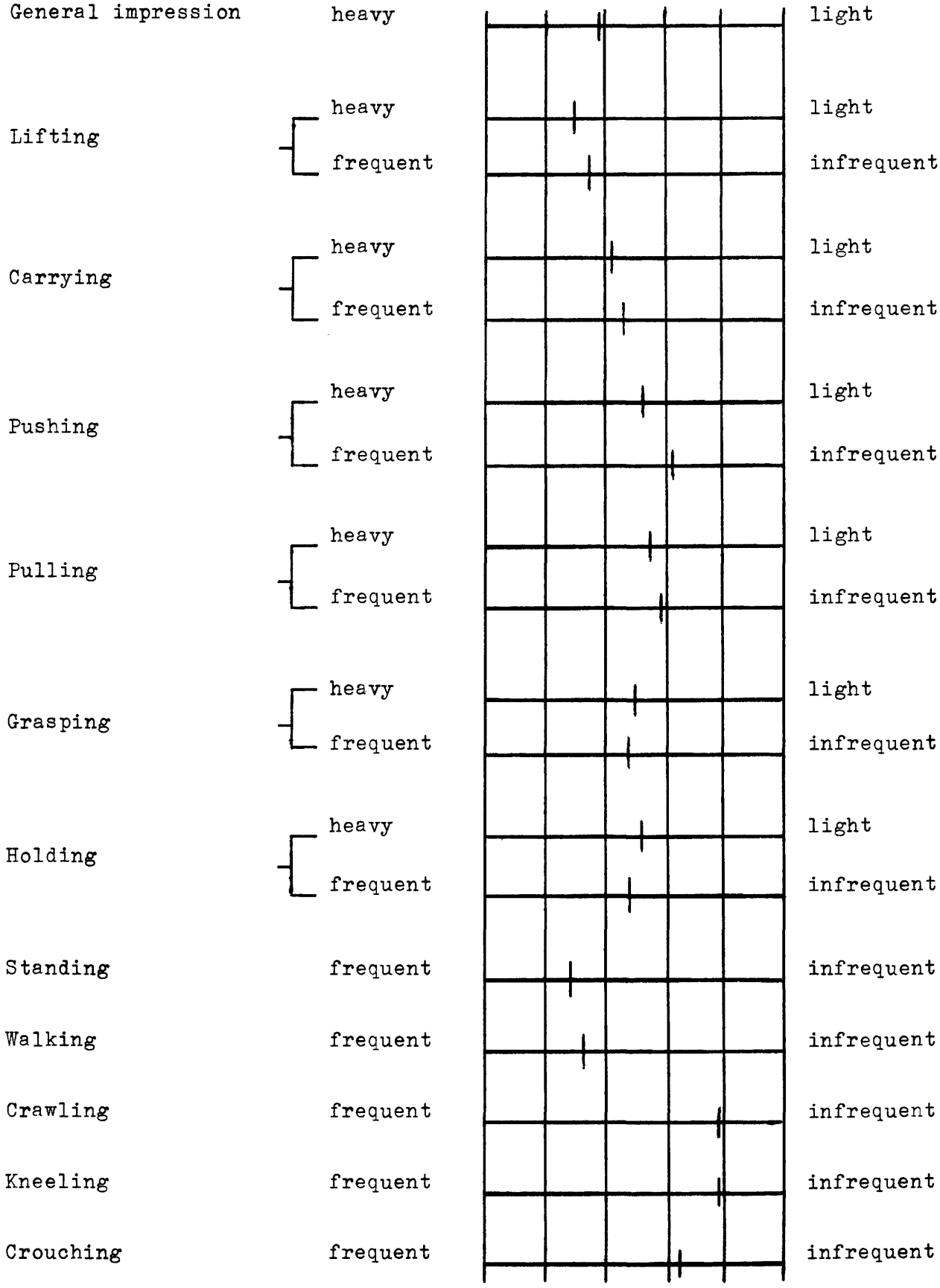

Fig. II-6: Opinion of workers on job stress in the materials haulage sector

Job stress in materials haulage

Non-supervisory personnel

N = 31

B. Supply gate loading point (tub - monorail)

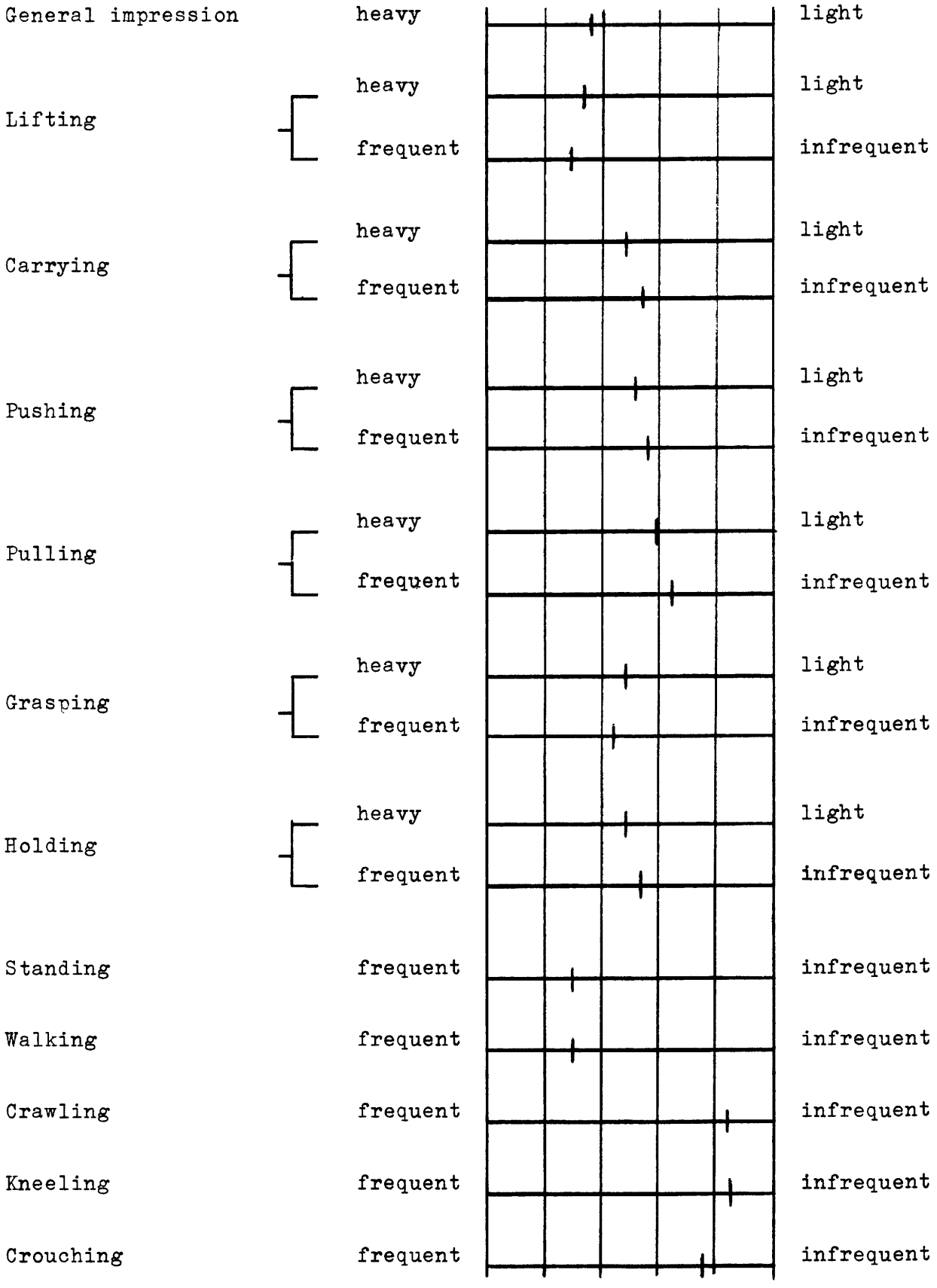

Fig. II-7: Opinion of workers on job stress in the materials haulage sector

Job stress in materials haulage

Non-supervisory personnel

N = 31

C. Conveyor junction

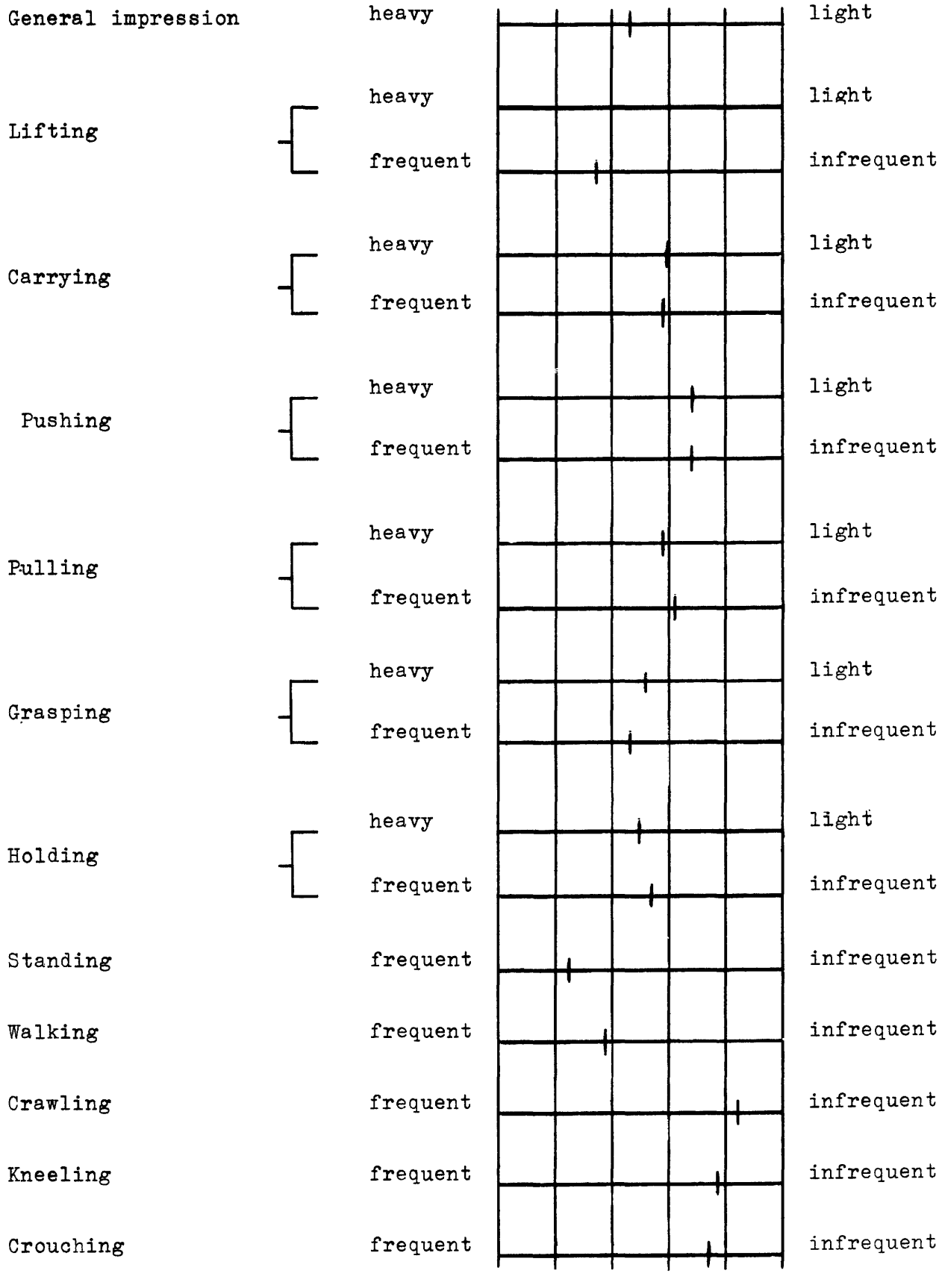

Fig. II-8: Opinion of workers on job stress in the materials haulage sector

Job stress in materials haulage

Non-supervisory personnel

N = 31

D. Removing materials from conveyor and stacking

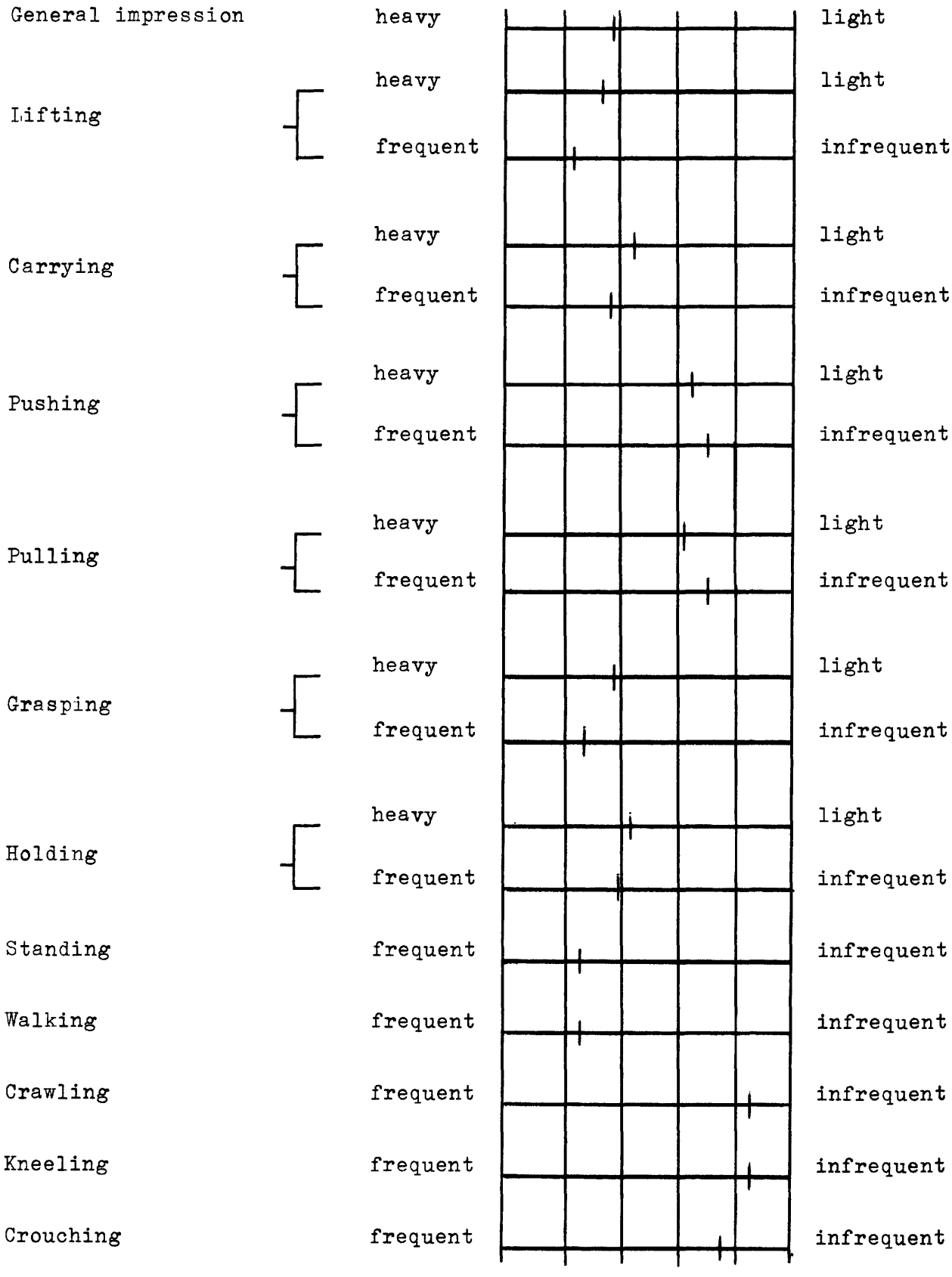

Fig. II-9: Opinion of workers on job stress in the materials haulage sector

Job stress in materials haulage

Non-supervisory personnel

N = 31

E. Monorail
Removing materials from container and stacking

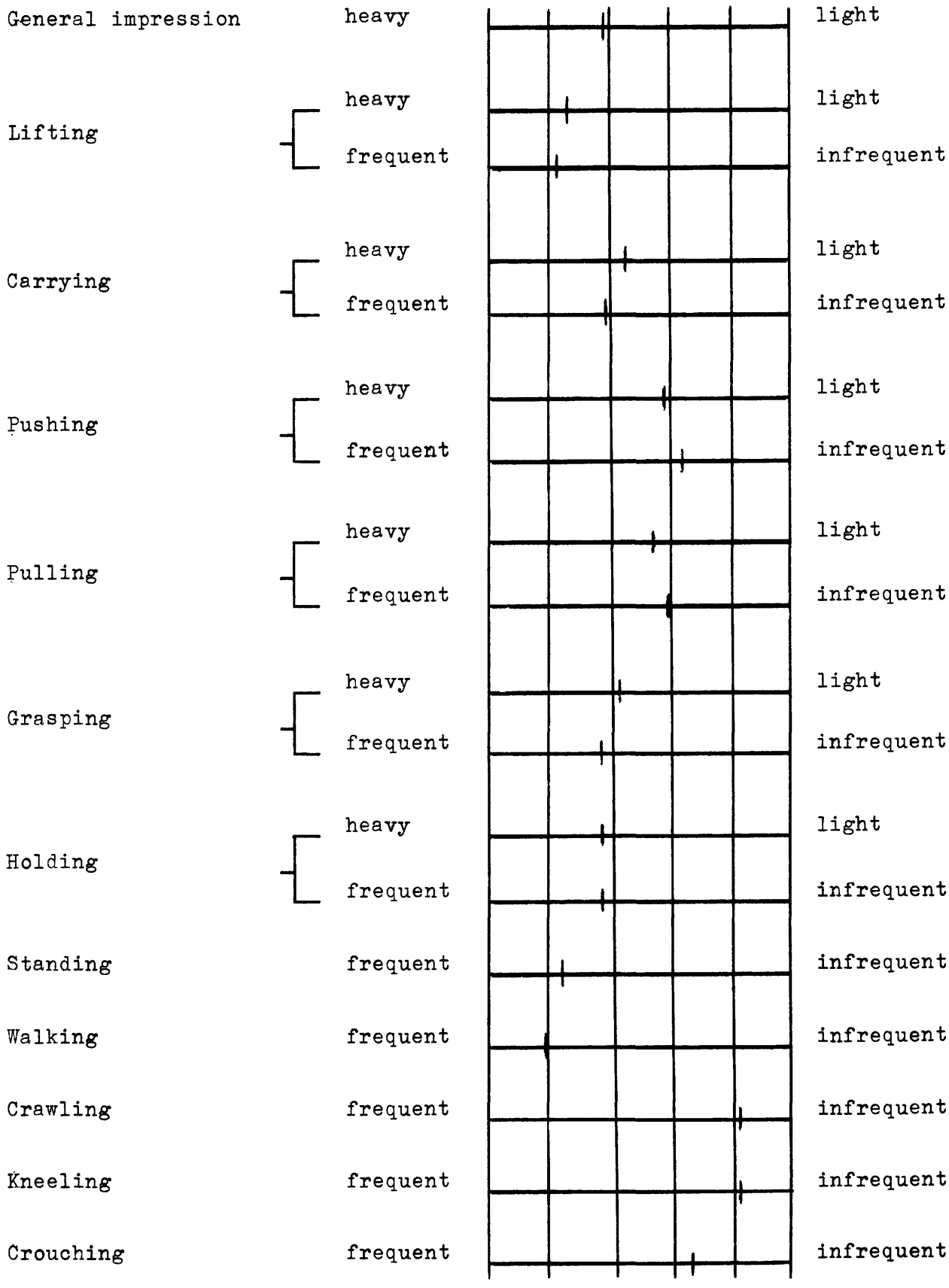

Fig. II-10: Opinion of workers on job stress in the materials haulage sector

Job stress in materials haulage

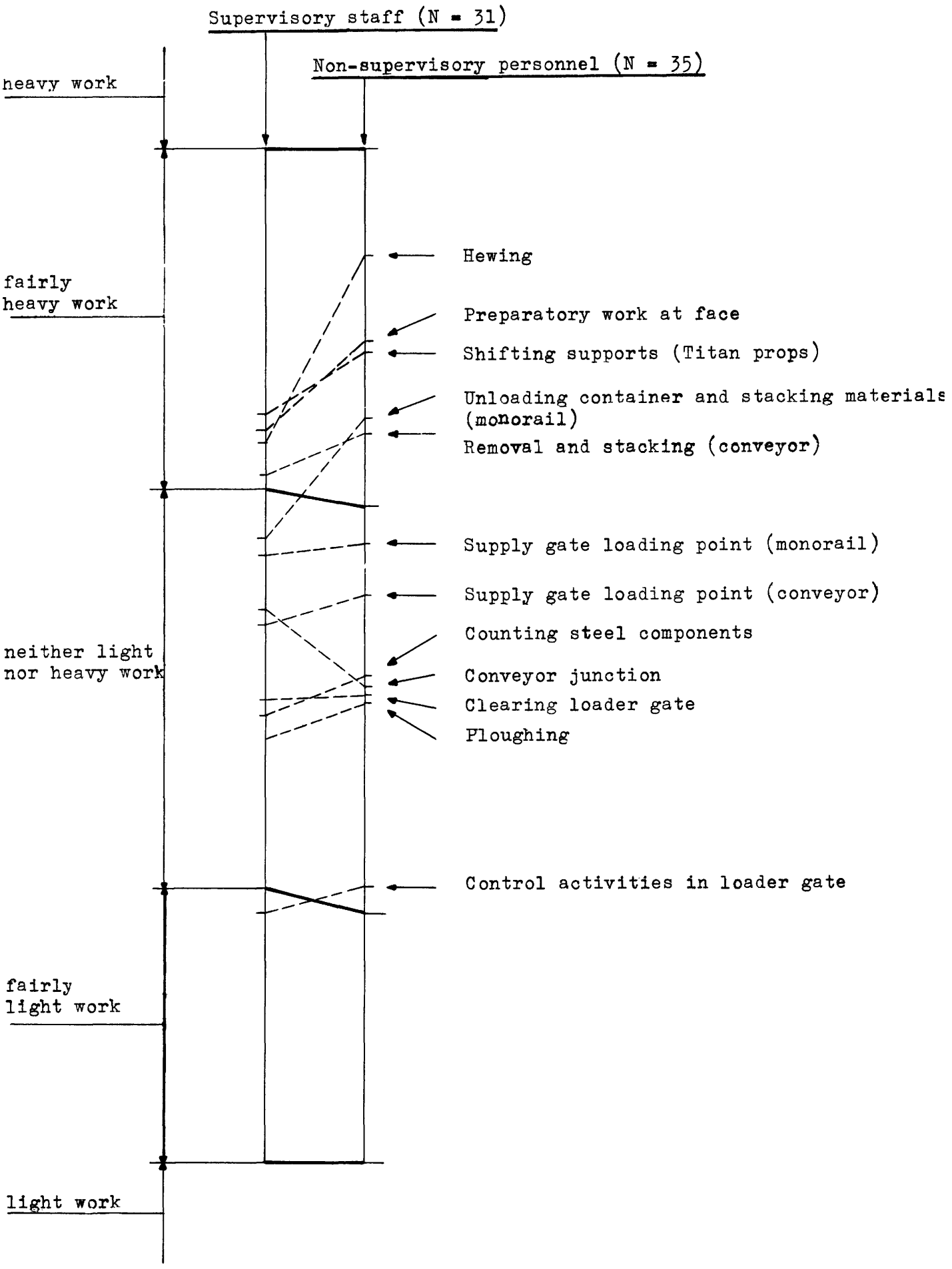

Fig. II-11: Results of paired comparisons of job stress for a number of underground activities

4. Conclusions

The results of the opinion survey on job stress in auxiliary haulage pointed to the need for more objective data on the requirements of the jobs concerned, especially as the workplaces had been adapted for miners who were relatively old or unfit.

It is open to question whether a general survey to determine subjective impressions of job stress, without a clear definition of terms and without reference to specific workplaces, can yield useful information for a selective deployment of labour.

It was also difficult to see where workplaces needed adapting to make them suitable for old or relatively unfit miners.

Job stress could not be measured objectively by physiological measurement. In order to solve personnel problems resulting from pit closures, valid information about the different workplace requirements was urgently needed.

This information was intended to assist the medical department in its selective re-employment scheme. The personnel department was to assign workers to particular jobs on medical advice.

The technical department required information regarding workplace adaptation.

The employment of older or relatively unfit miners must not be allowed to impede performance of the activities involved.

Re-employed workers must see that their jobs are worth while and adapted to their own potential.

The ergonomics team of the Emma/Hendrik pit hoped to meet all these requirements by systematically examining workplaces by a method of job description previously used in the mining area of northern France.

CHAPTER III

Description of workplaces in the auxiliary haulage sector

1. Method of description

The purpose of workplace description was to obtain useful information on job requirements for the performance of activities at various points in the auxiliary haulage sector.

Many studies have been devoted to the description of workplaces. Methods have been developed to identify workplaces and determine their level of difficulty. The ergonomics team of the Emma/Hendrik pit needed information on a considerable number of workplaces in a short space of time.

The team was familiar with the workplace description used in the mining area of northern France and therefore decided to use this model in its study of workplaces in the auxiliary haulage sector.

A short description of the model will suffice for the purposes of this report.

The model consists of a series of headings. The level of difficulty of each of these headings is graded by a figure on a scale ranging from 1 to 5 ("hard" to "light") based on rules enabling a differentiated assessment to be made. Because of this differentiation, a profile reflecting actual job requirements can be drawn up for each workplace layout.

Fig. III-1 shows the model used in the mining area of northern France.

The model was, however, adapted to our specific situation, i.e. the study facilities and the form in which information on job requirements can be considered valid.

Fig. III-2 is the model on which our study was based.

The description of the standards used to evaluate the level of difficulty was also adapted to our own situation.

A description of the standards will be found in Annex II.

2. Systematic observation

After administrative data had been compiled on the quatities of material to be transported for each face section and the weight of the different materials determined, an extensive and detailed study was made of certain workplaces.

This was necessary because the data on quantities and weights of material as well as repeated observation of activities gave an impression of the material haulage activities but not exact information for more objective evaluation of job stress.

The activities at a supply gate loading point, where material is transferred from tubs to the belt conveyor, and the activities at a conveyor junction, were systematically studied. This study included:

- sketches of the workplace layout and equipment available;
- time studies for an entire shift at a supply gate loading point and at the junction of two belt conveyors;
- observation of materials haulage activities for an appropriate interpretation of quantitative data.

H.B.N.P.C.
Groupe d'Hénin-Liétard

WORKPLACE UNDERGROUND

Job description	Job reference	Age limits

Corpulence	Height	1-2	3-4-5	6-7-8-9	10-11	12-13-14
		very small	small	average	tall	very tall

	Remarks	1	2	3	4	5
Near sight Long sight Hearing						
Movement Upright posture Abnormal postures Physical strength Powers of endurance Manual skills						
General equilibrium						
RESISTANCE TO ENVIRONMENT: Vibration Respiratory irritants Dust Bad weather Toxic substances Skin irritants						
Working hours						

Fig. III-1: Model of workplace description used in mining area of northern France

JOB DIAGRAM

Works	Department	Date
Duties	Description	

		Remarks	1	2	3	4	5
Vision	near						
	long						
	colours						
Hearing							
Posture Movement Muscles	upper limbs						
	lower limbs						
	back						
Use of hands							
Endurance							
General							
Lighting defects							
Noise							
Vibration							
Climatic conditions							
Dust							
Respiratory irritation							
Skin irritation							
Toxic gases							
Type of shift							

Fig. III-2: Model of workplace description

The study was of course preceded by preparatory work; in particular it was necessary to contact the persons actually engaged on haulage.

The works physician in the Emma/Hendrik pit took part in the preparatory work and observation.

The job analysts responsible for carrying out the time study also took part in the introductory proceedings and agreed a suitable study date with the persons whom they were to accompany throughout a shift during which measurements would be made.

These preparations had to be made very carefully. Time studies are certainly not pleasant for the person whose actions are constantly observed. Subjects must therefore be fully informed of the purpose and nature of the study.

In addition, job analysts must make a preliminary study to ascertain the extent to which the activities observed are in fact measurable as a function of time.

These preparations enabled the time studies to be conducted without difficulty.

Complete studies covering work at a supply gate loading point and at a conveyor junction will be found at Annexes III and IV.

Summary of systematic observation

Fig. III-3 shows the loading point in a supply gate together with measurements relevant to working posture.The worker must transfer material from the tub to the conveyor. He stands on a platform from which he can reach the uppermost material. To reach material lower down he must climb into the tub.

Once a tub has been emptied he can move it away by pulling on the cable of the car pusher; the next loaded tub can then be moved up to the conveyor.

Tables III-1 and III-2 summarize certain data obtained in the time study.

Fig. III-4 is a sketch of the conveyor junction. The worker must remove material from the belt and place or push it onto the next belt. The working height is determined by the conveyor belt level.

Further details of the time study will be found in Tables III-3 and III-4.

Type of material per tub	Number of pieces	Unit weight (kg)	Total weight (kg)	Time (min)	Average time per piece (sec)
Ties	27	20	540	3	6,6
Sacks of planks	17	15	255	1,5	6,6
3 planks in bundle	24	18	432	5	7,8
Stop blocks	81	4,5	364,5	7,5	4,8
Split sleepers	56	10	560	5	5,4
Wooden props	26	9,3	241,8	5,3	7,8
Wooden caps	72	7,5	540	8,8	7,2
Base plates	51	10	510	7,7	7,8
Bags marl dust	20	40	800	4,7	13,8

Table III-1: Material discharged by one man from tubs to conveyor

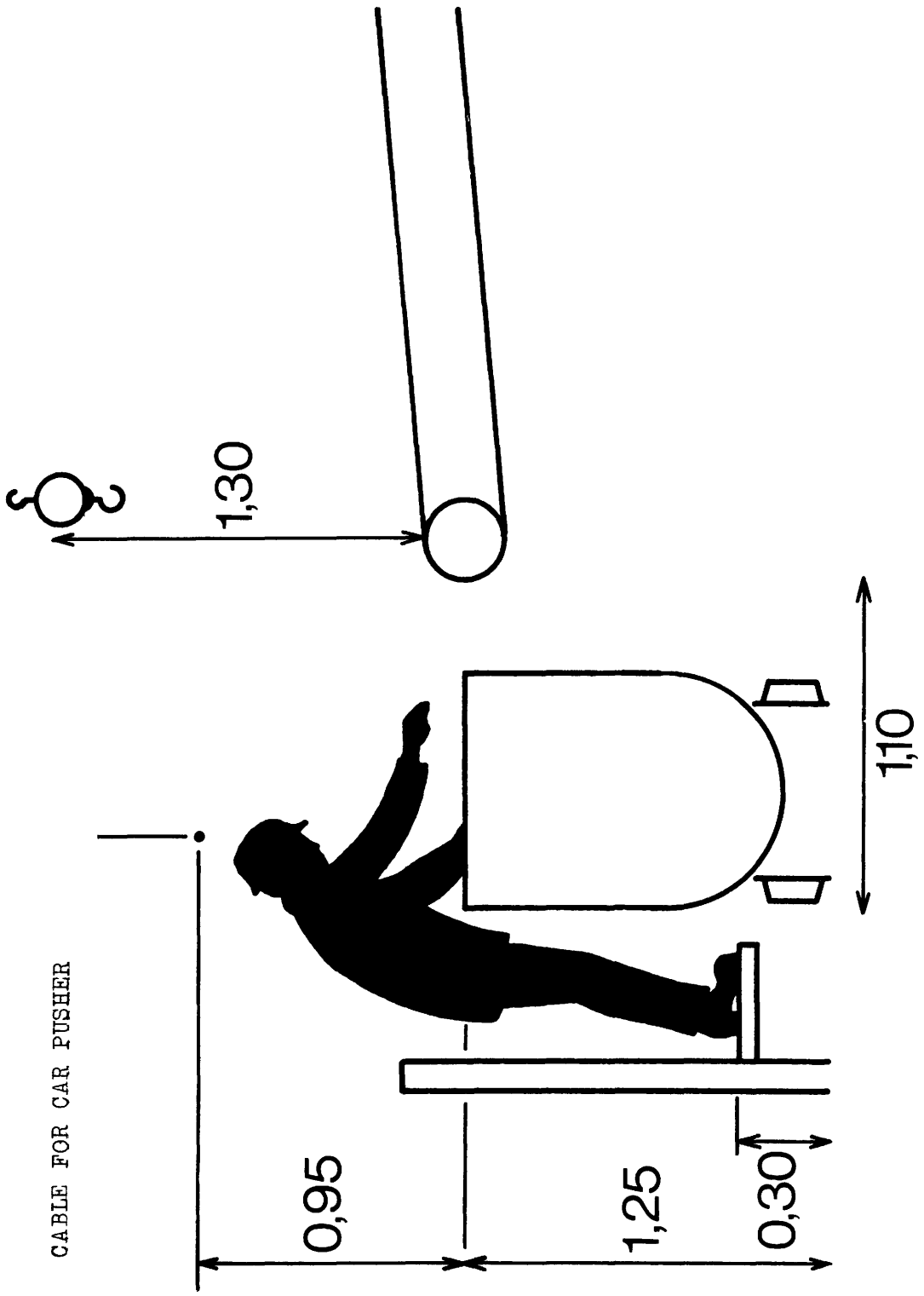

Fig. III-3: Workplace layout at a supply gate loading point

Type of material per tub	Number of pieces	Unit weight (kg)	Total weight (kg)	Time (min)	Average time per piece (sec)
Roadway steel	18	84	1512	10,9	36
Haarman caps	19	58,6	1113,4	6	16,2
Titan props	25	38	950	8,5	20,4
Titan props	19	47	893	8	25,2

Table III-2: Material discharged by two men from tubs to conveyor

Type of material	Number of pieces	Unit weight (kg)	Total weight (kg)	Time (min)	Average time per piece (sec)
Ties	27	20	540	2,9	6,4
Sacks of planks	17	15	255	1,9	6,6
3 planks in bundle	22	18	396	2	5,4
Stop blocks	54	4,5	243	4,3	4,8
Split sleepers	51	10	510	3,5	4,2
Wooden props	24	9,3	223,2	3,2	8
Wooden caps	72	7,5	540	8,6	7,2
Base plates	50	10	500	6,7	7,8
Bags marl dust	16	40	640	4	15
Haarman caps	19	58,6	1113,4	5,7	18
Titan props	25	38	950	9,3	22,2
Titan props	18	47	846	7,9	26,4

Table III-3: Transfer of material by one man from one conveyor belt onto the next at a supply gate conveyor junction

Type of material	Number of pieces	Unit weight (kg)	Total weight (kg)	Time (min)	Average time per piece (sec)
Roadway steel	36	84	3024	31,5	52,2

Table III-4: Removal of roadway steel from conveyor and stacking by two men

3. Evaluation of job stress

On the basis of the data collected, relevant aspects of the workplace layout were analysed and grouped under headings on analysis sheets.

Annexes V and VI contain the processed analysis sheets for a supply gate loading point and a conveyor junction.

The aspects grouped by headings were then tested against the description of standards (Annex II) and the requirements for each heading assessed.

These assessments were inserted in the model shown in Fig. III-2.

Figs III-5 and III-6 show the profile of job requirements at the supply gate loading point and at the conveyor junction.

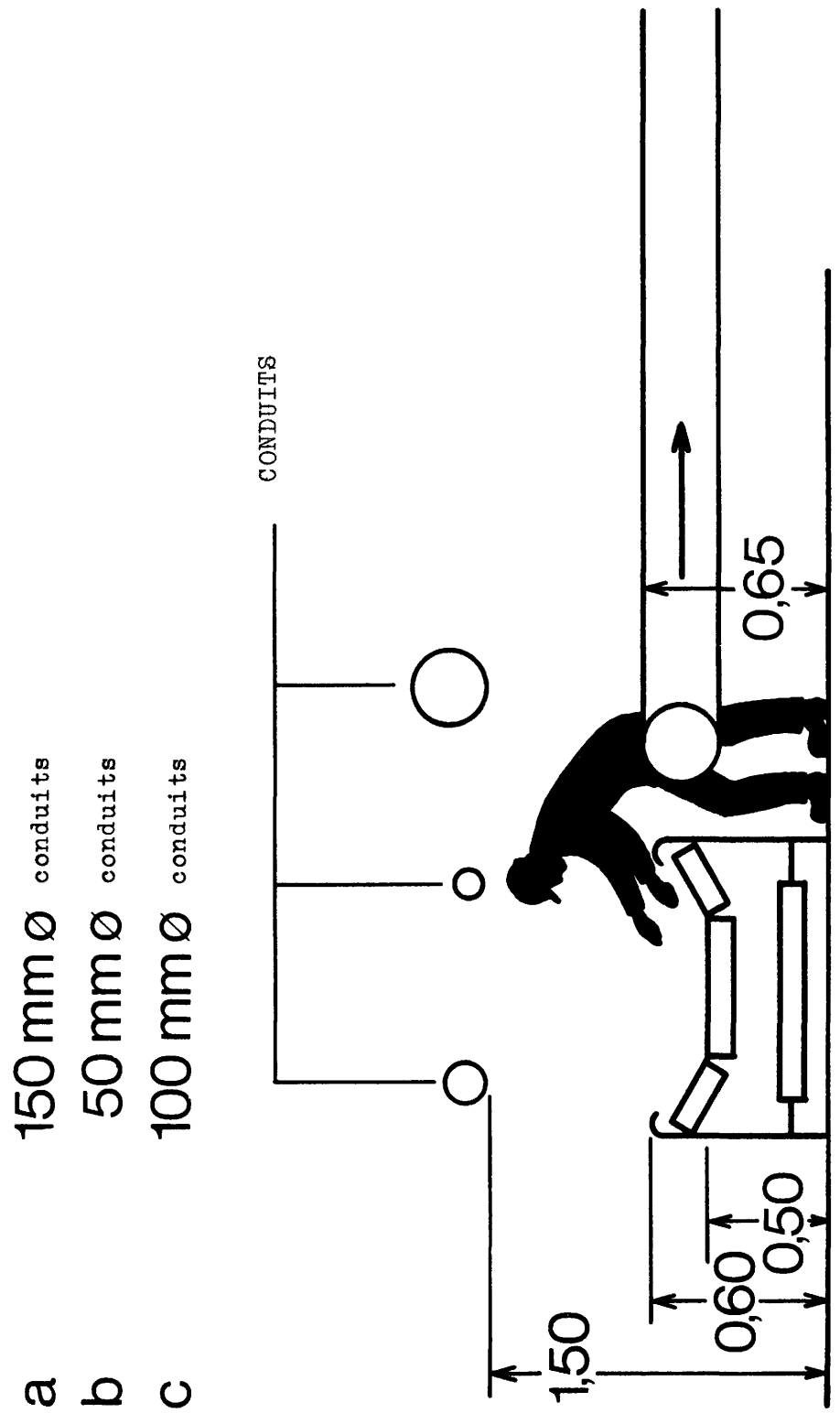

Fig. III-4: Workplace layout at conveyor junction

4. Conclusions

The job requirement profiles suggest a heavy job stress at the observed workplaces in the auxiliary haulage sector.

In accepted terms these workplaces would certainly be rated "heavy".

Analysis of the activities clearly showed the aspects of the workplace layout which determined the level of difficulty of the job requirements.

To sum up, the difficulties are:

- the high frequency of the operations;
- the handling of heavy weights;
- the difficult working posture.

These aspects were decisive for evaluation under the headings:

- upper limbs;
- lower limbs;
- back;
- endurance.

The diminished aptitude of older or relatively unfit miners is, however, particularly likely to affect these aspects.

Analysis of job stress at the observed workplaces clearly showed the need for a review of the general notions of job requirements in the auxiliary haulage sector.

The results of the study led to the preparation of an inventory of all workplaces in that sector. This inventory was drawn up with limited resources and within a short time.

Data on the quantities, types and weights of material to be transported already showed that the frequency of operations and the handling of weights corresponded to the workplace layouts covered by the time studies.

Admittedly there were differences in daily quantities as between the individual face sections, but on average they gave the same results as the individual workplaces studied.The frequency of individual operations reflected in the general data would lead to the same assessment of the relevant headings.

The photograph of a supply gate with a belt conveyor for transporting material clearly shows that the frequency of operations at loading points in that road and at conveyor junctions must be high.

Fig. III-7 shows how material moves on the conveyor.

Information was still lacking on the specific layout of each individual workplace which may influence the method of working and the evaluation of job requirements.

Sketches showing relevant dimensions already give sufficient information for well-founded evaluation. The ergonomics research team therefore decided to prepare sketches of the technical equipment and layout at each workplace in the auxiliary haulage sector.

The general data and these sketches showed the aspects necessary for assessment of each individual workplace.

The results were of great value to the management of the Emma/Hendrik pit in commissioning a study of the possibility of designing more suitable workplace layouts in the auxiliary haulage sector. In addition the description of workplace layouts proved stimulating to members of the ergonomics team.

A number of changes in workplace layout were designed and introduced in this way.

JOB DIAGRAM

Works	Department	Date
Emma/Hendrik	Face	
Duties	Description	
Unloading material	Supply gate loading point	

		Remarks	1	2	3	4	5
Vision	near				●		
	long					●	
	colours						●
Hearing						●	
Posture Movement Muscles	upper limbs			●			
	lower limbs			●			
	back			●			
Use of hands					●		
Endurance				●			
General						●	
Lighting defects					●		
Noise							●
Vibration							●
Climatic conditions					●		
Dust							●
Respiratory irritation							●
Skin irritation					●		
Toxic gases							●
Type of shift							●

Fig. III-5: Job requirement profile at a supply gate loading point

JOB DIAGRAM

Works	Department	Date
Emma/Hendrik	Face	
Duties	Description	
Transport of material	Conveyor junction	

		Remarks	1	2	3	4	5
Vision	near				●		
	long					●	
	colours						●
Hearing						●	
Posture Movement Muscles	upper limbs			●			
	lower limbs			●			
	back			●			
Use of hands					●		
Endurance				●			
General						●	
Lighting defects			●				
Noise							●
Vibration							●
Climatic conditions					●		
Dust							●
Respiratory irritation							●
Skin irritation					●		
Toxic gases							●
Type of shift							●

Fig. III-6: Job requirement profile at a conveyor junction

Fig. III-7: Belt conveyor for carrying material in a supply gate

CHAPTER IV

Adaptation of auxiliary haulage workplaces to the aptitude of older or relatively unfit miners

1. Results of workplace description

Comprehensive studies of the activities performed at a loading point in a supply gate and at a conveyor junction in the auxiliary haulage sector of a face section showed that a description of these activities could be reduced to a small number of aspects of the workplace layout concerned. If data is available on the:

- working height;
- reach;
- weight of material handled;
- frequency of operations

an evaluation of the requirements for work of this kind is perfectly feasible.

This may be particularly useful for the selective employment of older or relatively unfit miners.

Above all the description of these aspects showed how the different workplace layouts needed to be adapted to make them suitable for gradually aging personnel.

The description of workplace layouts provided a clear basis for ergonomic solutions at each individual workplace.

Initially, existing layouts were adapted; at a later stage in the study it became possible to plan ergonomically appropriate workplace layouts even before new coal faces were opened. A number of examples of appropriate workplace layouts are discussed in this chapter.

2. Adapted workplace layouts at supply gate loading points

Improvements in workplace layouts at supply gate loading points centred on better working heights and reaches and easier handling of the weights involved.

The working height, in other words the height of the edge of the tub, was reduced to about 90 cm by tilting the loaded tub against a supporting beam. For this purpose a lifting beam and a 3-ton compressed air lifting tackle were used at the workplace. The chain hook of the lifting tackle was attached to the eye of a clamp mounted on the edge of the tub.

The height of the conveyor belt with a hinged reversing system was then brought to the level of the tilted tub.

The photographs in Figs IV-1 and IV-2 show how the clamp is fixed to the edge of the tub and the tub after tilting.

In places where the supply gate is a prolongation of the cross cut, the correct working height is obtained by tilting the tub parallel to the conveyor (see Fig. IV-3).

At another point a side-tipper was installed at the loading point because of the supply gate gradient. In this way loaded tubs could be tilted while maintaining a safe inclination of the conveyor belt so as to prevent material from being pushed back.

Fig. IV-4 shows the design of the side-tipper.

The handling of weights, which puts a strain on the upper limbs, the back and powers of endurance, is facilitated by special aids, i.e. a lifting beam, compressed air lifting tackle and a fixing clamp.

Fig. IV-1: Loading point in a supply gate. A clamp is fixed to the tub edge. The tub is tilted against a supporting beam by means of compressed air tackle. This gives a working height of about 90 cm. The conveyor belt is on the same level. The workplace is manned by two persons who transfer material by hand or with the aid of the tackle from the tub onto the belt, as shown in the next illustration.

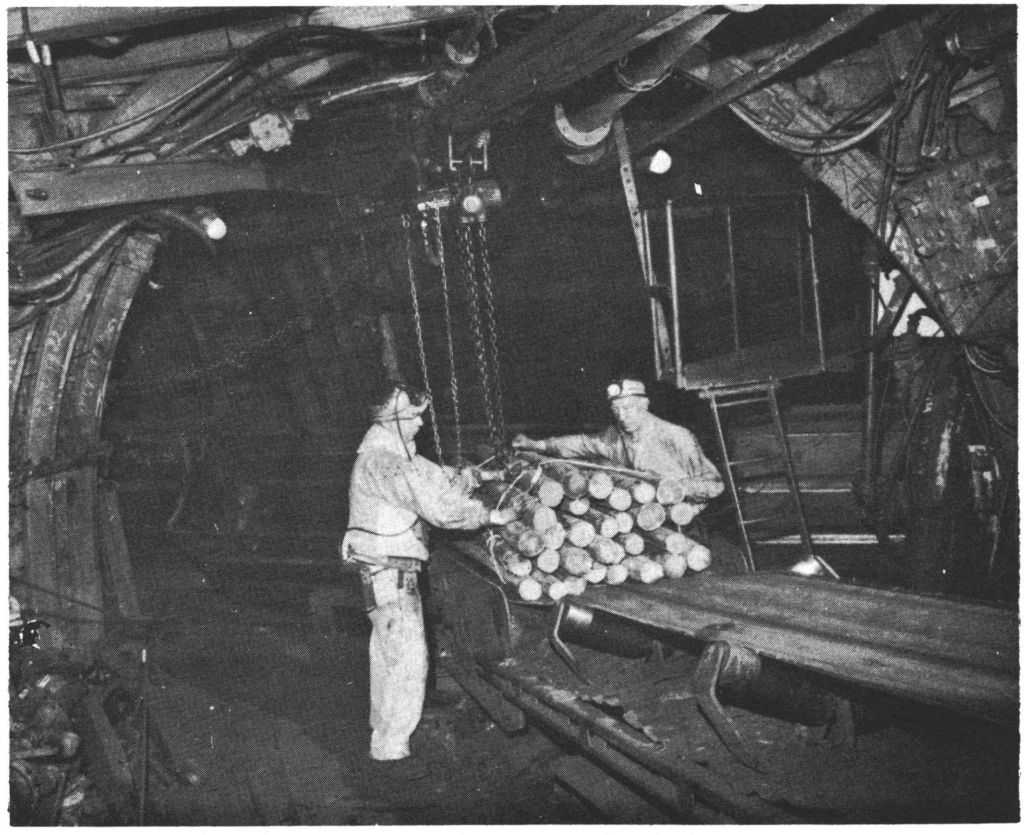

Fig. IV-2: Tub in tilted position. A bundle of wooden props has been placed on the conveyor; the cord is being cut.

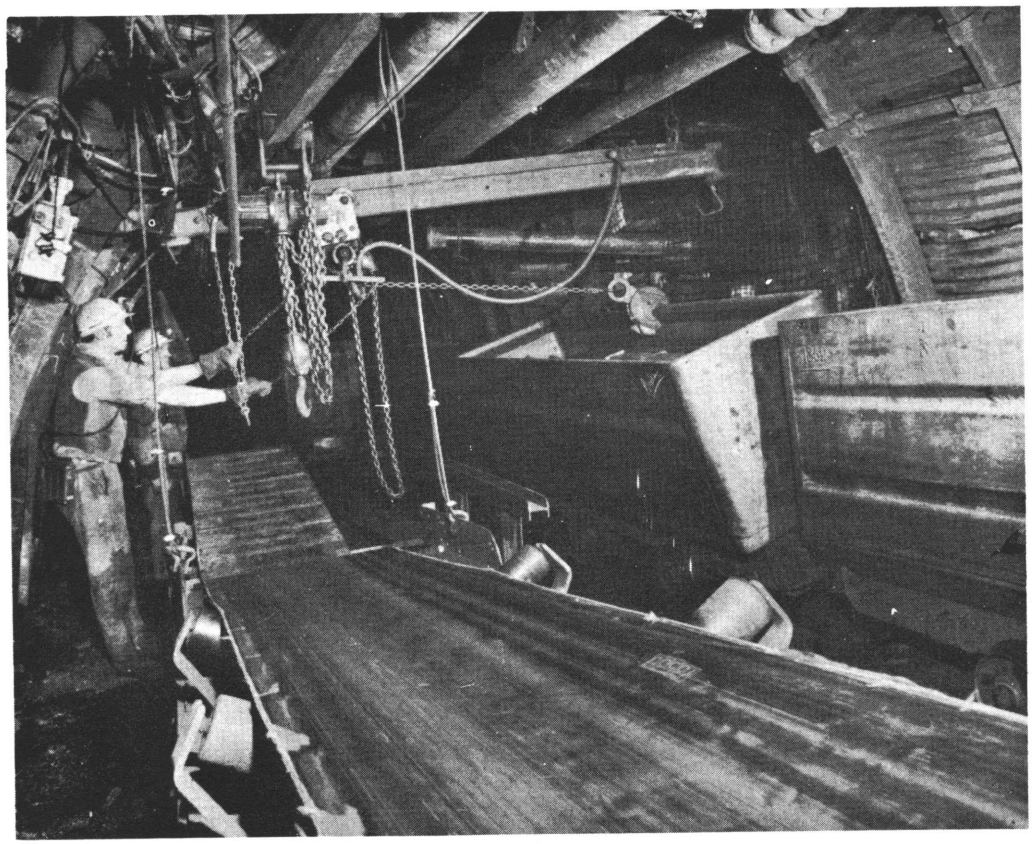

Fig. IV-3: Another loading point. The supply gate is a prolongation of the cross cut. Once again lifting tackle and clamp are provided to tilt the tub against a supporting beam. When the tub is tilted its edge is level with the roller track.

To prevent material from jamming between individual rollers, the rollers are fitted in channels which give a better sliding movement.

Supply gate loading points are manned by two persons who may lift or push material by hand or with the lifting tackle from the tub onto the conveyor. This allows adaptation to the potential of the workers concerned.

3. Adapted workplace layouts at conveyor junctions

The description of workplace layout at conveyor junctions clearly showed the strain resulting from the operator's physical posture, the need to handle weights and the frequency of individual operations.

The solution to these difficulties was obvious. By allowing the material, previously pushed from one belt to the next by physical force, to slide over a belt crossing, the strain would be considerably reduced.

On the other hand the construction of crossings of this kind was not a straightforward matter. The requirements to be met at the various junctions called for detailed study in each case.

The following factors had to be taken into account in the design:

- the angle formed by the conveyor belts;
- the different kinds of material to be transported with widely varying dimensions;
- the space available at junctions in supply gates;
- any difference in height between the belts.

At junctions where space, and in particular height, were sufficient, slide channels were installed. The difference in height between the two belts then gave the gradient needed for the material to slide.

The channel radius depended on the angle formed by the belts.

At junctions with inadequate space, or in particular inadequate height, for slide channels to be installed, flat belt junctions were designed.

The two belts were brought to the same level.

At the appropriate point, the trough shape of the belt was flattened by inserting a sheet measuring about 1500 x 800 x 5 mm below it.

A junction plate (sometimes wedge-shaped) was inserted between the belts. A hinged guide beam ⊏NP 14 or ⊏NP 16 of a length of 1500 to 2000 mm was fitted on the conveyors. To prevent damage to the belt, a $\frac{3}{4}$" tube was welded onto the base of the guide beam. The beam radius corresponded to the angle formed by the belts.

The curved guide system, using either slide channels or flat belt junctions, gave room for material of lengths up to about 3 m.

Examples of belt junctions appear in Figs IV-5, IV-6 and IV-7.

Some principal features of the design of the conveyor junctions are described here. More detailed design data are given in Annexes VII-a to VII-h.

In each instance the specific requirements of junctions must be taken into account in the design. The conveyors were frequently used for purposes other than the transport of material to the face. Conveyor junctions must then be capable of carrying coal cut at the face. In these cases provision was necessary for rapid replacement of materials haulage junctions by channels for coal and dirt.

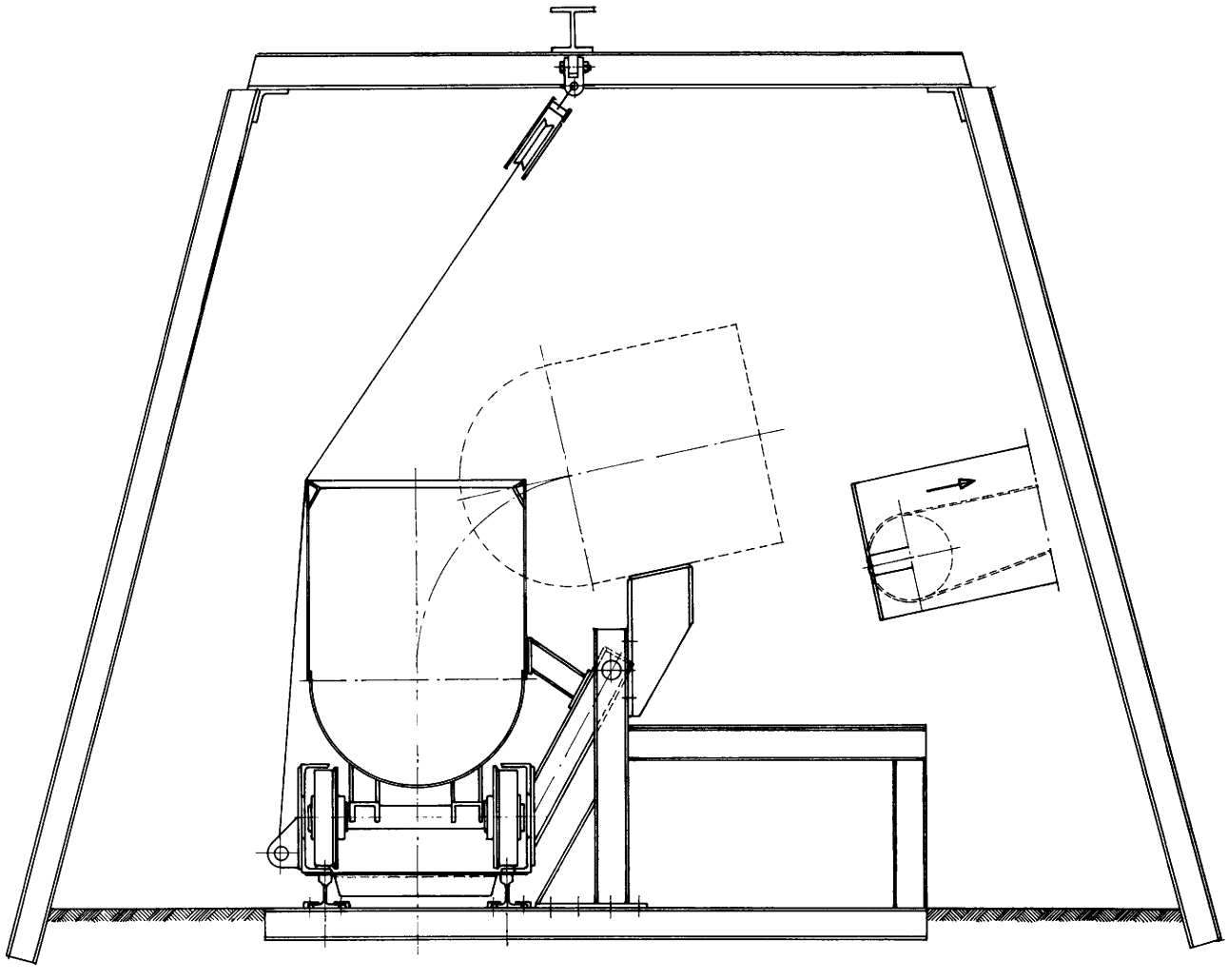

Fig.IV-4: Side-tipper for tubs carrying material

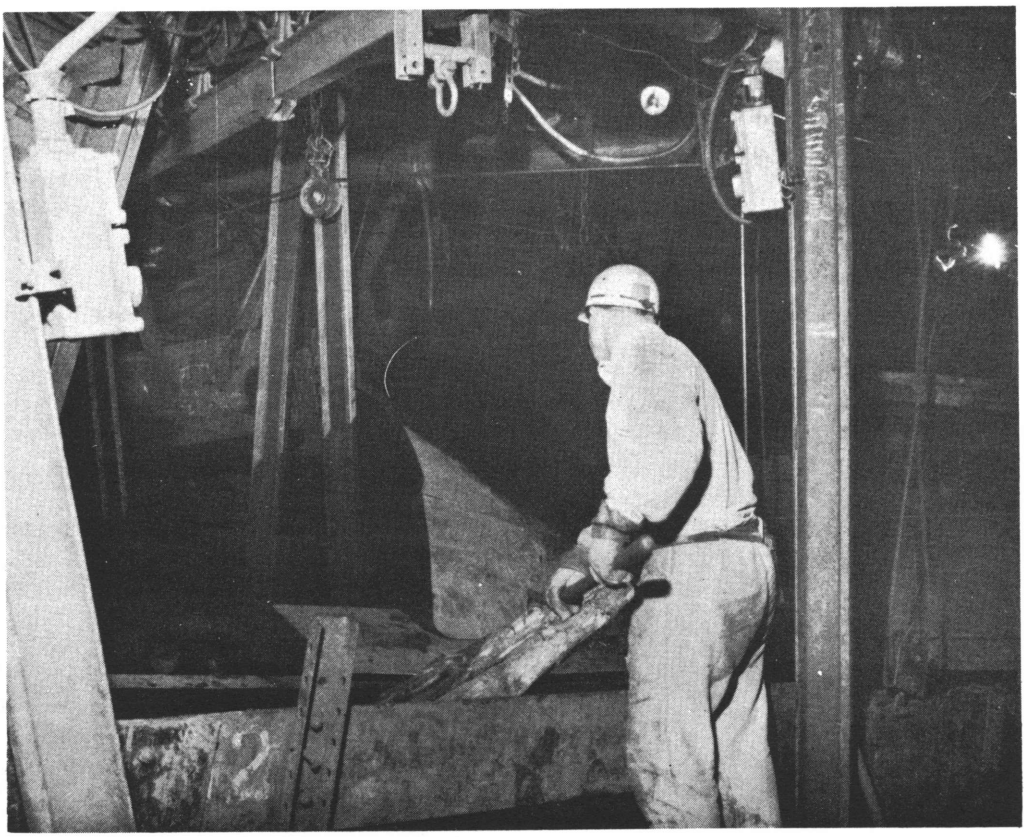

Fig. IV-5: Modified conveyor junction. The two belts, which meet at an acute angle, are joined together by a curved slide channel. The material slides from one belt to the other.

Heavy material moves under its own weight.

Wood sometimes has to be shifted with a hook.

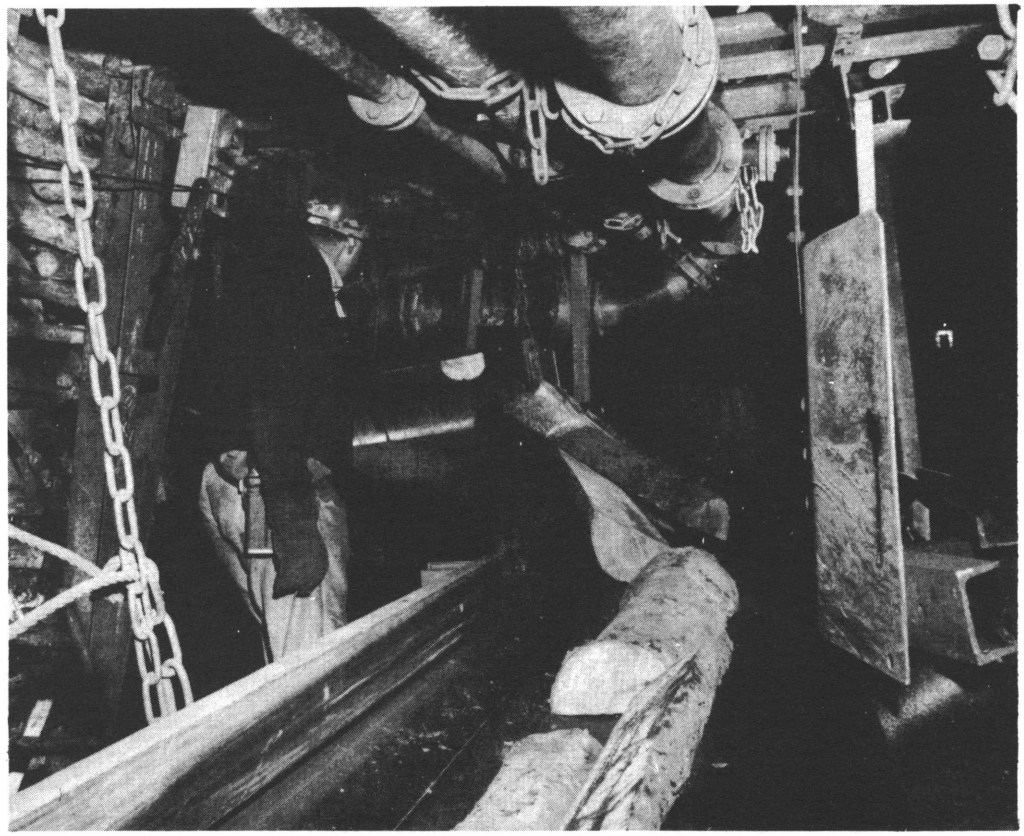

Fig. IV-6: Another design of conveyor junction. Material is guided by plates across the junction. Each junction requires a suitable design depending on the space available and the gradient between the two belts.

In the present case the space was further reduced by the presence of a chain conveyor for carrying coal from the face.

Fig. IV-7: Example of a curved slide channel. The change in workplace layout is clear. While operations in the auxiliary haulage sector previously involved physical effort which could be rated fairly heavy or even heavy, the job now consists mainly in checking the free movement of material on the conveyor. This work now requires only light physical effort.

CHAPTER V

The results

One direct benefit of the descriptions of workplace layouts in auxiliary haulage and the evaluation of job stress was that they gave more objective information on the selective re-employment of older or relatively unfit miners. In addition, the urgent need for adaptation of working requirements to the diminished potential of such personnel became clear.

The descriptions of workplace layouts led to appropriate adaptation measures.

These measures resulted in practice both in a noticeable reduction in job stress and in economic benefits.

1. Results in regard to job stress

The measures taken at individual workplaces in the auxiliary haulage sector resulted in a reduction in stress factors affecting the postural and motor system and making demands on powers of endurance.

Older or relatively unfit miners experienced particular difficulties in this area, leading in many cases to medical advice for a transfer to less demanding activities.

Changed workplace layouts at supply gate loadings points

More favourable working heights and reaches are obtained by tilting the tubs and bringing the conveyor reversing points to the same height. Standing in a relaxed working posture, the operator

can push material over the edge of the tub onto the conveyor (lighter material may be lifted). Bending to reach material at a lower level cannot be avoided altogether, but the need for it is reduced considerably. The handling of heavy material is facilitated by auxiliary devices; it can be removed from the tub by means of lifting gear and placed on the conveyor. However, lifting equipment is always available for use, so that the operator can adapt the work to his own potential.

Since each loading point is manned by two persons and the work is shared between them in the most convenient manner, the frequency of operations presents no further difficulties. It is on the contrary necessary to make sure that material is spaced out adequately on the conveyor, so that it can be suitably handled at subsequent workplaces on the route to the face.

Fig. V-1 shows the job requirement profile at adapted loading points.

JOB DIAGRAM

Works	Department	Date
Emma/Hendrik	Face	
Duties	Description	
Unloading material	Supply gate loading point	

		Remarks	1	2	3	4	5
Vision	near				●		
	long					●	
	colours						●
Hearing						●	
Posture Movement Muscles	upper limbs				●		
	lower limbs				●		
	back				●		
Use of hands					●		
Endurance					●		
General						●	
Lighting defects					●		
Noise							●
Vibration							●
Climatic conditions					●		
Dust							●
Respiratory irritation							●
Skin irritation					●		
Toxic gases							●
Type of shift							●

Fig. V-1: Job requirement profile for a supply gate loading point

Changed workplace layout at conveyor junctions in supply gates

Thanks to the new design of conveyor junctions, material can now be shifted across these junctions over connecting plates or along slide channels without the persons working at this point having to perform heavy physical efforts. Physical effort has been replaced by a need for mental concentration. A great deal of the product crosses the junction under the impetus of the conveyor belt movement or down the gradient of the slide channels. Operating staff must make sure that no material jams; this is liable to happen if it rests on the belt at an angle or has a rough surface so that it does not slide easily, or if the gradient is too slight to allow light material to move easily.

Observation of these workplaces showed that operators even perform a certain amount of superfluous work at the junctions. The relaxed posture and low number of operations in this workplace layout make the work suitable for personnel who, on medical advice, must only perform light work underground.

Fig. V-2 shows the job requirement profile for the adapted conveyor junctions.

2. Economic advantages of the modified workplace layout

In addition to the possibility of obtaining more suitable jobs for aging personnel or persons of diminished potential (a factor which also offers certain economic advantages) the haulage capacity of supply gates is increased. Since the large number of handling operations has been reduced, greater quantities of material can be carried on the conveyors. An increase in haulage capacity was necessary at several points in the pit because of the concentration

of coal-winning operations. In the past several persons were needed for certain jobs in the supply gates because heavy physical work had to be performed at intervals of a few metres. The same work can now be done by one person of below average capacity because of the changed workplace layout. The larger volume of material to be handled because of the concentration of coal-winning operations made it necessary to work on a two-shift haulage system for some face sections. Adaptation of workplaces removed the need for a full shift every twenty-four hours.

3. Continuation of workplace adaptation

The results achieved in the supply gate also led to improvements to conveyor junctions in the loader gates.

These workplaces too can now be manned by older or relatively unfit miners.

Previously they had to operate conveyors and make sure that there were no blockages at junctions. Coal had to be shovelled below and alongside conveyors, and junctions had to be cleared of dirt.

The changes in the design of conveyor junctions in the loader gates reduced the intensity of these activities.

Annexes VIII-a and VIII-b show examples of these conveyor junctions.

Often it even proved unnecessary to man these junctions at all.

JOB DIAGRAM

Works	Department	Date
Emma/Hendrik	Face	
Duties	Description	
Transport of material	Conveyor junction	

		Remarks	1	2	3	4	5
Vision	near				●		
	long					●	
	colours						●
Hearing						●	
Posture Movement Muscles	upper limbs					●	
	lower limbs				●		
	back					●	
Use of hands					●		
Endurance						●	
General						●	
Lighting defects			●				
Noise							●
Vibration							●
Climatic conditions					●		
Dust							●
Respiratory irritation							●
Skin irritation					●		
Toxic gases							●
Type of shift							●

Fig. V-2: Job requirement profile for a supply gate loading point

Conclusions

A need had arisen to obtain rapid information on job requirements at a large number of workplaces and to indicate factors which presented difficulties for the selective employment of older or relatively unfit miners at these points.

The selected method of job description proved suitable for this purpose; however, it is not possible to evaluate the relative importance of different requirements without close contact with industrial physicians.

Consideration of the results achieved by the ergonomic adaptation of workplaces suggested the need for objectivizing the methods of description.

A close check must of course be kept on adapted workplaces to see that there are no changes in a given workplace layout.

Intensive use of belt conveyors and the need to transport heavy equipment to the face sometimes entail correction of the initial workplace layout, but this can be done by simple technical means. Minor deviations in the installation from the original design appear to have an adverse influence on job stress.

The ergonomic measures were readily accepted by the persons assigned to the adapted workplaces, even if some criticisms were made; such comments are usually heard in mines on the point of closure. It was claimed that great concentration was still necessary to prevent material from jamming and interrupting transport flow. It was also asserted that the new situation would make personnel redundant. On the other hand some persons admitted that the changes enabled workers to stay in the mine who could not have been employed under the old conditions.

All these observations confirm the results of systematic ergonomic investigation.

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A N N E X E S

ANNEX I-1

Survey of job stress in materials haulage supply gates in Emma/Hendrik pit

Categories

Pit manager ☐
Department manager ☐
Supervisor ☐
Senior overman ☐
Deputy ☐
Collier ☐
Collier/maintenance and operation ☐
Assistant collier ☐
..... ☐

Duties

Department manager ☐
Supervision ☐
Personnel management ☐
Supply gate loading point - belt conveyor ☐
Supply gate loading point - monorail ☐
Conveyor junction ☐
Unloading material from conveyor and stacking ☐
Emptying material container and stacking material ☐

Age: .....years

Shift

Evening shift ☐
Afternoon shift ☐
Night shift ☐
Intermediate shift ☐

Annex I-1: Questionnaire used in survey of job stress

ANNEX I-2

Example for next questionnaire

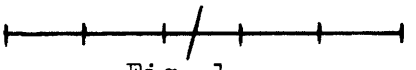
heavy  light

Fig. 1

An oblique stroke is entered in the centre of the horizontal line (Fig. 1). This shows that a particular type of work is neither heavy nor light (normal).

Shifting the stroke to the left indicates that the work is heavier than normal (Fig. 2).

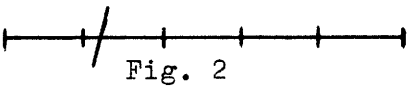
heavy  light

Fig. 2

Shifting the stroke to the right indicates that the work is lighter than normal (Fig. 3).

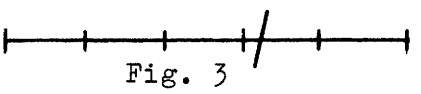
heavy  light

Fig. 3

The same holds good for the illustration of frequency or infrequency, as shown in Fig. 4.

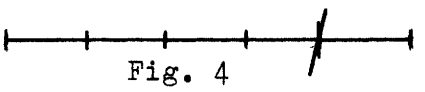
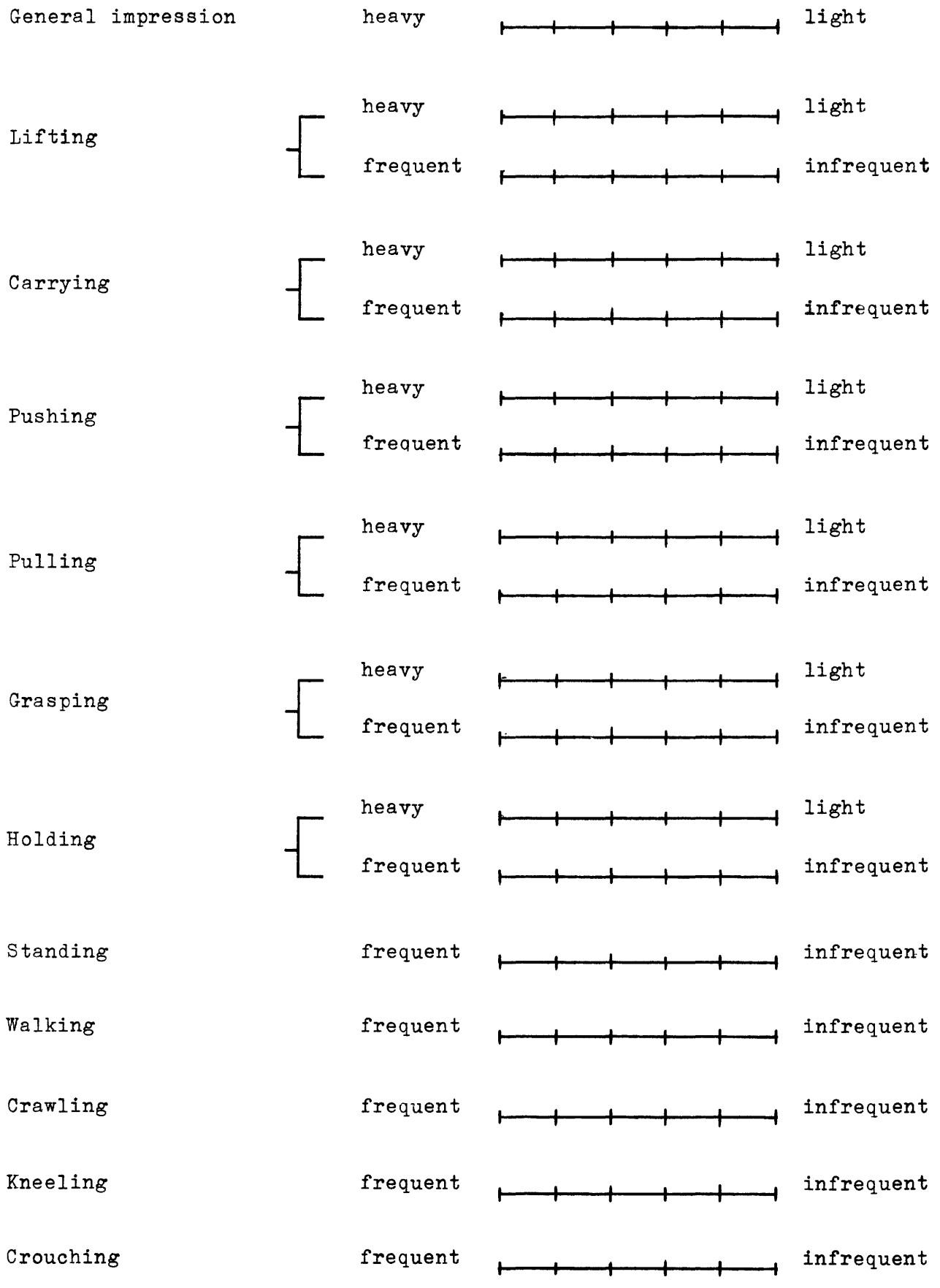
frequent  infrequent

Fig. 4

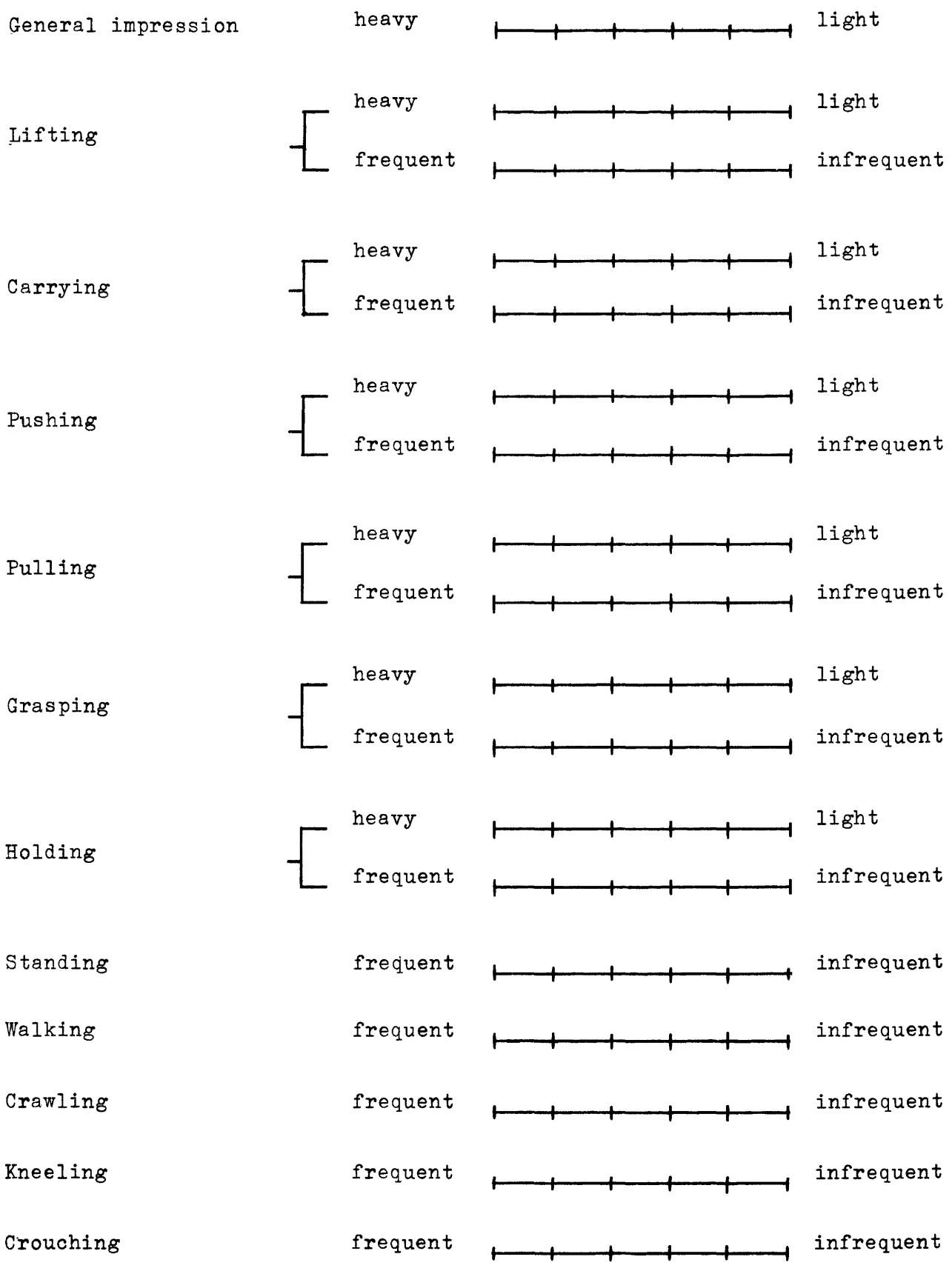
A. Supply gate loading point
Tub - conveyor

ANNEX I-3



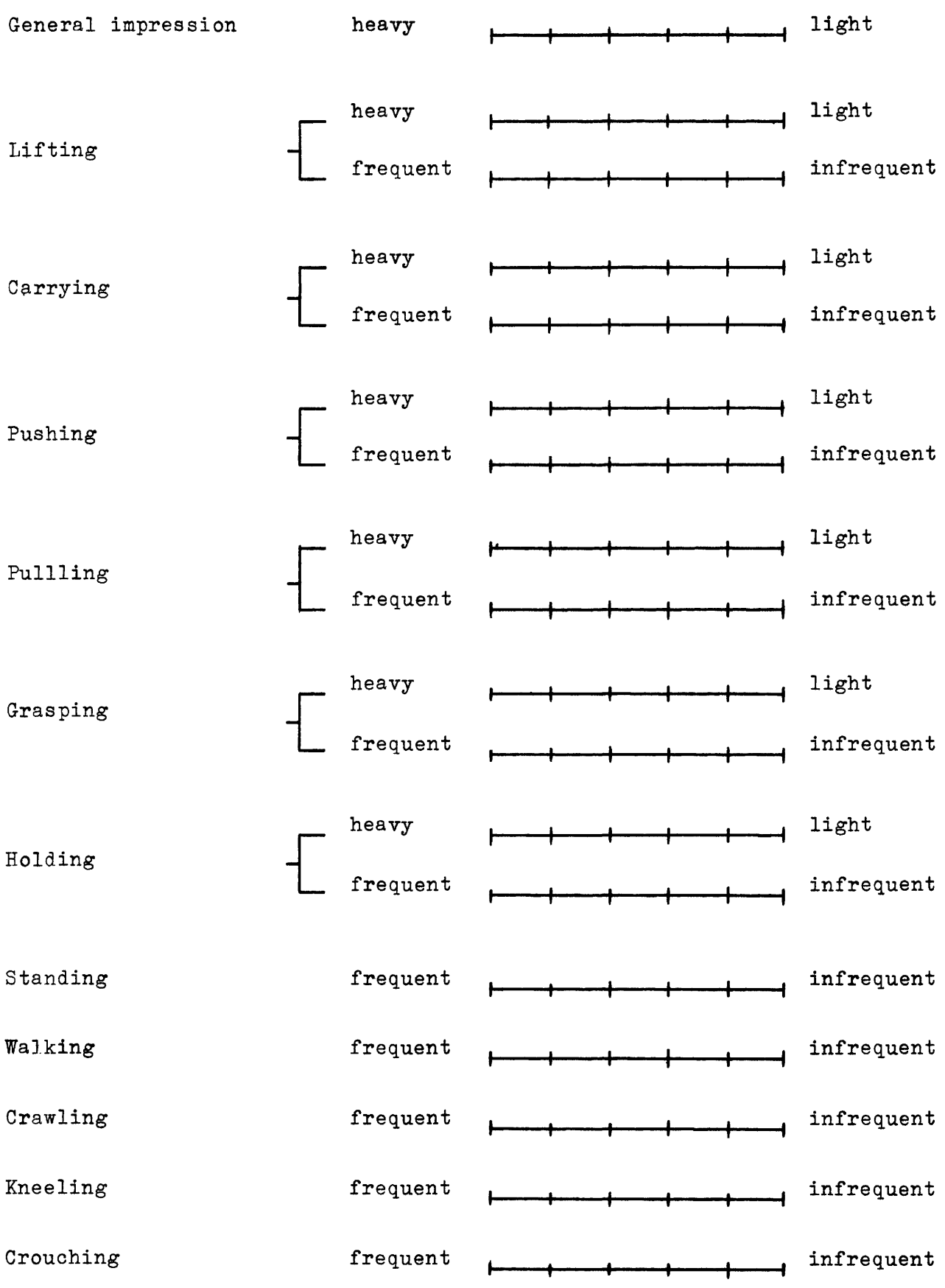
ANNEX I-4

B. Supply gate loading point
Tub - monorail



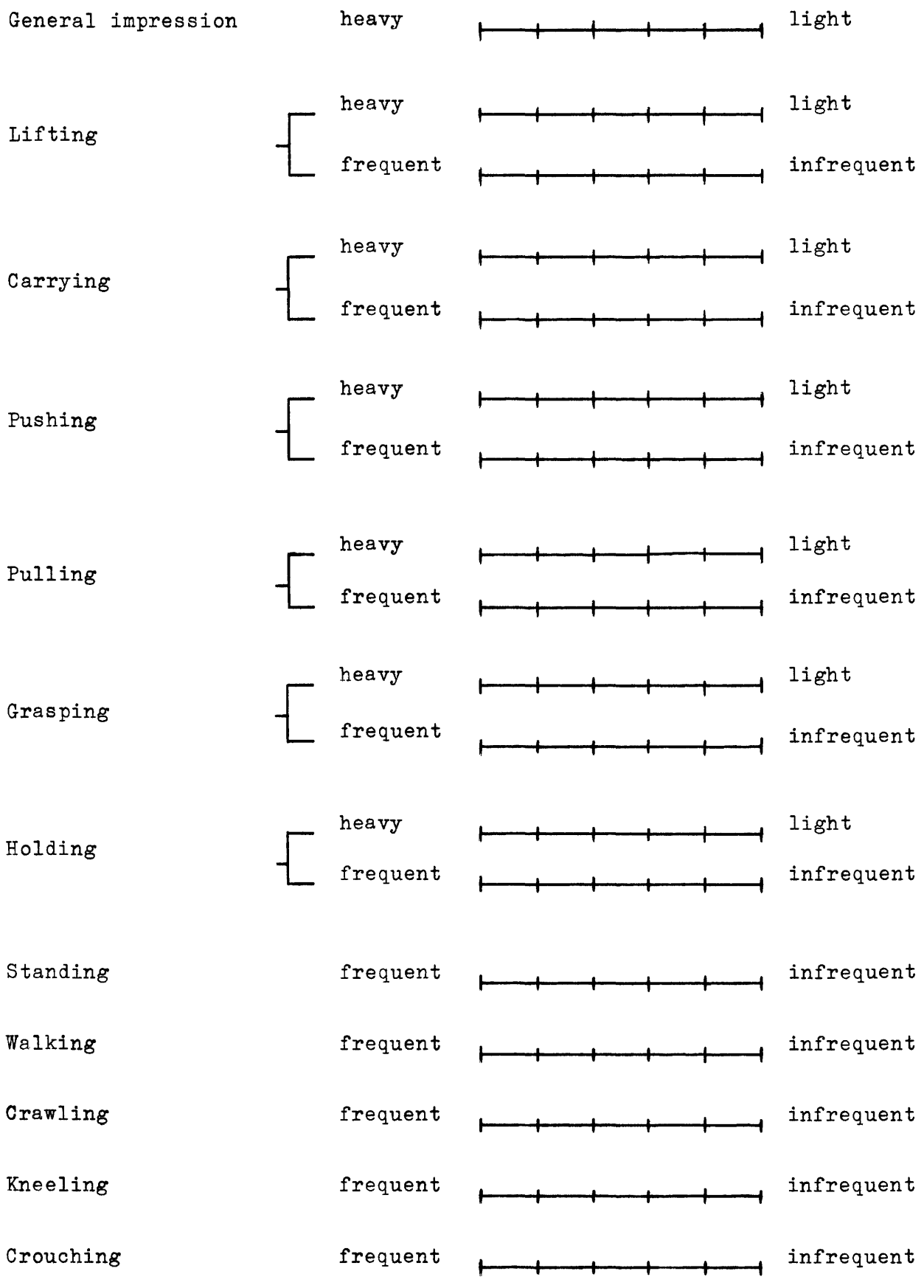
C. Conveyor junction

ANNEX I-5



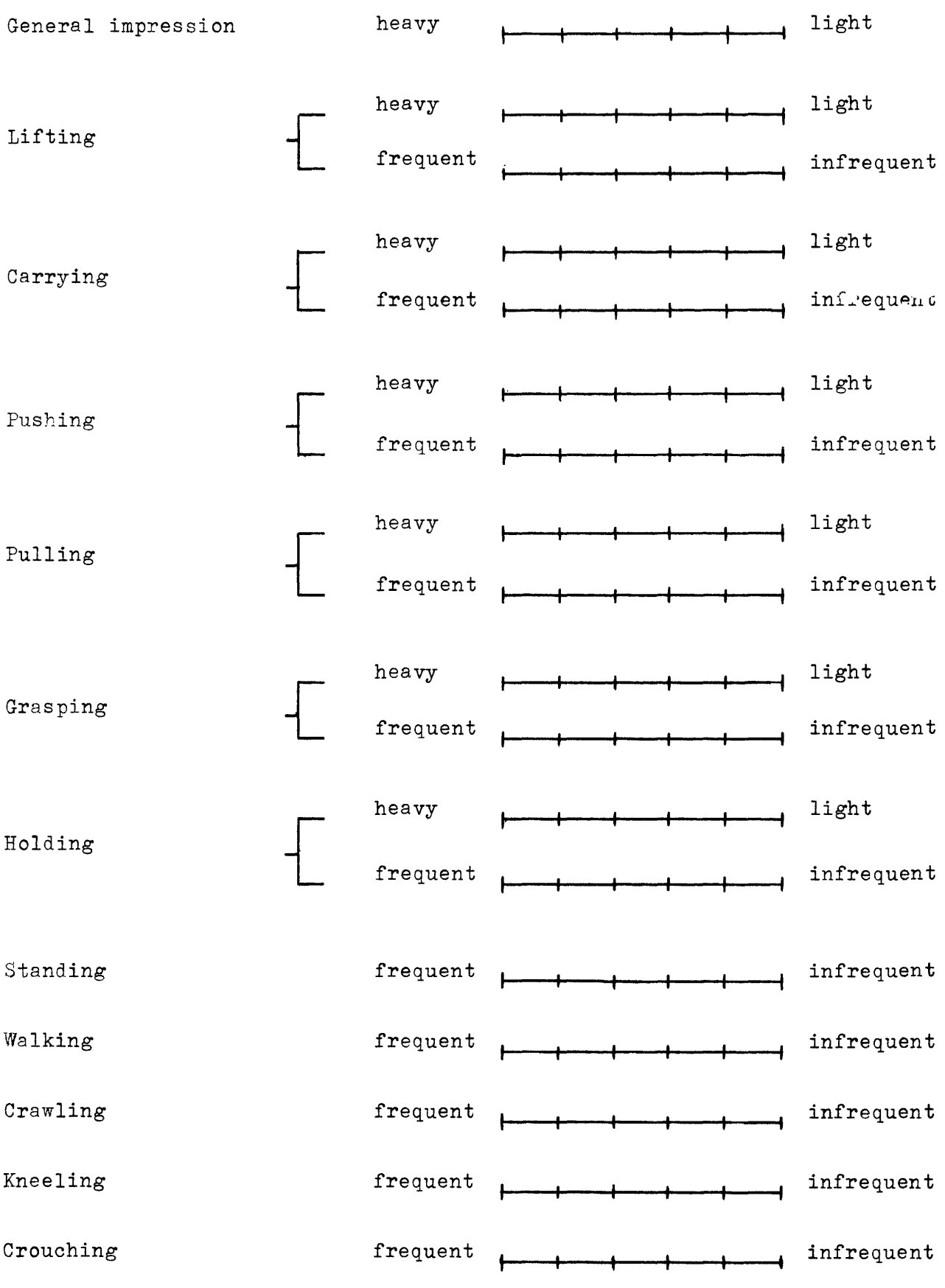
D. Unloading from conveyor and stacking

ANNEX I-6



ANNEX I-7

E. Monorail
Unloading material container and stacking



ANNEX I-8

Example for next questionnaire

Which do you find more difficult?

Digging your garden	O
Washing your car	O

If you find it harder to dig your garden than to wash your car, enter a cross in the circle against "Digging your garden". A cross the circle against "Washing your car" means that you find it harder to wash your car.

Enter only one cross in each case.

The question "Which do you find more difficult?" applies to the following pages.

Unloading and stacking (belt conveyor)	0
Shifting Titan props	0
Conveyor junction	0
Clearing loader gate	0
Supply gate loading point (monorail)	0
Operations in supply gate	0
Counting steel components	0
Preparatory work at face	0
Supply gate loading point (belt conveyor)	0
Hewing	0
Shifting Titan props	0
Unloading material container and stacking (monorail)	0
Clearing loader gate	0
Unloading and stacking (belt conveyor)	0
Operations in loader gate	0
Conveyor junction	0
Preparatory work at face	0
Supply gate loading point (monorail)	0
Ploughing	0
Counting steel components	0
Operations in loader gate	0
Supply gate loading point (belt conveyor)	0

Hewing	0
Shifting Titan props	0
Unloading material container and stacking (monorail)	0
Clearing loader gate	0
Unloading and stacking (belt conveyor)	0
Operations in loader gate	0
Conveyor junction	0
Preparatory work at face	0
Supply gate loading point (monorail)	0
Ploughing	0
Supply gate loading point (belt conveyor)	0
Shifting Titan props	0
Clearing loader gate	0
Hewing	0
Operations in loader gate	0
Unloading material container and stacking (monorail)	0
Preparatory work at face	0
Unloading and stacking (belt conveyor)	0
Ploughing	0
Conveyor junction	0
Counting steel components	0
Supply gate loading point (monorail)	0

Supply gate loading point (belt conveyor)	0
Supply gate loading point (monorail)	0
Conveyor junction	0
Counting steel components	0
Unloading and stacking (belt conveyor)	0
Ploughing	0
Unloading material container and stacking (monorail)	0
Preparatory work at face	0
Hewing	0
Operations in loader gate	0
Shifting Titan props	0
Clearing loader gate	0
Preparatory work at face	0
Supply gate loading point (belt conveyor)	0
Supply gate loading point (monorail)	0
Conveyor junction	0
Counting steel components	0
Unloading and stacking (belt conveyor)	0
Ploughing	0
Unloading material container and stacking (monorail)	0
Preparatory work at face	0
Hewing	0

Operations in loader gate	0
Shifting Titan props	0
Supply gate loading point (belt conveyor)	0
Conveyor junction	0
Unloading and stacking (belt conveyor)	0
Supply gate loading point (monorail)	0
Unloading material container and stacking (monorail)	0
Counting steel components	0
Hewing	0
Ploughing	0
Shifting Titan props	0
Preparatory work at face	0
Clearing loader gate	0
Operations in loader gate	0
Ploughing	0
Supply gate loading point (belt conveyor)	0
Conveyor junction	0
Unloading and stacking (belt conveyor)	0
Supply gate loading point (monorail)	0
Unloading material container and stacking (monorail)	0
Counting steel components	0
Hewing	0

Ploughing	0
Shifting Titan props	0
Preparatory work at face	0
Clearing loader gate	0
Supply gate loading point (belt conveyor)	0
Unloading and stacking (belt conveyor)	0
Unloading material container and stacking (monorail)	0
Conveyor junction	0
Hewing	0
Supply gate loading point (monorail)	0
Shifting Titan props	0
Counting steel components	0
Clearing loader gate	0
Ploughing	0
Operations in loader gate	0
Preparatory work at face	0
Counting steel components	0
Supply gate loading point (belt conveyor)	0
Unloading and stacking (belt conveyor)	0
Unloading material container and stacking (monorail)	0
Conveyor junction	0
Hewing	0

Supply gate loading point (monorail)	0
Shifting Titan props	0
Counting steel components	0
Clearing loader gate	0
Ploughing	0
Operations in loader gate	0
Supply gate loading point (belt conveyor)	0
Unloading material container and stacking (monorail)	0
Hewing	0
Unloading and stacking (belt conveyor)	0
Shifting Titan props	0
Conveyor junction	0
Clearing loader gate	0
Supply gate loading point (monorail)	0
Operations in loader gate	0
Counting steel components	0
Preparatory work at face	0
Ploughing	0
Clearing loader gate	0
Supply gate loading point	0
Unloading material container and stacking (monorail)	0
Hewing	0

ANNEX I-15

Example for next questionnaire

How difficult do you find digging your garden?

Enter a cross in one of the boxes.

Digging the garden is heavy ☐☐☐☐☐ light work

Now fill in yourself below:

1. Supply gate loading point (belt conveyor)	heavy	☐☐☐☐☐	light
2. Supply gate loading point (monorail)	heavy	☐☐☐☐☐	light
3. Conveyor junction	heavy	☐☐☐☐☐	light
4. Unloading and stacking (belt conveyor)	heavy	☐☐☐☐☐	light
5. Unloading material container and stacking (monorail)	heavy	☐☐☐☐☐	light
6. Hewing	heavy	☐☐☐☐☐	light
7. Shifting Titan props	heavy	☐☐☐☐☐	light
8. Clearing loader gate	heavy	☐☐☐☐☐	light
9. Operations in loader gate	heavy	☐☐☐☐☐	light
10. Preparatory work at face	heavy	☐☐☐☐☐	light
11. Ploughing	heavy	☐☐☐☐☐	light
12. Counting steel components	heavy	☐☐☐☐☐	light

ANNEX II-1

Rules for evaluating medical headings in the job diagram

Near sight

Under this heading we are concerned with objects situated at a distance of up to 5 m which are liable to influence actions and decisions; light intensity is an important factor in assessing the corresponding requirements.

See also heading "Lighting defects".

Under "Duties" indicate whether one-eyed workers or persons wearing glasses can be employed.

1. Duty in which objects of less than 1 mm must be distinguished and correcting glasses may not be used.

2. Duty in which objects of 1 mm must be distinguished; the wearing of correcting glasses is not an obstacle.

3. Duty in which objects of 5 mm must be distinguished and the wearing of glasses is not an obstacle.

4. Duty in which objects of 2 cm must be distinguished.

5. Duty in which objects of 5 cm or more must be distinguished.

Long sight

Under this heading we are concerned with objects situated at a distance of more than 5 m which are liable to influence actions and decisions.

Important factors in determining requirements are the relationship between distance and dimensions of objects to be distinguished and light intensity. See under heading "Lighting defects".

ANNEX II-1

Under "Duties" indicate whether one-eyed workers or persons wearing glasses can be employed.

1. Duty in which an object of less than 1 cm must be distinguished at a distance of 5 or more (visual acuity 1 or more).

2. Duty in which objects of 2 cm must be distinguished at a distance of 5 m or more (visual acuity $\frac{1}{2}$ to 1).

3. Duty in which an object of 4 cm must be distinguished at a distance of 5 m or more (visual acuity $\frac{1}{4}$ to $\frac{1}{2}$).

4. Duty in which an object of 6 cm must be distinguished at a distance of 5 m or more (visual acuity 1/6 to 1/4).

5. Duty in which an object of 10 cm must be distinguished at a distance of 5 m or more (visual acuity 1/10 to 1/6).

Colour vision

1. Duty requiring perfect colour separation.

2. Duty requiring red/green separation.

3. Duty requiring no colour separation.

ANNEX II-2

Hearing

In fixing requirements under "Hearing", noise in the working environment must be taken into account.

See heading "Noise".

Under "Duties" indicate whether the use of hearing aids is permitted.

1. Duty in which a low noise corresponding to whispering at a distance of 5 m must be distinguished.
2. Duty in which a low noise corresponding to whispering at less than 5 m or conversation at more than 5 m must be heard.
3. Duty in which a noise corresponding to a conversation at about 5 m must be heard.
4. Duty in which a noise corresponding to a conversation at 1 m must be heard.
5. Duty in which hearing is not required in an environment that presents no risk to deaf persons.

Upper limbs

1. Duty in which heavy material must regularly be handled at shoulder level or above, or loads in excess of 50 kg must be coped with below shoulder level.
2. Duty in which light material must regularly be handled at shoulder level or above, or loads of up to 50 kg must be coped with below shoulder level.
3. Duty in which light loads must occasionnally be handled at shoulder level or above, or in which loads of up to 50 kg must be coped with below shoulder level.
4. Duty in which loads of up to 20 kg must be handled below shoulder level.
5. Duty in which loads of up to 8 kg must be handled below shoulder level.

Lower limbs

1. Duty in which work must be performed for long periods in an unnatural posture (crouching or kneeling) or in which the worker must crawl over uneven ground with his load and negotiate obstacles.

2. Duty in which kneeling may alternate with a bent posture or in which the worker must crawl over uneven ground and negotiate obstacles, use ladders or steps or stand a long time under his load.

3. Duty in which the worker must move mainly erect over uneven ground or perform his work standing, although changes of position are possible.

4. Duty in which the worker has simply to move erect over even ground or in which he may sit down when he is not working in an upright posture.

5. Duty which can be performed seated.

Back

1. Duty in which work must be performed in a highly unnatural (semi-prone) posture under a load, or in which material must be shovelled for long periods or loads of more than 50 kg lifted in a natural posture.

2. Duty in which work must be performed under a load in an unnatural (kneeling) posture, or in which the worker must crawl or lift loads of 35 to 50 kg in a natural posture or shovel material for long periods.

3. Duty in which the unnatural posture (kneeling more or less) may alternate with a natural posture or in which more than one load of more than 20 to 35 kg must be lifted in a natural posture, or in which a great deal of bending is involved.

4. Duty in which loads of up to 20 kg must be lifted in a natural posture or in which the worker must bend during some of his activities.

5. Duties which may be performed seated and do not involve load handling

Use of hands

Under this heading the function of grasping and holding with one or both hands and finger dexterity must be considered. Pointing, pressing and pushing are simpler activities performed with the hands.

1. Duty in which the hands and the fingers of both hands are used.

2. Duty in which two hands and the fingers of one hand are used merely for grasping.

3. Duty in which both hands are used merely for grasping.

4. Duty in which one hand is used merely for grasping.

5. Duty in which the hands are used for even simpler operations.

ANNEX II-4

Endurance

The assessment of "Endurance" is based on the following.

a) Dynamic stress

Factors to be considered are:

1. loads to be handled;
2. duration of handling of these loads;
3. continuity or discontinuity of load handling or activities comparable therewith;
4. dependence of the operations on machinery.

b) Static stress, under which points 1 to 4 under a) above must be considered.

c) Possible peak stress.

d) Climatic conditions.

Assessment under these headings must be based on the observations of the "technical work study department" or "job analysis department"

1. Duty involving continuous dynamic or static stress without regular interruptions for less strenuous activities or breaks.
2. Duty involving continuous dynamic or static stress with regular interruptions for less strenuous duties but without recurrent breaks.
3. Duty involving dynamic or static stress and regular interruptions for less strenuous activities and breaks.
4. Duty alternating with less strenuous and completely stress-free activities.
5. Duty involving alternating stress-free activities.

ANNEX II-5

General

Under this heading an evaluation is made of possible risks to an individual worker or groups of workers, or of material damage in conjunction with circumstances and events which may be more or less unforeseen, more or less alternating or involve more or less strain.

The following factors must be noted:

Work performed individually or in groups, in confined area, on raised surfaces or in the vicinity of depressions, on smooth, greasy or uneven ground.

Risks created by moving equipment, objects, dangerous machinery, sharp objects, electric current and fire.

Rapid succession of events etc.

1. Duty involving risks to the group, individual or material which are difficult to avoid.

2. Duty involving risks which are difficult to avoid for the individual or material but not for the group.

3. Duty involving considerable risks, known in advance, to men and material.

4. Duty involving slight risks, known in advance, to men and material.

5. Duty involving no risk either to men or material.

ANNEX II-5

Lighting defects

1. Duty performed in relatively dark surroundings with direct illumination of the object to be distinguished.

3. Duty performed in moderately lit surroundings with direct illumination of the object to be distinguished.

5. Duty in well-lit surroundings.

Noise

1. Duty in surroundings filled with persistent deafening noise, making verbal communication very difficult.

3. Duty performed in noisy surroundings in which verbal communication is still possible.

5. Duty in surroundings in which there is no obstructive noise.

Vibration

1. Duty exposed to persistent and violent vibrations.

3. Duty exposed to intermittent vibrations.

5. Vibration-free duty.

ANNEX II-6

Climatic conditions

The following factors must be noted:

heat, cold } possible changes in temperature

humidity, both of air and working environment, high winds, draughts

any combination of these circumstances.

Reference should be made to any regulations concerning climatic conditions.

1. Duty in which the worker is constantly exposed to a combination of adverse climatic conditions.

3. Duty generally performed under only slightly adverse climatic conditions or in the open air.

5. Duty performed in a protected and comfortable climatic environment.

Dust

1. Duty in an environment with a rating of 4, according to measurements by the "Ventilation Service".

2. Duty in an environment with a rating of 3.

3. Duty in an environment with a rating of 2.

4. Duty in an environment with a rating of 1b.

5. Duty in an environment with a rating of 1a.

ANNEX II-6

Respiratory irritation

This heading generally concerns gases, fog or vapour in the atmosphere; the type of harmful substances should be shown under "Remarks".

Reference should be made to the existence of maximum permissible concentrations and any relevant safety provisions.

1. Duty in an environment in which substances harmful to the respiratory tract - gases, fog or vapour - are regularly encountered.

3. Duty performed in an environment in which there is a limited likelihood of encountering gases, fog or vapour harmful to the respiratory tract.

5. Duty performed in an environment free from gases, vapour or fog harmful to the respiratory tract, or in places where their occurrence is kept under control by regular supervision and appropriate measures.

ANNEX II-7

Irritation of skin and mucous membranes

The nature of the harmful substances should be indicated under "Remarks".

Reference should be made to the existence of maximum permissible concentrations and to any relevant safety regulations.

1. Duty in which the worker is regularly in contact with substances which may irritate the skin and mucous membranes.

3. Duty in which the worker is in limited contact with substances which may irritate the skin and mucous membranes.

5. Duty in which the worker does not come into contact with substances which may irritate the skin and mucous membranes.

Toxic substances

The nature of the substances should be indicated under "Remarks".

Reference should be made to the existence of maximum permissible concentrations and to any relevant safety regulations.

1. Duty involving regular risk of poisoning.

3. Duty involving a limited risk of poisoning.

5. Duty involving no risk of poisoning or a risk kept under control by regular supervision and appropriate measures.

Type of shift

1. Duty in which all shifts - continuous or alternating - must be worked.

3. Duty performed during the day and afternoon shifts.

5. Duty involving one particular shift (not the night shift).

ANNEX III

Summary of activities

Description		Time (in 1/100 min)	No. of units	Unit weight	%
Walking		4078			8,92
Sitting in manrider		6655			14,56
Waiting		8008			17,52
Operating conveyor		2485			5,44
Meal break		2705			5,92
Moving tubs with car-pusher		1735			3,79
Moving tub or trolley by hand		2206			4,82
Transferring material from tub to conveyor	stop blocks	747	81	4,5 kg	34,73
	wooden caps	1181	99	7,5 kg	
	wooden props	1188	71	9,3 kg	
	split sleepers	2666	320	10,- kg	
	sacks of planks	622	29	15,- kg	
	oak planks	633	33	18,- kg	
	sleepers	1221	68	20,- kg	
	billets	127	12	20,- kg	
	wooden props	180	15	21,- kg	
	base plates	769	51	10,- kg	
	Titan props	2060	55	38,- kg	
	Titan props	802	19	47,- kg	
	Haarman caps	597	19	58,6 kg	
	roadway steel	2613	36	84,- kg	
	bags marl dust	469	20	40,- kg	
Miscellanous:	pulling 6 Titan props	700			4,30
	coupling tubs	510			
	discussing work	100			
	telephoning	300			
	loading old belt conveyor	310			
	reversing conveyor	45			
		45712	928	16342 kg	100 %

ANNEX III: Time study of working activities at a supply gate loading point

ANNEX III-1

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
	Begin 07.03 hr (from shaft)					
628	Walking from shaft to manrider					
4230	Sitting in manrider					
1375	Walking from manrider to loading installation					
1105	Removing jacket and waiting for instructions					
290	Replacing derailed tubs					
2485	Operating conveyor to transport 12 pcs roadway steel					
441	Unloading sacks of planks	mixed	20			15 kg
38	Pushing tubs forwards					
302	Unloading sleepers from tub	11 12 11 11 14 7 12 9 13 12 9 9 11 9 10 13*) 17 9 9 13 12 12 14 14 9 10 10	27	11	67x25x16	20 kg
	* At that moment the worker climbs into the tub					
55	Pulling tub forwards					
228	Unloading sleepers from tub	10 11 11 10 12 14 11 12*) 22 16 14 9 13 11 14 14 14 10	18	13	67x25x16	20 kg
1485	Pulling tub forwards + pause					
691	Unloading sleepers from tub	25 30 400 14 18 9 9 10 11 10 9 11 11*) 19 10 10 12 12 12 12 12 13 12	23	13	67x25x16	20 kg
115	Pulling tub forwards					
181	Unloading sacks of planks from tub (60 planks per sack)	8 10 10 8 11 11 12 13 9 9 14 10 11 13 11 11 10	17	11		15 kg
50	Pulling tub forwards					
132	Unloading planks from tub (3 planks in bundle)	23 13 16 12 12 17 15 14 10	9	15	120x12x5	18 kg
113	Pulling tub forwards					
501	Unloading planks from tub (3 planks in bundle)	15 12 12 11 12 12 12 9 9 10 200 18 13 14 10 12 12 13 13 13 15 16 11 27	24	13	120x12x5	18 kg
35	Pulling tub forwards					
180	Unloading wooden props from tub (4 props in bundle)	19 12 12 13 10 10 16 9 11 12 10 10 11 11 14	15	12	90x10	21 kg

ANNEX III-2

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
60	. Pulling tub forwards					
747	Unloading stop blocks from tub	18 7 7 7 9 8 7 6 6 7 6 7 6 6 7 6 6 7 12 8 8 7 7 7 7 7 8 7 9 6 8 9 10 9 8 8 6 7 8 9 6 8 6 6 10 7 9 7 7 8 7 12 105*) 12 9 6 8 9 9 8 8 8 7 7 8 8 8 8 9 7 8 7 9 8 8 7 7 9 8 9 22	81	8	120x12/2	4,5 kg
70	Pulling tub forwards					
494	Unloading split sleepers from tub	14 7 6 10 10 10 10 10 9 8 8 9 8 10 8 8 10 7 7 7 9 9*) 20 7 6 6 8 6 9 7 7 8 8 7 7 10 7 8 7 9 10 9 6 6 9 9 10 11 12 11 11 10 9 10 10 10	56	9	67x13x16	10 kg
35	Pulling tub forwards					
472	Unloading split sleepers from tub	4 10 8 10 7 10 9 8 8 9 10 9 9 8 8 7 8 7 8 8 10 9 9 9 9 10*) 17 6 7 6 8 9 7 9 8 8 12 21 10 11 9 9 11 9 15 11 10 10 8 10 10	51	9	67x13x16	10 kg
755	With supervisor: pulling tub with 6 Titan props (type 9) forwards and pushing further					
272	Unloading Titan props	55 38 65 30 50 34	6	45		38 kg

ANNEX III-3

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
190	Waiting					
1190	Changing trolley					
328	Unloading wooden props from trolley	10 21 18 16 15 13 14 21 19 17 16 18 15 18 18 16 17 14 17 15	20	16	160x10	9,3 kg
103	Pulling trolley forwards by hand					
241	Unloading wooden caps from trolley	10 11 11 10 12 10 10 19 17 17 14 12 11 12 9 9 10 9 10 10 8	21	11	200x12/2	7,5 kg
59	Pulling trolley forwards (by hand)					
63	Unloading wooden caps from trolley	8 9 11 12 14 9	6	10	200x12/2	7,5 kg
41	Pulling trolley forwards (by hand)					
529	Unloading wooden props from trolley same trolley as for 6 caps)	8 12 12 14 13 14 13 16 13 211 10 13 12 13 14 12 12 12 13 12 14 14 14 14 14 10	26	13	160x10	9,3 kg
23	Pulling trolley forwards (by hand)					
331	Unloading wooden props from trolley	8 15 11 11 12 15 14 11 14 11 14 14 14 13 18 15 13 21 13 13 14 13 14 12 8	25	13	160x10	9,3 kg
80	Pulling trolley forwards (by hand)					
877	Unloading wooden caps from trolley	11 11 12 12 11 14 15 12 11 10 14 11 12 11 12 10 10 10 11 11 16 13 12 14 12 12 13 11 12 13 11 12 12 13 12 16 21 10 13 17 12 11 10 11 13 16 17 14 10 12 14 9 12 11 10 9 13 9 12 10 16 10 9 15 12 11 10 10 17 15 11 10	72	12	200x12/2	7,5 kg

ANNEX III-4

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
420	Changing empty trolley					
334	Unloading split sleepers from tub This tub was unloaded by supervisor while the worker under observation changed empty trolleys	15 6 6 16 8 6 4 4 4 4 5 4 4 4 4 4 4 5 4 5 5 9 6 6 4 5 12 7 6 10 6 5 4 4 7*) 18 5 4 6 5 9 19 8 7 7 8 7 6 7 6	50	7	67x13x16	10 kg
	Supervisor unloads stop blocks from tub	not recorded				
310	Coupling tubs					
2705	Meal break (10.52 h)					
160	Pulling tub forwards and discussing work					
490	Unloading split sleepers from tub	14 21 19 6 12 9 8 5 5 6 6 7 7 7 7 9 11 12 7 6 6 5 7 7 9 10 6 7 8 7 6 8 8 7 9 7 8 12 14 12 10*) 14 7 9 8 14 8 9 8 6 8 9 8 14 7 4	56	9	67x13x16	10 kg
36	Pulling tub forwards					
418	Unloading split sleepers from tub	4 5 6 7 7 6 7 7 4 8 7 10 8 8 6 7 6 7 11 7 9 7 10 7 8 7 8 8 7 10 11*) 20 6 9 7 8 8 8 6 9 8 12 8 9 9 7 9 9 8 9 11 8	52	8	67x13x16	10 kg
30	Pulling tub forwards					
458	Unloading split sleepers from tub	10 4 5 6 7 11 11 8 9 8 7 7 7 8 8 7 8 8 7 7 8 7 8 9 9 10 10*) 18 6 7 8 8 8 7 7 8 9 9 8 10 9 10 9 8 9 8 10 9 10 7 9 8 9 9 7	55	8	67x13x16	10 kg

ANNEX III-5

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
180	Pulling tub forwards and releasing trolley chain					
127	Unloading billets from tub (10 billets in bundle)	10 10 9 9 12 15 9 11 11 11 10 10	12	11	110x6	20 kg
100	Pulling tub forwards and releasing trolley chain					
769	Unloading base plates from tub	*)100 11 11 9 12 10 17 9 10 40 15 10 13 9 30 10 10 40 12 12 8 10 12 9 10 9 12 10 12 11 14 14 10 15 11 12 15 17 11 11 16 10 16 14 12 11 21 13 10 8 15	51	13	ø 28	10 kg
490	Pulling tub forwards and waiting					
469	Unloading marl dust bags from tub	10*) 29 18 24 20 26 25 22 27 20 21 25 35 32 24 19 29 24 21 18	20	23		40 kg
380	Pulling trolley forwards and telephoning					
1085	Unloading trolley with roadway steel (2 men)	18 pieces. Not recorded in detail.	18	60	260	84 kg
120	Pulling trolley forwards					
1528	Unloading roadway steel from trolley (2 men)	65 42 48 65 60 100 81 89 206 164 59 80 40 130 65 110 92 32	18	85	260	84 kg
658	Pulling trolley forwards, coupling tubs and waiting					
597	Unloading Haarman caps from trolley (2 men)	75 109 20 16 19 23 24 21 26 24 24 30 26 26 36 27 21 34 16	19	27	240	58,6 kg
625	Pulling tub forwards and waiting					
310	Loading old conveyor belt (35 m)				26"	280 kg
936	Unloading Titan props from tub (type 9, 2 men)	54 39 34 45 44 48 32 38 41 34 36 42 59 38 44 84 28 22 69 24 19 21 23 18	24	39		38 kg
79	Pulling tub forwards					
802	Unloading Titan props from tub (type 14, 2 men)	24 24 30 38 36 52 72 32 34 29 32 34 59 78 39 46 61 48 34	19	42		47 kg

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
92	Pulling tub forwards					
852	Unloading Titan props from tub (type 9, 2 men)	8 31 92 38 34 36 39 36 39 35 34 32 40 35 38 24 32 27 22 23 34 42 36 34 11	25	34		38 kg
	End 13.20 h					
740	Waiting					
45	Reversing belt conveyor					
2745	Waiting					
1610	Walking to manrider					
2425	Sitting in manrider					
465	Walking from manrider to shaft					
500	Waiting at shaft					
	At pithead 14.45 h					
	Age of miner: 48					
457.12						

ANNEX IV

Summary of activities

Description	Time (in 1/100 min)	No.of units	Unit weight	%
Walking	4688			10,33
Sitting in manrider	6751			14,87
Waiting	6074			13,38
Operating conveyor	1420			3,13
Meal break	3037			6,69
Conveyor stopped	3774			8,32
Handling stop blocks	1281	152	4,5 kg	
Handling wooden caps	1350	99	7,5 kg	
Handling wooden props	1038	69	9,3 kg	
Handling split sleepers	3193	316	10,- kg	
Handling sacks of planks	713	37	15,- kg	
Handling oak planks	503	32	18,- kg	
Handling sleepers	976	76	20,- kg	
Handling billets	279	11	20,- kg	32,31
Handling wooden props	216	15	21,- kg	
Handling base plates	719	50	10,- kg	
Handling Titan props	2481	55	38,- kg	
Handling Titan props	881	19	47,- kg	
Handling Haarmann caps	574	19	58,6 kg	
Handling roadway steel	349	8	84,- kg	
Handling roadway steel	113	4	77,- kg	
Unloading + stacking roadway steel	3149	36	84,- kg	8,41
Unloading + stacking marl dust bags	667	18	40,- kg	
Miscellaneous: lowering belt reversing unit	332			
clearing up on conveyor belt to loading point	58 285			2,56
report on planks	440			
straightening caps	49			
	45390	1016	17735,- kg	100%

Annex IV: Time study of activities at conveyor junction

ANNEX IV-1

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
	Beginning of record 7.03 h(from shaft)					
621	Walking from shaft to manrider					
4240	Sitting in manrider					
1410	Walking from manrider to loading installation					
727	Personal needs					
721	Waiting for instructions					
315	Walking to workplace					
179	Removing jacket					
120	Carrying roadway prop from 1st to 2nd conveyor		1		260	84 kg
97	Conveyor stopped					
342	Carrying roadway props from 1st to 2nd conveyor	43 30 21 19 29 38 19 44 23 46 30	4 7	28 33	220 260	77 kg 84 kg
180	Lowering belt reversing unit					
1121	Operating 2nd conveyor for steel transport from 2nd to 3rd conveyor					
441	Carrying sacks of planks from 2nd to 3rd conveyor (60 planks per	210 12 15 14 13 12 10 12 13 10 14 13 13 12 12 13 11 13 9 10	20	12		15 kg
325	Carrying sleepers from 1st to 2nd conveyor	41 11 9 11 8 8 7 8 11 11 8 13 10 11 10 8 10 11 13 13 12 11 12 14 10 10 10 14	28	11	67-25-16	20 kg
75		63 12	18	13		
1370	Conveyor stopped					
35	Sleepers from 1st to 2nd conveyor	10 10 15			67-25-16	20 kg
398	Conveyor stopped					
180	Sleepers from 1st to 2nd conveyor	32 13 13 10 12 12 13 10 14 14 12 12			67-25-16	20 kg
361		13 17 10 13 13 17 14 11 10 8 11 13 9 11 10 12 17 11 12 12 12 12 11 12 10 11 11 11 12 14 14	30	12		
27	Report on planks					
272	Sacks of planks from 1st to 2nd conveyor (60 planks per sack)	94 11 10 9 10 12 13 12 8 10 12 12 10 12 11 13 13	17	11		15 kg

ANNEX IV-2

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min					Units of material per tub	Average time per unit	Dimensions	Unit weight
10	Report on planks									
170	Oak planks from 1st to 2nd conveyor (3 planks in bundle)	58	13	15	12	11	5	14	120-12-5	18
			18	17	11	15				
295	Conveyor stopped from below									
253	Oak planks from 1st to 2nd conveyor (3 planks in bundle)	56	13	14	10	10	23	13	120-12-5	18
			11	12	8	9				
			10	10	15	30				
			12	12	11	10				
80	Oak planks		13	14	12	14			120-12-5	18
			15	12						
31	Report on planks									
216	Wooden props from 1st to 2nd conveyor (4 props in bundle)	57	13	12	11	12	15	11	90x10	21
			10	10	12	13				
			10	10	10	10				
			12	14						
39	Reports on planks									
217	Stop blocks from 1st to 2nd conveyor	40	6	7	7	9	80	8	120x12/2	4,5
			9	7	7	6				
			8	5	5	5				
			8	6	7	5				
			7	9	10	8				
			6	7	6	8				
			9							
98	Conveyor stopped									
431	Stop blocks		6	5	7	6			120x12/2	4,5
			8	8	10	8				
			7	6	8	7				
			9	7	7	8				
			6	7	8	8				
			7	7	10	5				
			7	9	31	7				
			7	9	9	7				
			7	8	8	8				
			8	6	6	8				
			9	8	7	8				
			9	8	8	6				
			6	10	8	8				
			11	5						
36	Report on planks									
520	Sleepers from 1st to 2nd conveyor	57	8	8	11	12	55	9	67-13-16	10
			8	9	9	8				
			8	7	8	8				
			9	9	9	8				
			8	7	8	9				
			13	11	8	6				
			6	6	7	9				
			6	8	8	7				
			6	8	10	9				

ANNEX IV-3

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
390		38 8 7 8 7 10 8 7 8 8 9 10 9 9 6 8 7 7 8 8 8 9 9 11 8 10 8 14 7 7 7 7 7 7 9 8 9 12 21 9 13	52	7	67-13-16	10
98	Sleepers	8 10 10 7 8 10 9 10 8 8 10			67-13-16	10
21	Report on planks					
1130	Titan props from 1st to 2nd conveyor (type 9)	775 40 64 31 45 175	6	71		38
1573	Wooden props from 1st to 2nd conveyor	1265 11 17 14 14 15 13 20 17 19 15 15 18 18 17 15 18 15 17 20	20	16	160 x 10	9,3
342	Wooden caps from 1st to 2nd conveyor	114 13 9 8 12 12 17 11 14 24 8 9 13 12 9 9 9 10 9 10 10	21	11	200x12/2	7,5
72	Conveyor stopped					
49	Straightening wooden caps					
228	Switching on 2nd conveyor					
73	Wooden caps from 1st to 2nd conveyor	23 8 7 10 16 9	6	10	200x12/2	7,5
370	Wooden caps from 1st to 2nd conveyor	29 14 13 14 13 12 31 13 12 32 15 13 14 10 13 12 13 12 15 12 13 15 16 14	24	15	160 x 10	9,3
350		28 14 12 12 12 14 13 11 14 11 13 14 15 13 17 14 13 13 20 12 13 15 13 12 12	24	14	160 x 10	9,3

ANNEX IV-4

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min					Units of material per tub	Average time per unit	Dimensions	Unit weight
935	Wooden caps from 1st to 2nd conveyor	85	13	10	12	11	72	12	200x12/2	7,5
			22	7	10	11				
			10	12	12	11				
			13	10	10	10				
			11	9	19	8				
			10	14	12	11				
			12	12	12	13				
			11	13	11	12				
			15	20	20	7				
			10	23	8	8				
			14	10	18	13				
			18	5	14	10				
			13	10	12	10				
			12	10	16	5				
			14	5	21	6				
			9	9	14	11				
			12	11	15	21				
			5	11	11					
307	Sleepers from 1st to 2nd conveyor	214	22	4	4	5	54	6	67-13-16	10
			11	6	6	4				
			5	4	4	4				
			4	4	3	3				
225			3	3	4	3			67-13-16	10
			4	3	3	8				
			6	4	4	4				
			3	10	7	6				
			14	5	4	4				
			7	11	4	4				
			4	5	5	8				
			25	4	7	7				
			5	5	6	9				
			7							
485	Stop blocks from 1st to 2nd conveyor	225	5	3	3	3	54	5	90x10/2	2,6
			3	5	7	8				
			7	7	9	3				
			3	8	4	4				
			5	5	5	4				
			4	5	4	4				
			5	5	4	10				
			5	4	4	4				
			5	5	5	4				
			4	4	5	5				
			5	6	4	3				
			5	3	4	5				
			6	5	5	6				
			7							
2131	Meal break (10.57 h)									
148	Stop blocks from 1st to 2nd conveyor		31	5	5	4	18	8	90x10/2	2,6
			4	4	4	4				
			4	4	4	4				
			3	4	4	4				
			5	51						

ANNEX IV-5

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
739	Sleepers from 1st to 2nd conveyor	280 18 21 6 6 8 7 6 8 6 6 7 6 7 7 7 10 7 8 8 8 6 6 5 7 8 5 5 6 6 8 6 5 7 14 8 8 11 9 19 9 9 13 8 8 8 11 8 8 24 37	51	9	67-13-16	10
416	dito	41 7 6 7 7 6 7 5 5 5 7 7 14 5 6 7 6 7 9 7 9 8 8 7 8 7 7 8 8 8 10 11 15 8 7 7 7 8 6 8 9 12 8 9 8 8 9 8 9	52	10	67-13-16	10
27	dito	9 9 9				
471		52 7 7 11 11 9 9 7 7 8 7 8 8 7 7 6 7 7 7 8 8 10 9 8 10 10 14 7 6 8 7 6 7 7 9 9 9 7 9 9 9 7 8 8 10 9 10 6 9 8 8 10	52	8	67-13-16	10
32	Report on planks					
279	Billets from 1st to 2nd conveyor (10 in bundle)	161 20 10 12 10 13 10 11 12 11 9	11	12	100 x 6	20
151	Report on planks					
719	Base plates from 1st to 2nd conveyor	58 12 9 9 10 15 12 10 39 16 9 12 8 33 9 7 41 12 10 10 13 11 8 9 9 10 10 13 12 13 13 13 17 16 11 12 21 10 12 14 13 15 16 11 10 22 11 10 9 14	50	13	28 ø	10

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
57	Report on planks					
36	Report on planks					
158	Walking from conveyor junction upwards					
667	Unloading sacks of dirt from 1st conveyor and stacking	151 22 19 21 25 25 24 25 28 19 30 28 33 27 20 28 32 110	18	30		40
19	Walking					
315	Waiting; conveyor stopped					
80	Waiting; conveyor running					
	Removing roadway steel from conveyor and stacking with another worker		36		260	84
31	Unloading and stacking stop signals					
90	Waiting					
30	Unloading from conveyor and stacking	Operators use the signal cable to ask for the conveyor to be set in motion. They then wait until it has brought the roadway steel to the stacking point, after which they give the stop signal with the same cable.				
59	Waiting					
21	Unloading from conveyor and stacking					
88	Waiting					
18	Unloading from conveyor and stacking					
106	Waiting					
7	Unloading from conveyor and stacking					
32	Waiting					
13	Unloading from conveyor and stacking				260	84
25	Waiting					
14	Unloading from conveyor and stacking					
34	Waiting					
45	Unloading from conveyor and stacking					
16	Waiting					
11	Unloading from conveyor and stacking					
34	Waiting					
15	Unloading from conveyor and stacking					
46	Waiting					
31	Unloading from conveyor and stacking					
48	Waiting					
23	Unloading from conveyor and stacking					
20	Waiting					
37	Unloading from conveyor and stacking					
92	Waiting					

ANNEX IV-7

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
20	Unloading from conveyor and stacking					
103	Waiting					
26	Unloading from conveyor and stacking					
42	Waiting					
27	Unloading from conveyor and stacking					
64	Waiting					
25	Unloading from conveyor and stacking					
36	Waiting					
35	Unloading from conveyor and stacking					
95	Waiting					
31	Unloading from conveyor and stacking					
42	Waiting					
13	Unloading from conveyor and stacking					
48	Waiting					
36	Unloading from conveyor and stacking					
48	Waiting					
35	Unloading from conveyor and stacking					
92	Waiting					
24	Unloading from conveyor and stacking					
33	Waiting					
21	Unloading from conveyor and stacking					
121	Waiting					
20	Unloading from conveyor and stacking					
79	Waiting					
38	Unloading from conveyor and stacking					
29	Waiting					
28	Unloading from conveyor and stacking					
69	Waiting					
16	Unloading from conveyor and stacking					
90	Waiting					
66	Unloading from conveyor and stacking					
52	Waiting					
31	Unloading from conveyor and stacking					
82	Waiting					
23	Unloading from conveyor and stacking					
81	Waiting					
25	Unloading from conveyor and stacking					
68	Waiting					

ANNEX IV-8

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
23	Unloading from conveyor and stacking				260	84
50	Waiting					
36	Unloading from conveyor and stacking					
35	Waiting					
16	Unloading from conveyor and stacking					
84	Waiting					
25	Unloading from conveyor and stacking					
181	Waiting					
70	Backwards to conveyor junction					
574	Haarmann caps (2.40) froms 1st to 2nd conveyor	70 64 35 21 20 22 22 19 29 25 22 21 35 23 31 32 23 28 32	19	28	240	58,6
1129	Conveyor stopped					
878	Titan props from 1st to 2nd conveyor (type 9)	35 30 88 43 32 44 35 41 26 50 44 42 48 46 70 28 25 66 21 22 19 23	22	40		38
870	dito (type 14)	125 30 38 31 44 69 43 39 34 28 37 31 80 58 44 53 58 37	18	44		47
1161	dito (type 9)	230 98 48 30 31 37 30 32 46 31 35 47 34 30 29 35 34 19 23 26 33 42 37 23 84 17	26	37		38
10	Wooden props from 1st to 2nd conveyor		1		160x10	93
11	Titan props from 1st to 2nd conveyor		1			47
87	Titan props from 1st to 2nd conveyor		1			38
152	Lowering belt reversing unit					
288	Waiting					
32	Reversing conveyor					
58	Clearing up					
39	Reversing conveyor					
285	On conveyor to loading point					
2344	Waiting at loading point					
1634	Walking to manrider					

Total time in 1/100 min	Description	Unloading time per unit of material in 1/100 min	Units of material per tub	Average time per unit	Dimensions	Unit weight
2511	Sitting in manrider					
531	Walking to shaft					
500	Waiting at shaft					
453,90						
	At pithead 14.45 h					
	Age of miner : 50					

ANNEX V

Works		Department	Workplace/Duties		Date
Emma/Hendrik		Face	Loading point tub - conveyor		
Transfer of material from tubs to conveyor					
Criteria for the assessment					Remarks
Vision	Near	Material to be unloaded Conveyor control switches Telephone dial Car-pusher control cable	1 2 (3) 4 5		
	Long	Rail traffic Workplace surroundings	1 2 3 (4) 5		
	Colours	None	1 2 3 4 (5)		
Hearing		Telephone Communication with next man	1 2 3 (4) 5		

Annex V: Work aspect analysis

ANNEX V-1

Muscular strength	Upper limbs	Lifting material from tub and pushing onto conveyor	1 (2) 3 4 5	Material quantities, types and weights; see time study
Movement	Lower limbs	Standing on platform Climbing into tub	1 (2) 3 4 5	
Posture	Back	Lifting material from tub and pushing onto conveyor Reaching down into tub	1 (2) 3 4 5	Material quantities, types and weights; see time study

ANNEX V-2

Use of hands	Grasping and holding material Pulling car-pusher cable Using knife to cut cords Using telephone Coupling tubs	1 2 (3) 4 5	
Endurance	Unloading tubs at own pace Interruption of regularity of operations for unloading materials when tubs are moved forwards by car-pusher	1 (2) 3 4 5	Frequency and duration of operation; see time study
General	Watching for moving material when unloading tubs Watching for rail traffic	1 2 3 (4) 5	

ANNEX V-3

Lighting defects	Electric lighting in cross cut	1 2 (3) 4 5	
	Head-lamp		
Noise	None	1 2 3 4 (5)	
Vibration		1 2 3 4 (5)	
	None		
Climatic conditions		1 2 (3) 4 5	
	No special features		
Dust	Category I	1 2 3 4 (5)	
Respiratory irritation	None	1 2 3 4 (5)	
Skin irritation	Chromium from K.F. props	1 2 (3) 4 5	Protective
			gloves
	Cement from concrete blocks		
Toxic substances	None	1 2 3 4 (5)	
Type of shift	No alternate shifts	1 2 3 4 (5)	

ANNEX VI

Works	Department	Workplace/Duties	Date
Emma/Hendrik	Face	Conveyor junction	

Movement of material across conveyor junction

	Criteria for the assessment			Remarks
Vision	Near	Inserting conveyor switch-key	1	
		Conveyor control button	2	
		Conveyor operating switch	(3)	
		Emergency switch cable		
		Material on moving belt	4	
		Telephone dial	5	
		Signal cable		
	Long	Material on moving belt	1	
		Workplace surroundings	2	
			3	
			(4)	
			5	
	Colours	None	1	
			2	
			3	
			4	
			(5)	
Hearing		Telephone	1	
		Communication with next man	2	
			3	
			(4)	
			5	

Annex VI: Work aspect analysis

ANNEX VI-1

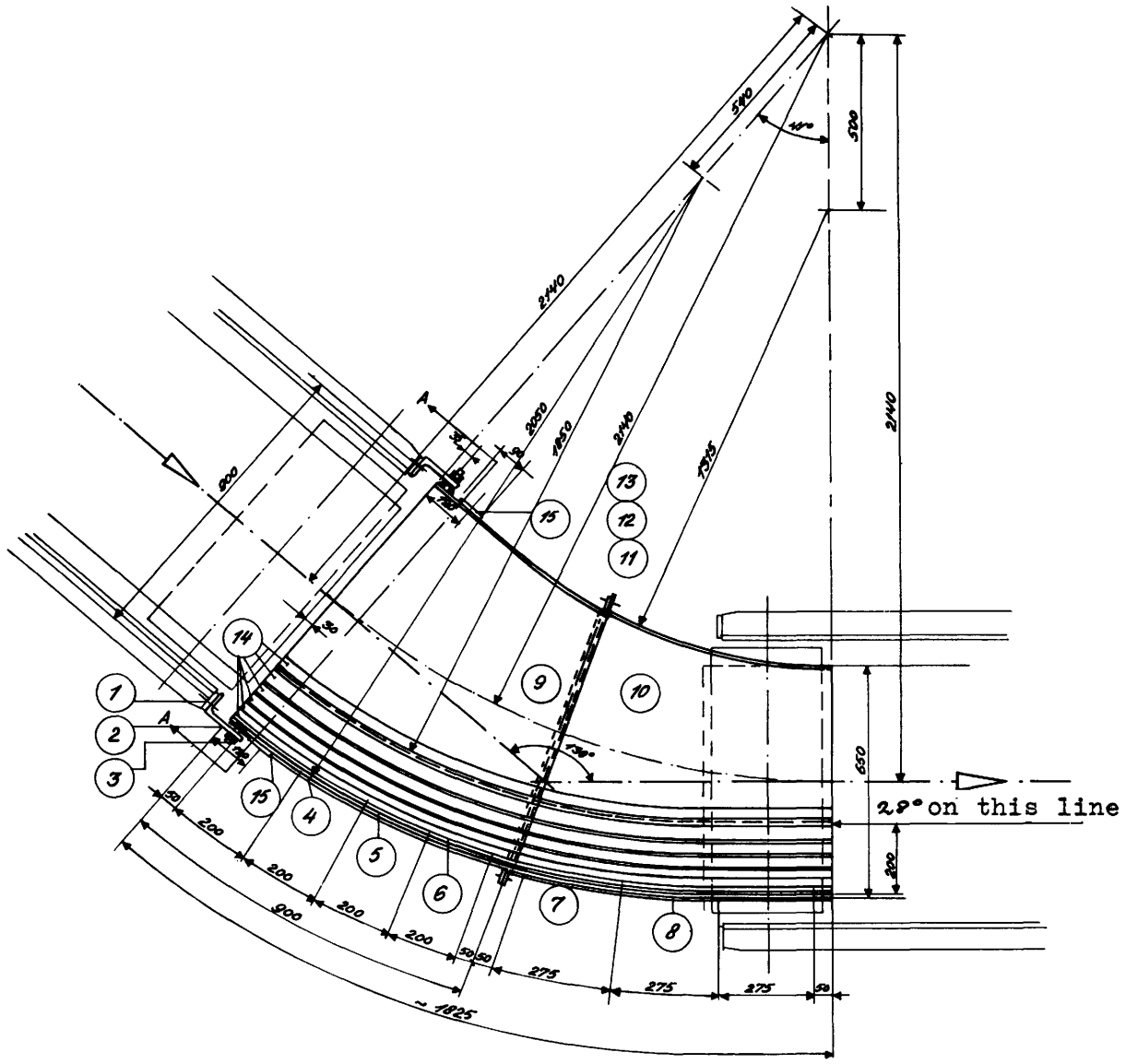
Muscular strength	Upper limbs	Lifting each piece of material from one conveyor and pushing onto the next For long pieces of steel strip, conveyor must be stopped, the strip pushed onto the next conveyor, and the conveyor started up again	1 (2) 3 4 5	Material quantities, types and weights; see time study
Movement	Lower limbs	Standing	1 (2) 3 4 5	
Posture		Lifting material Bending while transferring material from one conveyor to the next Working height 50-65 cm	1 (2) 3 4 5	Material quantities, types and weights; see time study

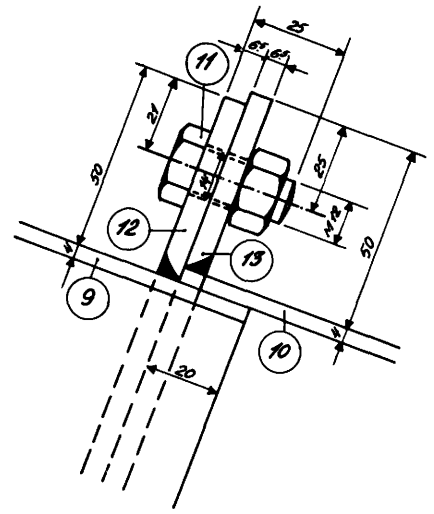
ANNEX VI-2

Use of hands	Operating conveyor switches Grasping and holding material Pulling on signal cable	1 2 (3) 4 5	
Endurance	Prescribed working rate for transferring material from one conveyor to another Lifting different types of material	1 (2) 3 4 5	Frequency and duration of operations; see time study
General	Correct grasping and holding of material on moving belt	1 2 3 (4) 5	

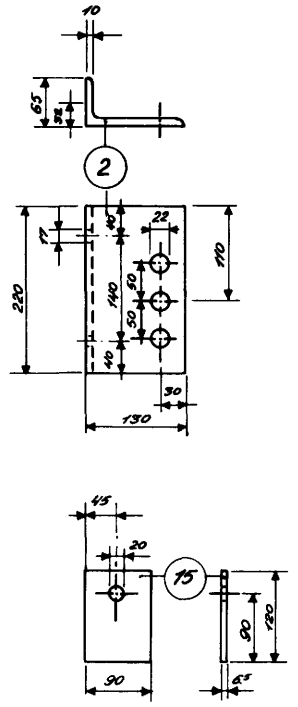
ANNEX VI-3

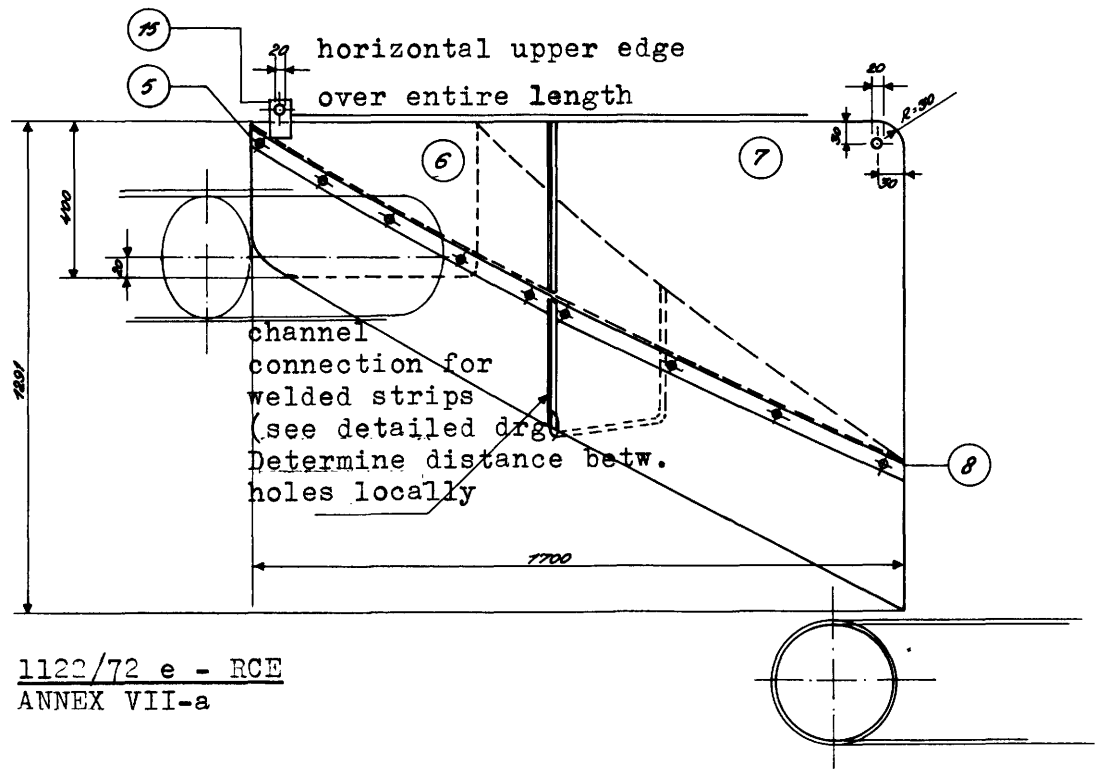
Lighting defects	Head-lamp	(1) 2 3 4 5	
Noise	Moving belt conveyors	1 2 3 4 (5)	
Vibration	None	1 2 3 4 (5)	
Climatic conditions	No special features	1 2 (3) 4 5	
Dust	Category I	1 2 3 4 (5)	
Respiratory irritation	None	1 2 3 4 (5)	
Skin irritation	Chromium from K.F. props Cement from concrete beams	1 2 (3) 4 5	Protective gloves
Toxic substances	None	1 2 3 4 (5)	
Type of shift	No alternating shift	1 2 3 4 (5)	

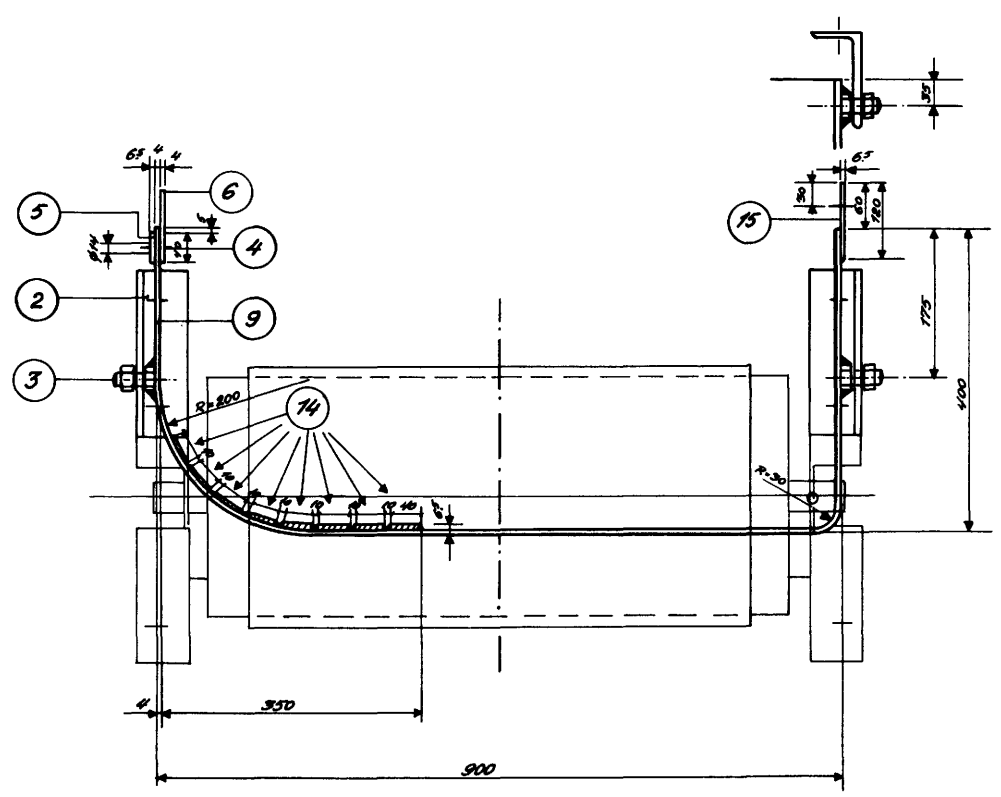




channel connection
(detailed drg)



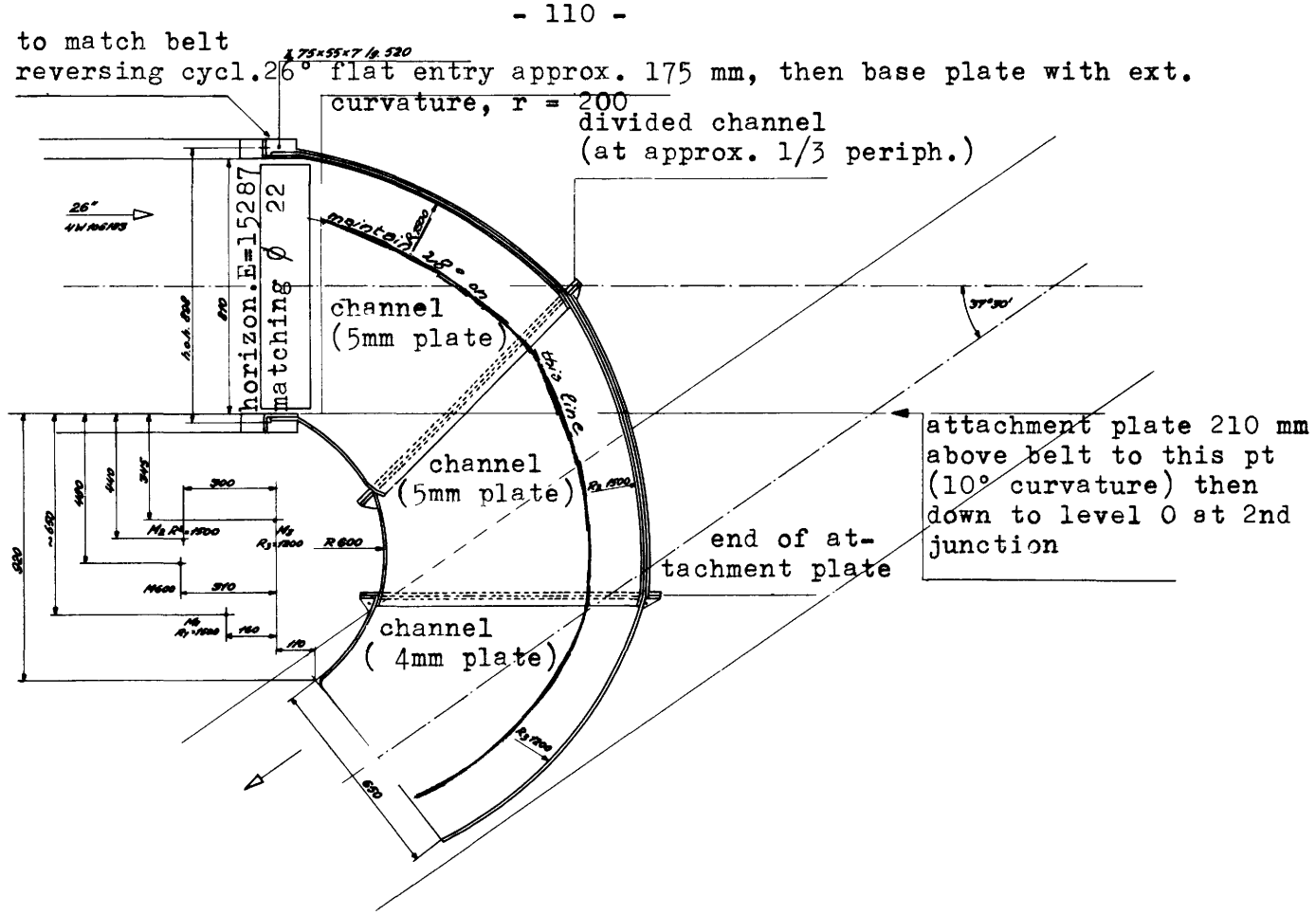


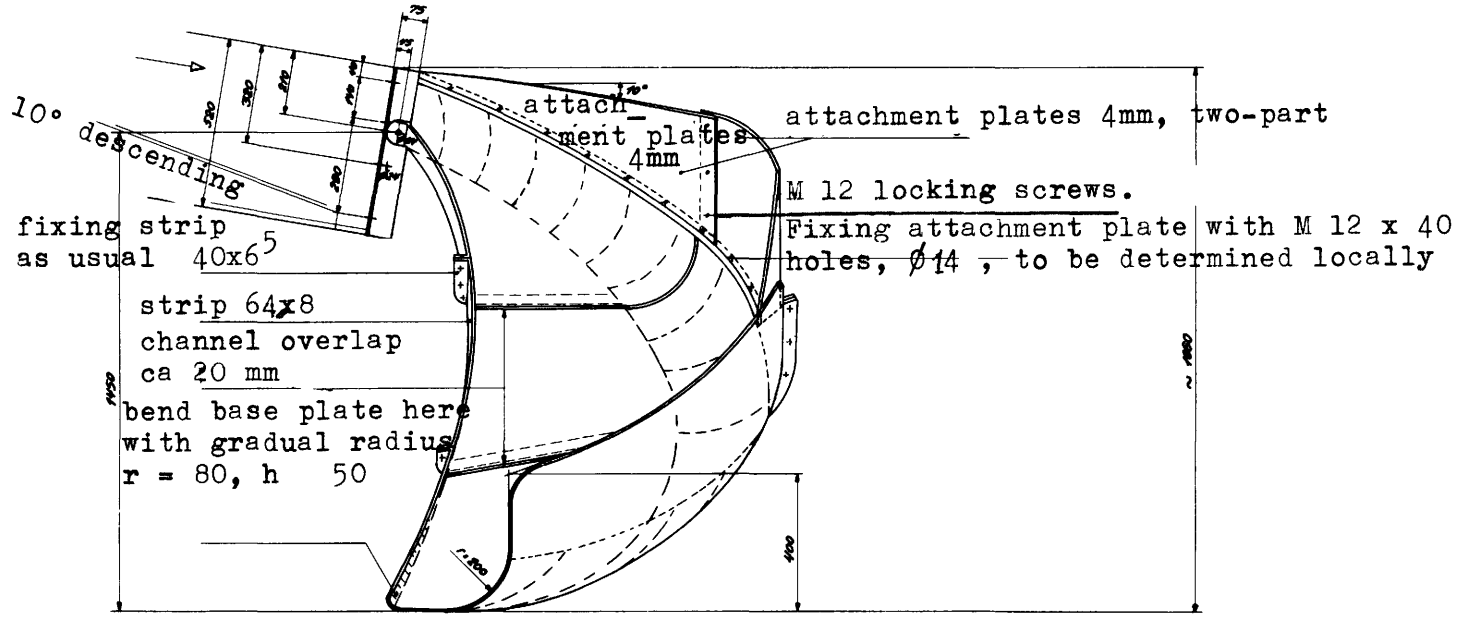


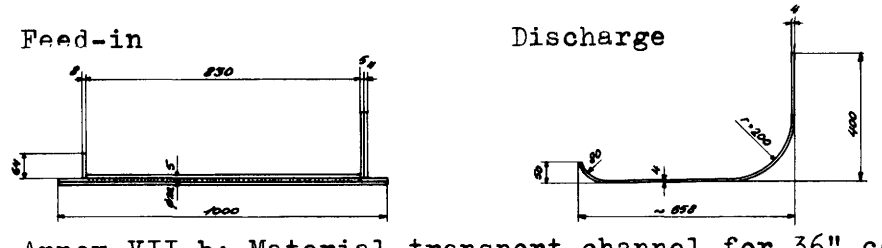
section A-A

	17							
	16							
2	15	Strap 90×6.5×120	Nr.33 DIN 17100					62-11-59
8	14	strip 40×6.5	"					" 62-11-16
1	13	Plate 50×6.5	"					" 62-11-27
1	12	Plate 50×6.5	"					" 62-11-27
12	11	bolt M12×25	4D		60	100	25	cf STM 60-100-A
1	10	Channel section Al. 4mm	Nr.38 DIN 17100					cf. 62-1-5
1	9	Channel section Al. 4mm	"					" 62-1-5
1	8	strip 40×6.5	"					" 62-11-16
1	7	Side plate 4mm	"					" 62-1-5
1	6	Side plate 4mm	"					" 62-1-5
1	5	strip 40×6.5	"					" 62-11-16
9	4	bolt M12×25	4D		60	100	25	cf STM 60-100-A
2	3	bolt M30×50	4D		60	100	59	L=40
2	2	Section 65×13×4	Nr.33 DIN 17100					×62-16-9
4	1	bolt M16×35	4D		60	100	42	cf STM 60-100-A
Pos.	Qty.	Description and dimensions	Material	Supplier	Article No.			Remarks

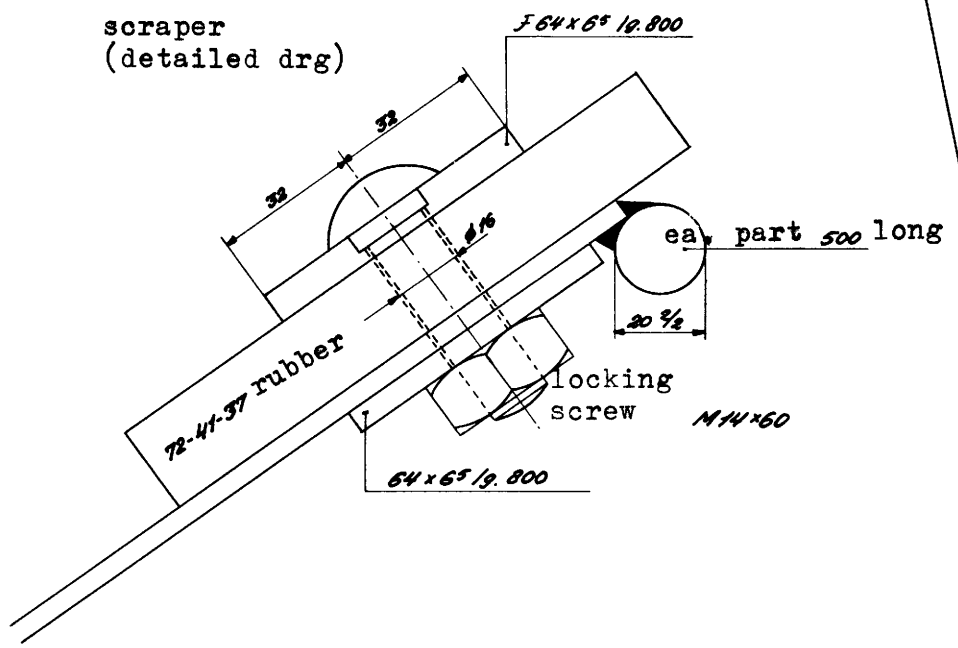
Annex VII-a: Slide for material transport, 139° left

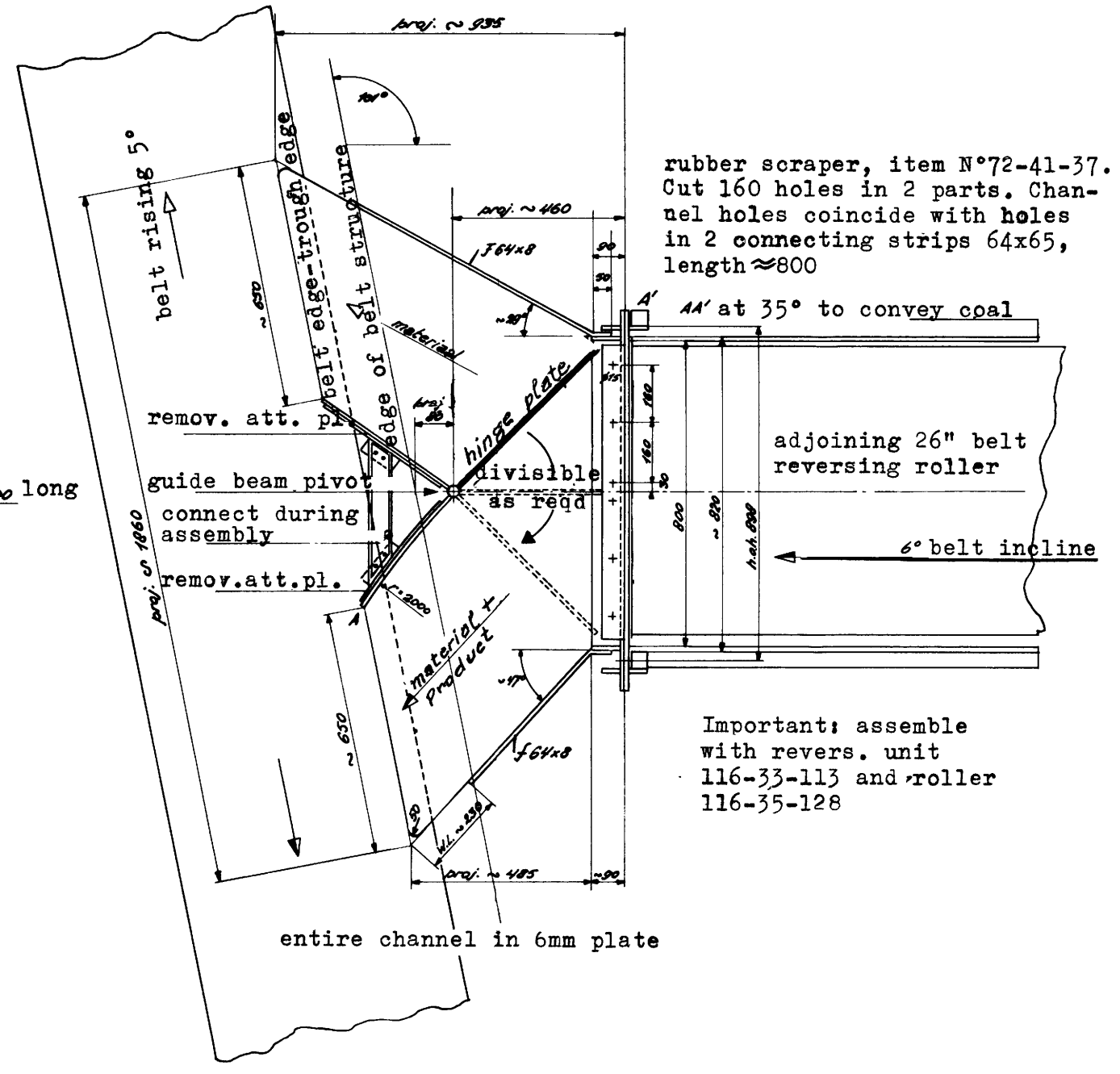






Annex VII-b: Material transport channel for 36" conveyor junction, angle 37° 30' right

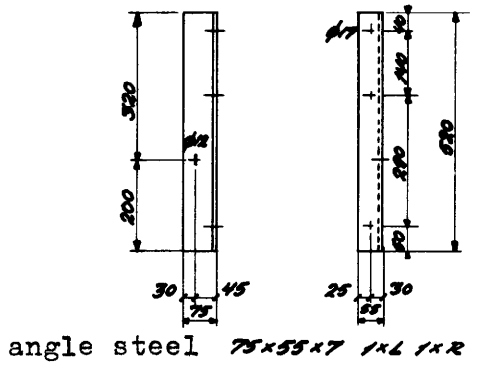


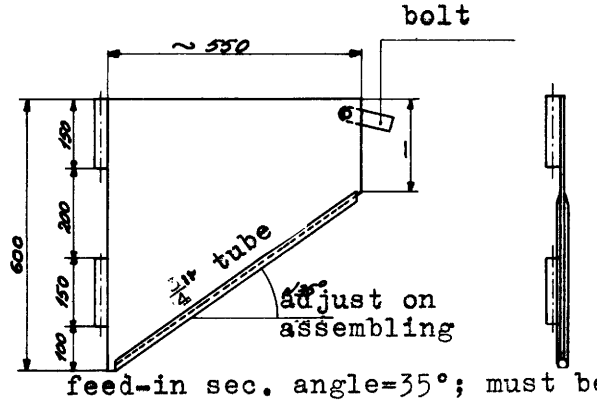


rubber scraper, item N°72-41-37. Cut 160 holes in 2 parts. Channel holes coincide with holes in 2 connecting strips 64x65, length ≈800

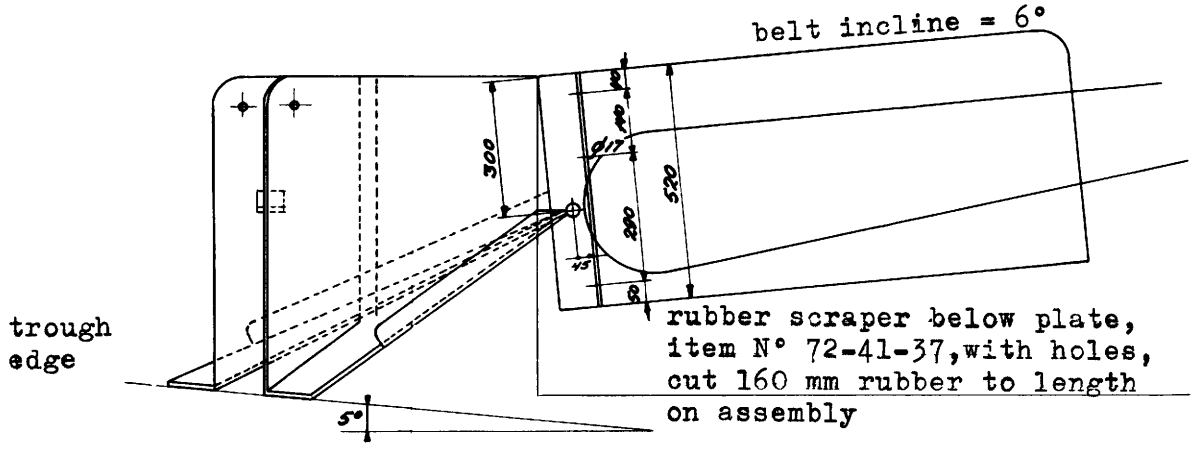
AA' at 35° to convey coal

Important: assemble with revers. unit 116-33-113 and roller 116-35-128



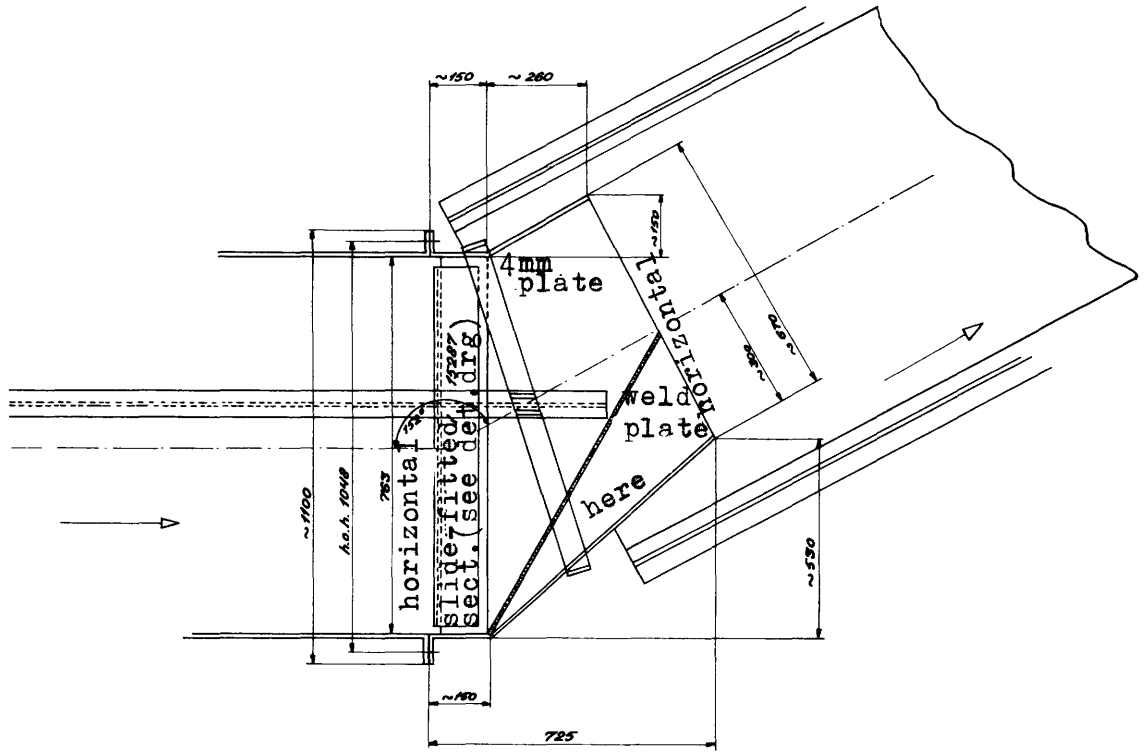


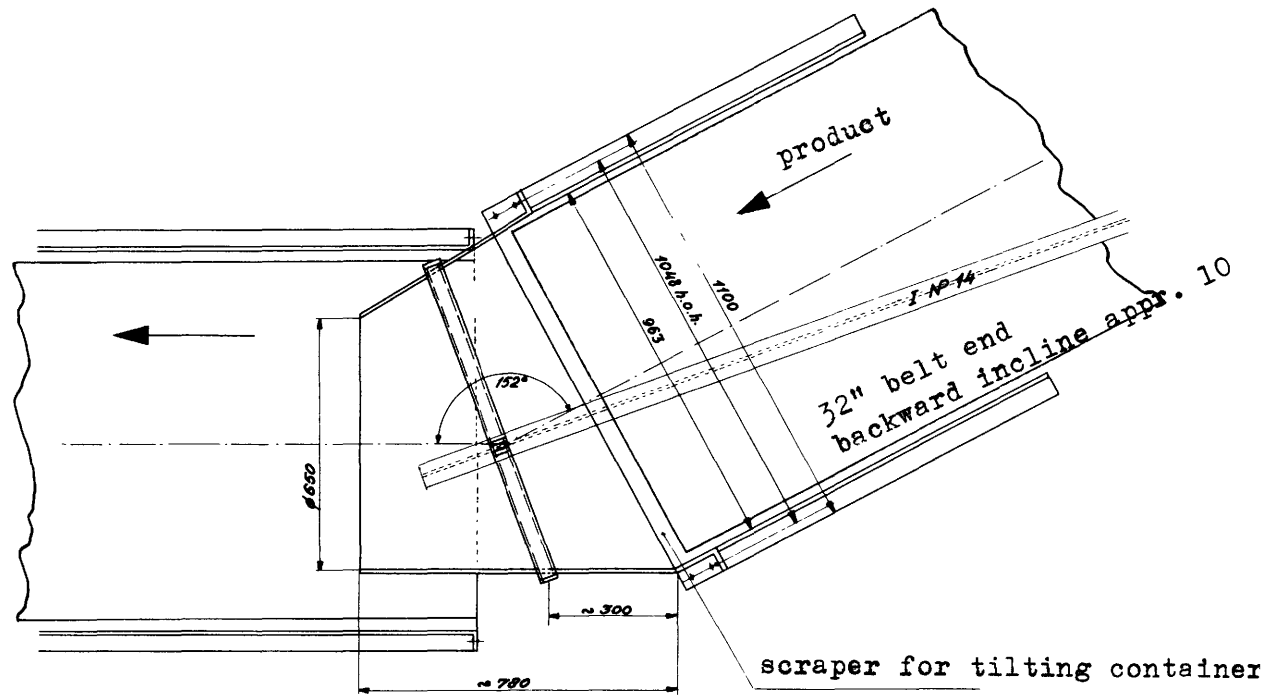
feed-in sec. angle=35°; must be flat laterally. Fit hinge plate. Determine correct dims. on installation. Plate must reach min. height of 150 mm to pass from pos. 1 to 2 at drive roller



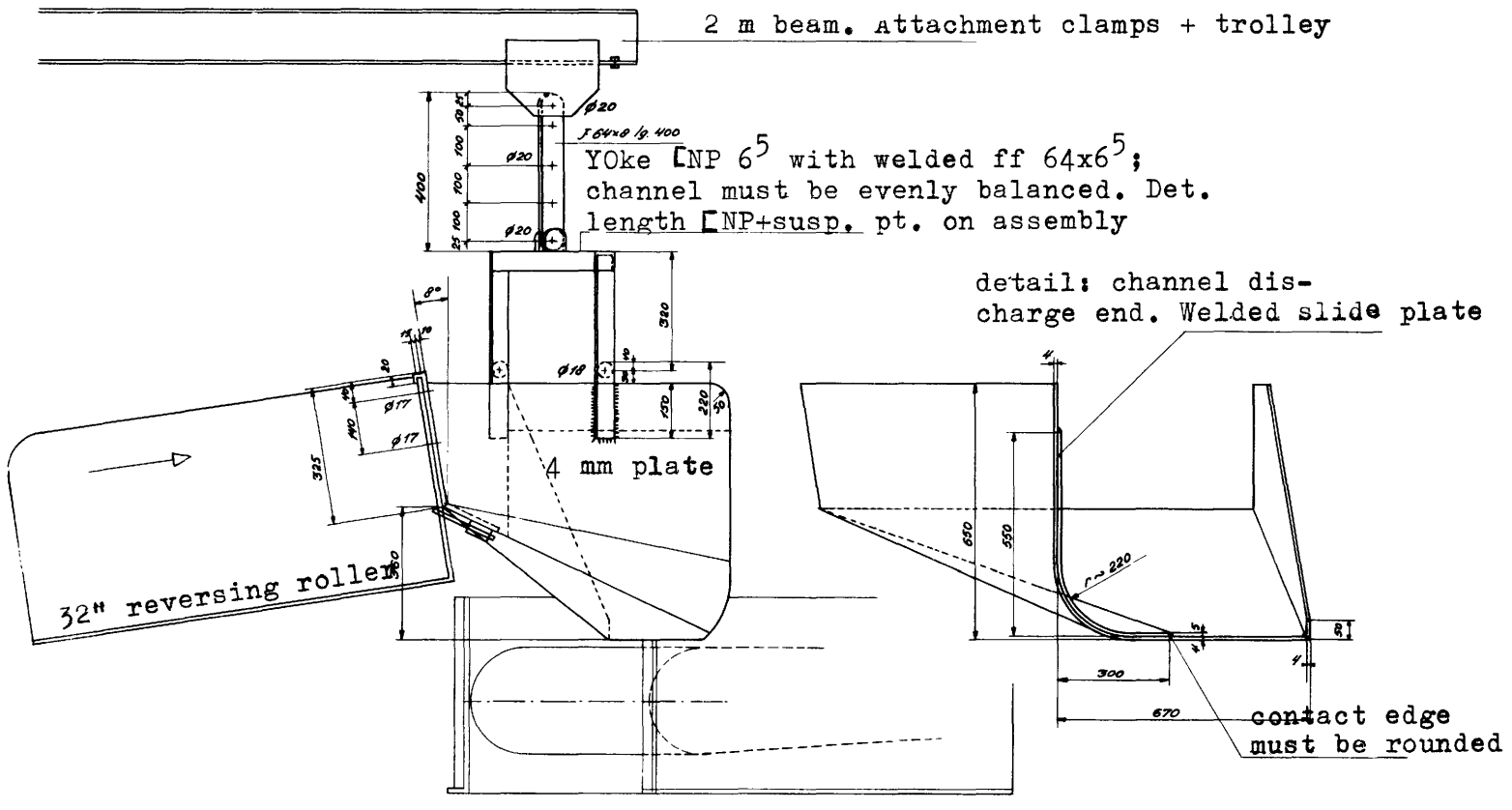
rubber scraper below plate, item N° 72-41-37, with holes, cut 160 mm rubber to length on assembly

Annex VII-c: Channel 101°_79° for material and coal from 26" to 32"



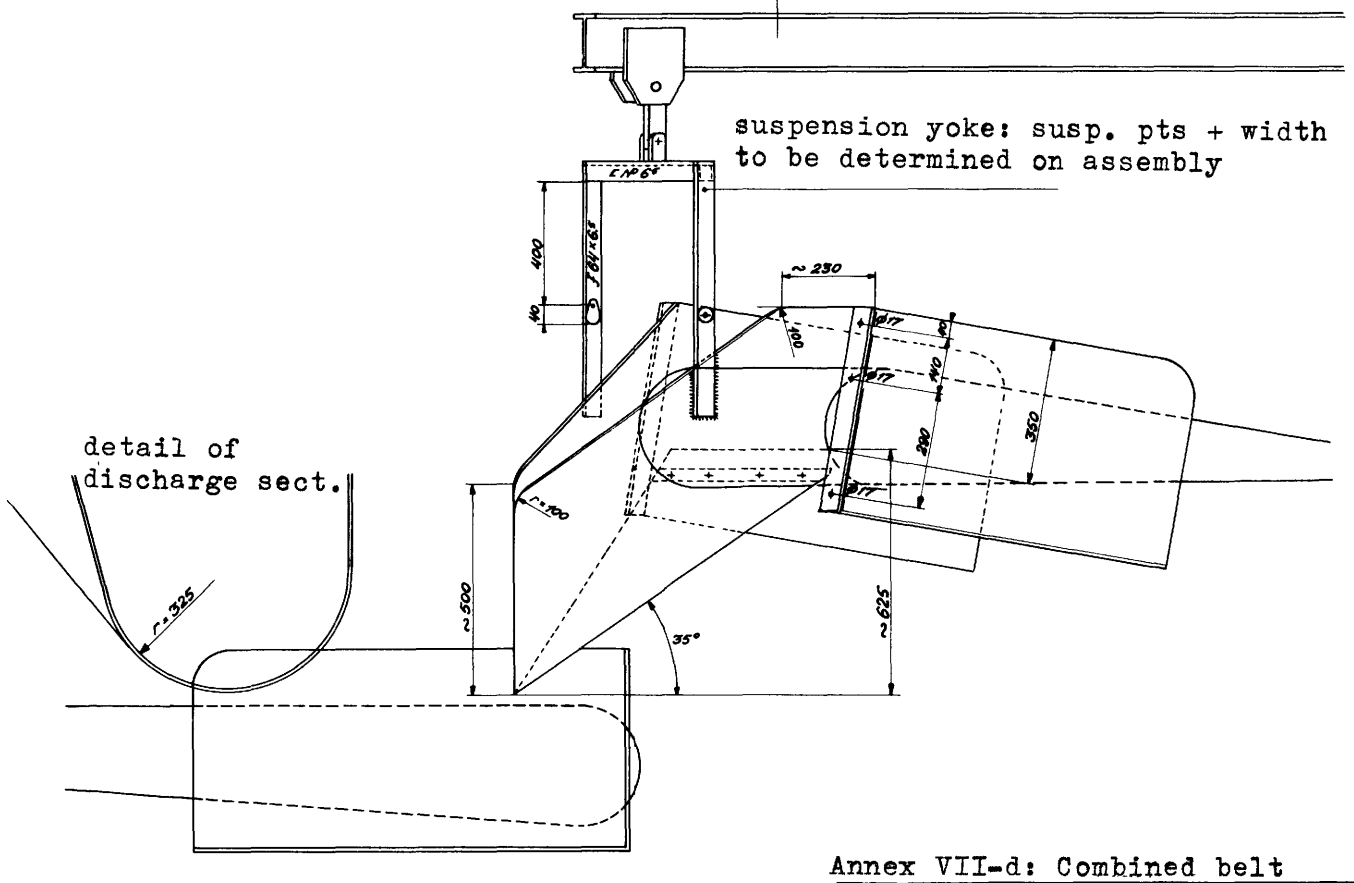


entire tilting container in 5 mm sheet



supply channel with susp. + trolley for ⊏NP 14

MATERIAL CONVEYOR CHANNEL

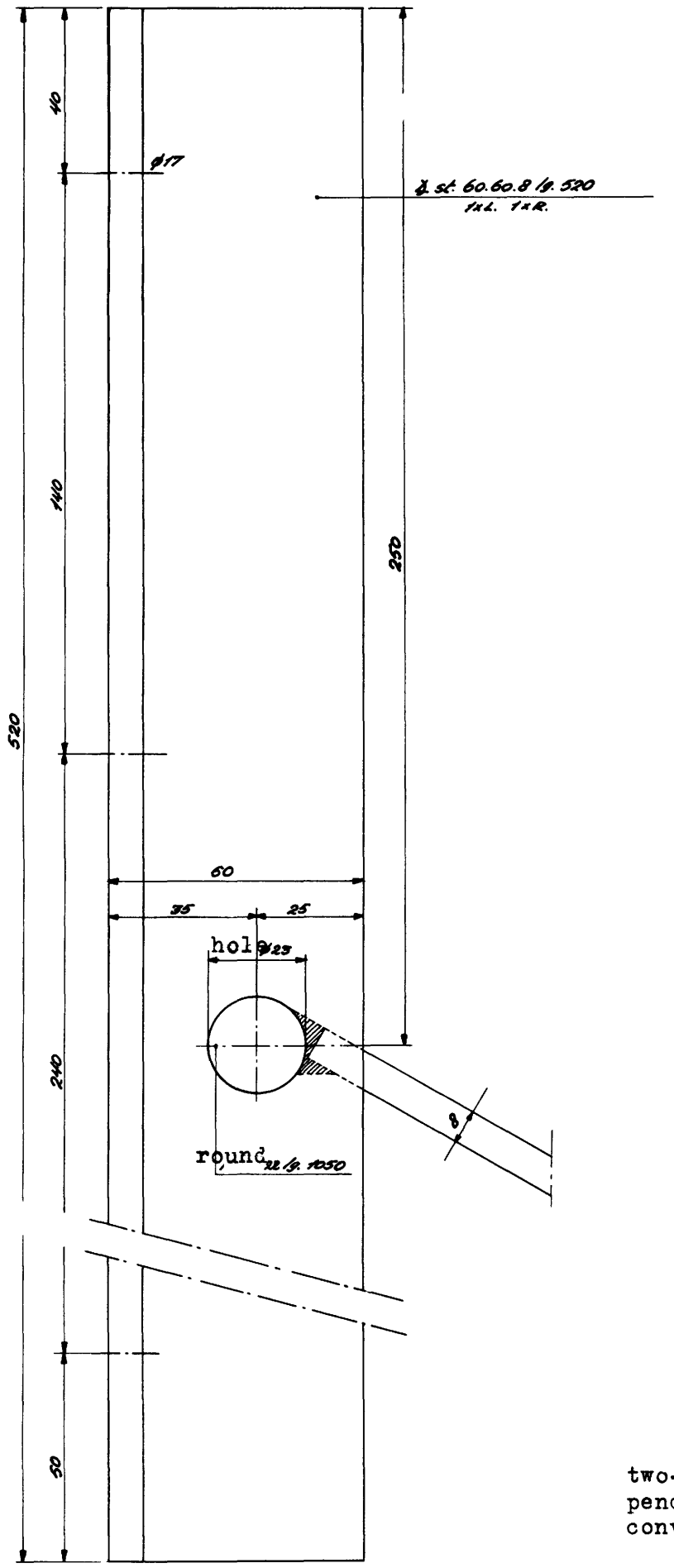


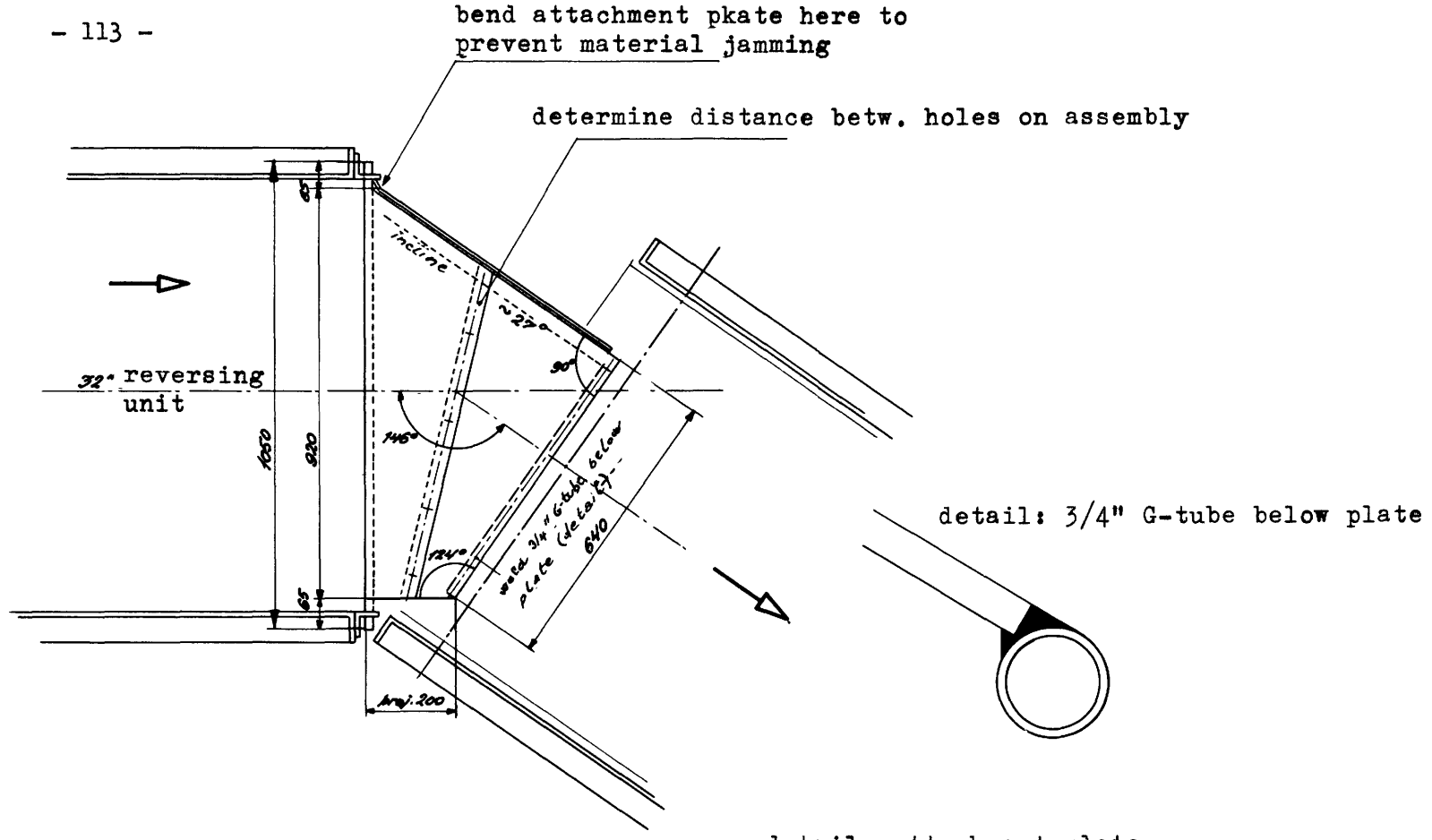
CONVEYOR CHANNEL FOR PRODUCT

Annex VII-d: Combined belt junction (angle = 152°,32" belts)

1122/72 e - RCE

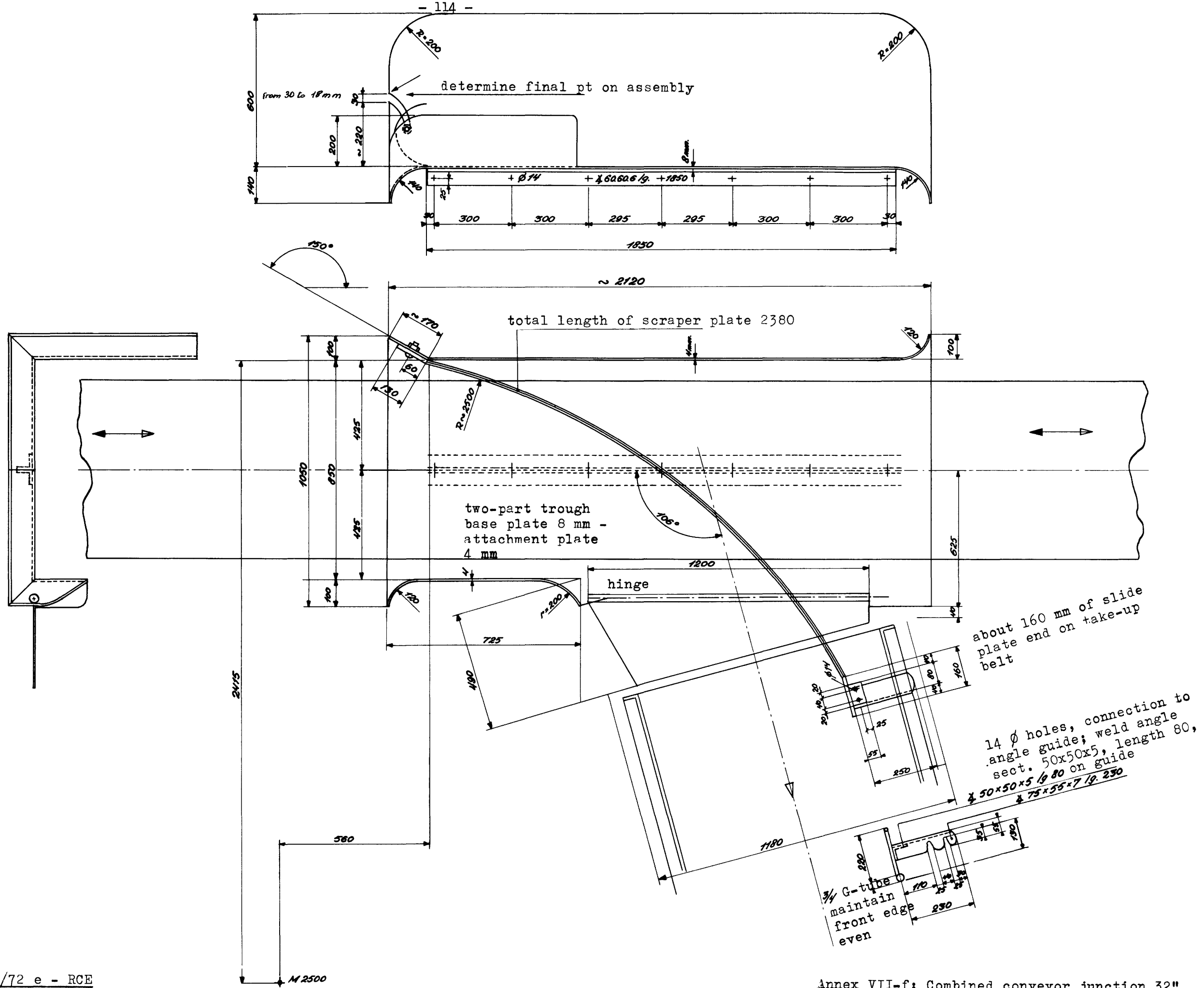
ANNEX VII-d





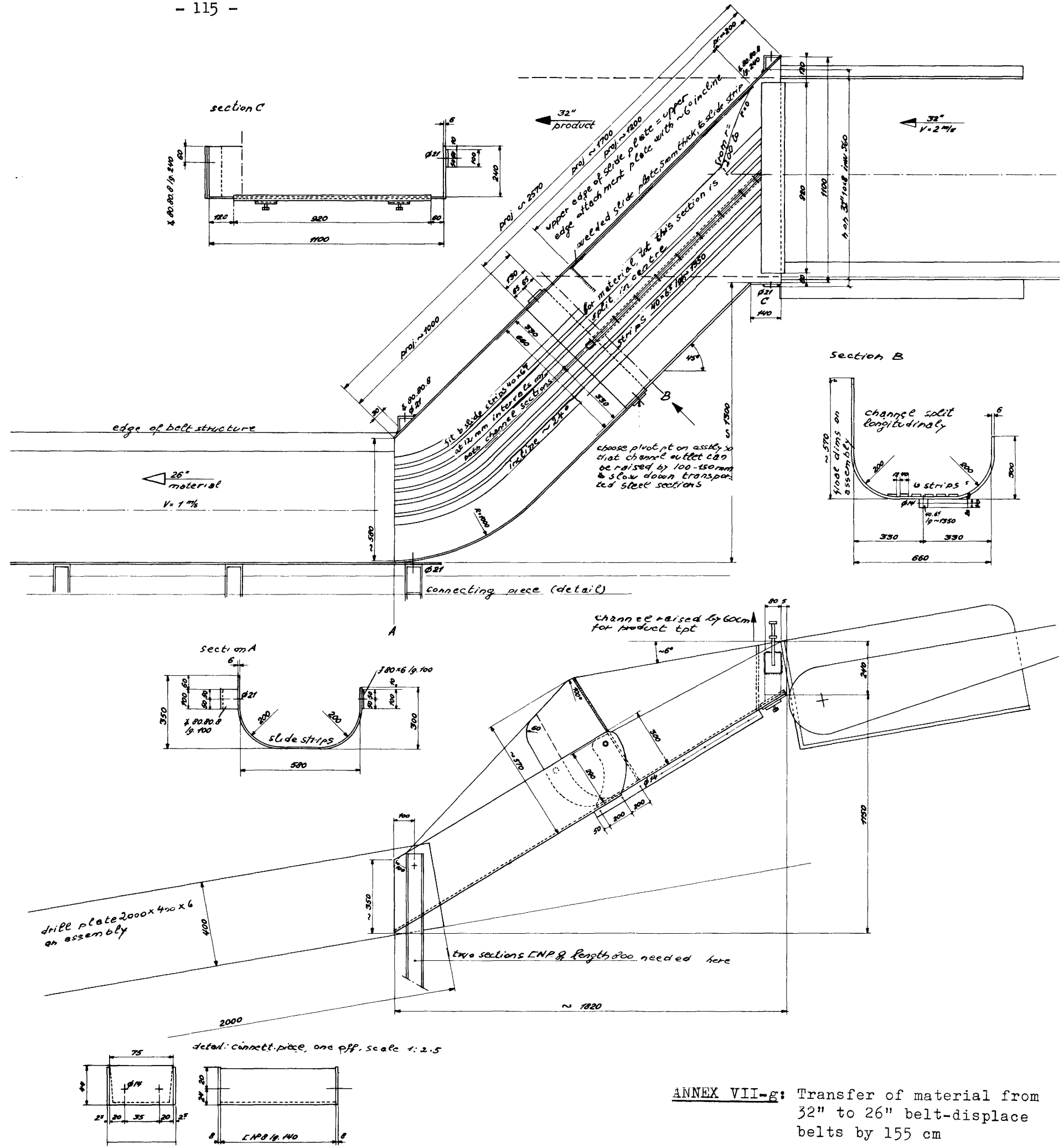
1122/72 e - RCE
ANNEX VII-e

Annex VII-e: Material plate for 146° junction

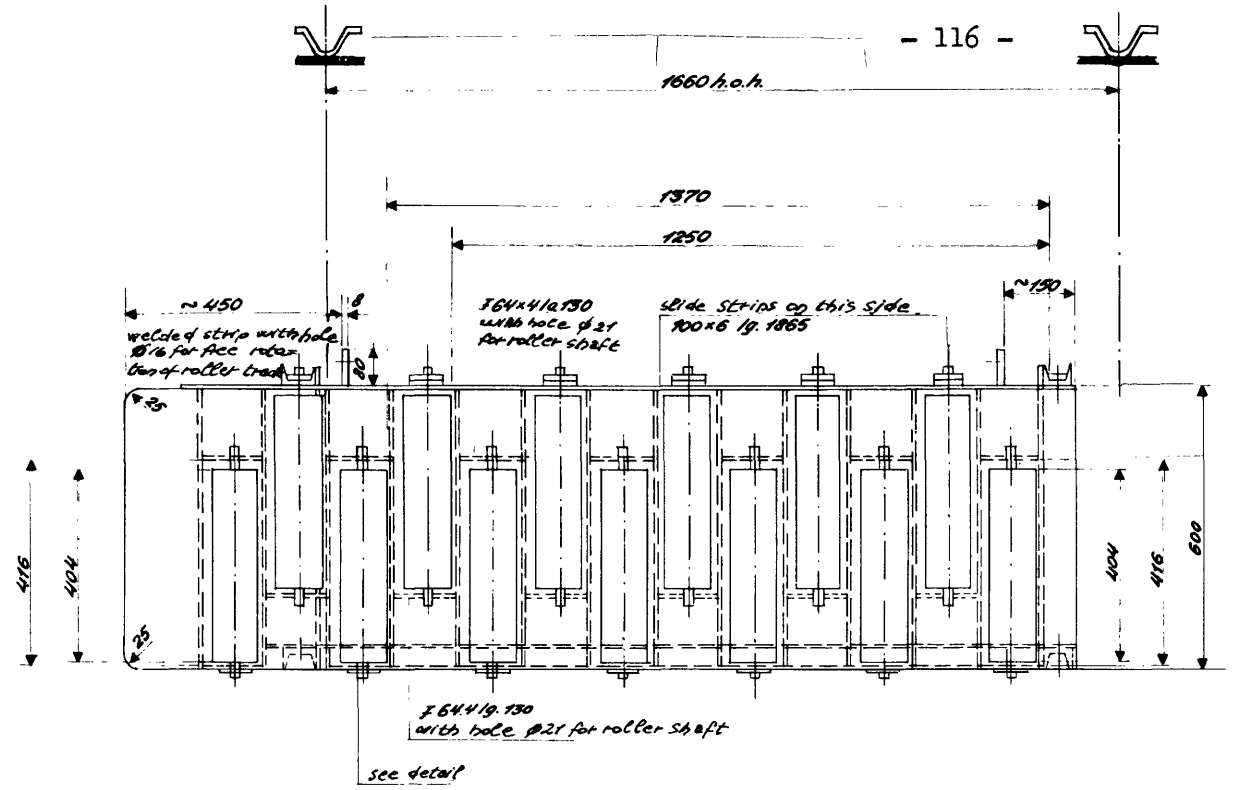


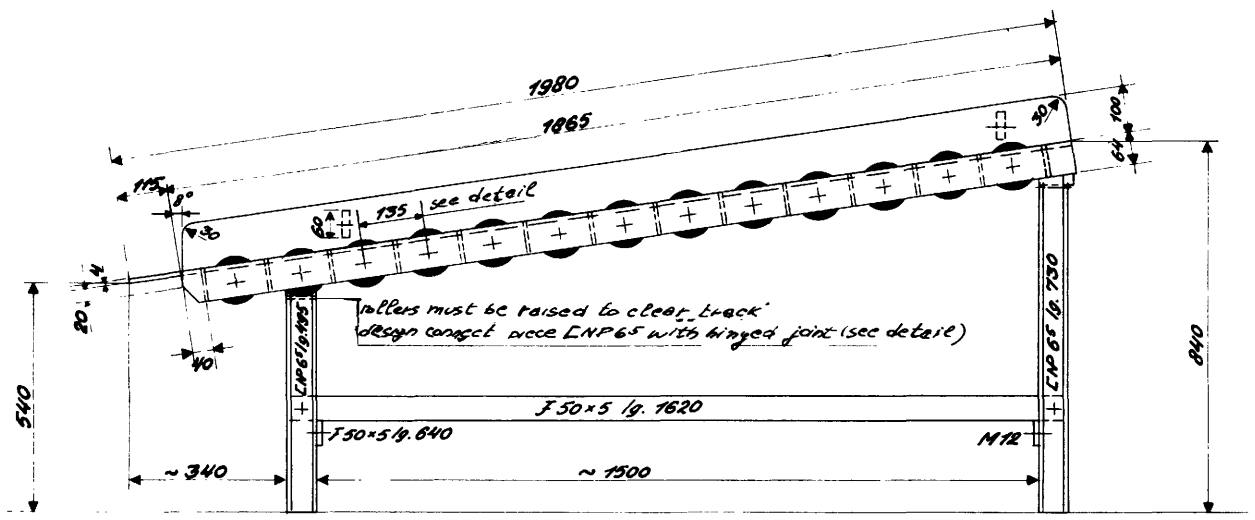
1122/72 e - RCE
ANNEX VII-f

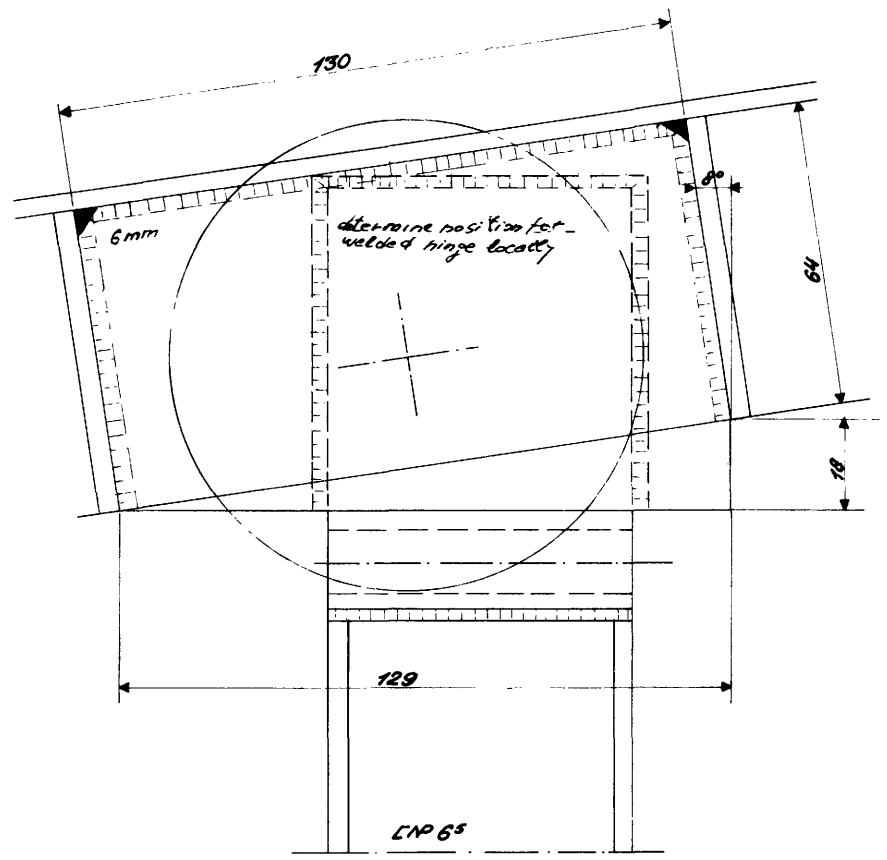
Annex VII-f: Combined conveyor junction 32" (106° right)

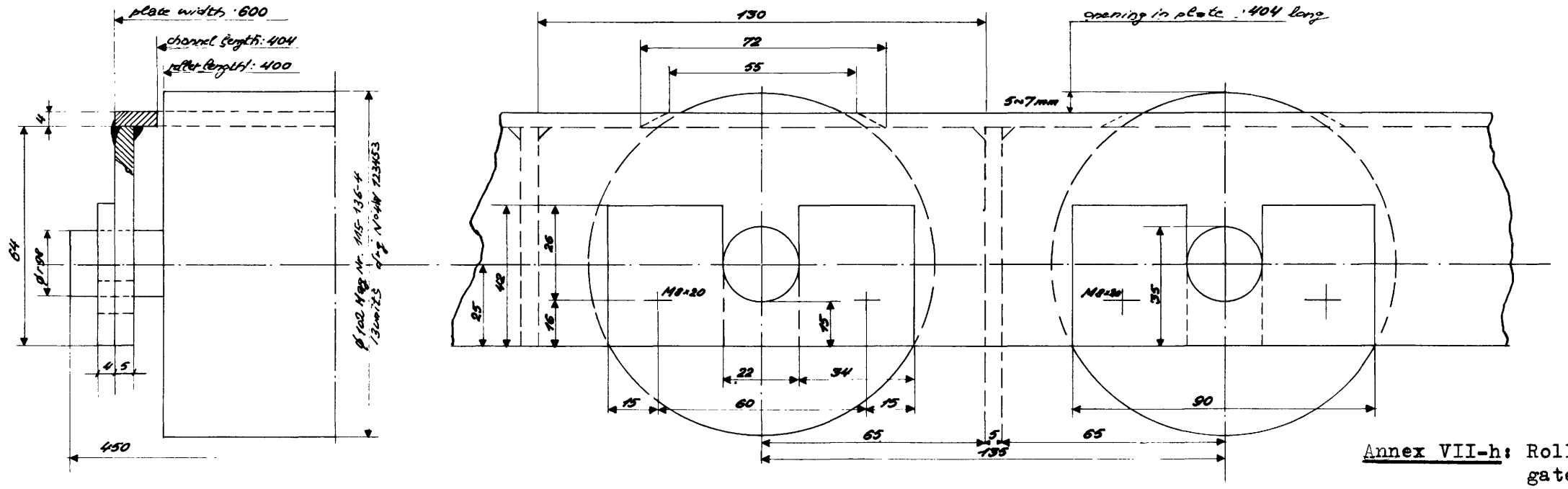


ANNEX VII-g: Transfer of material from 32" to 26" belt-displace belts by 155 cm



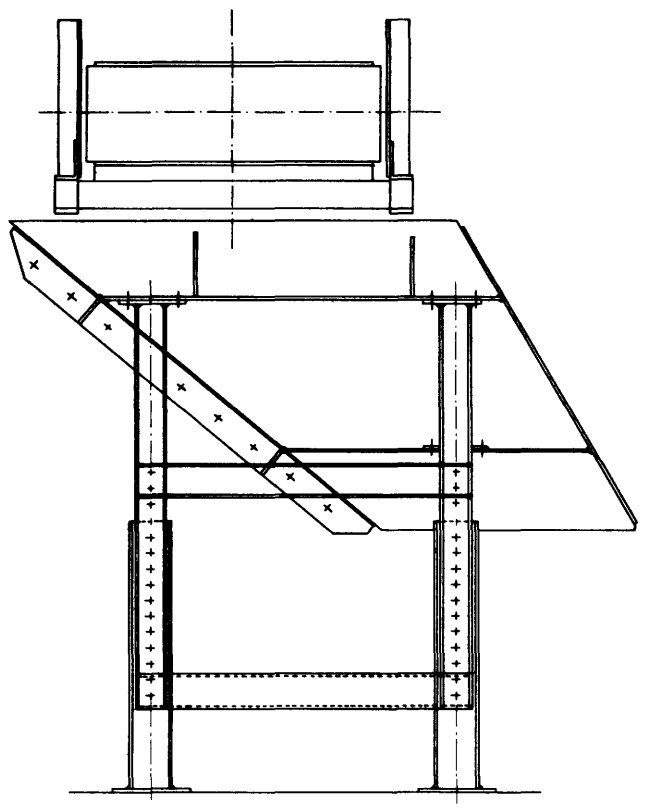




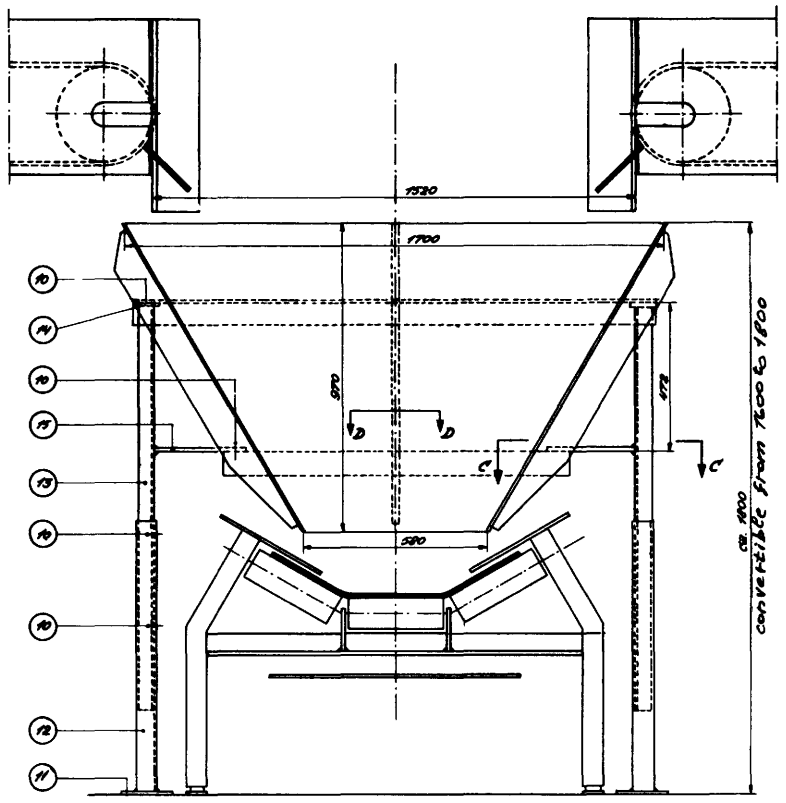


Annex VII-h: Roller track for supply gate loading point

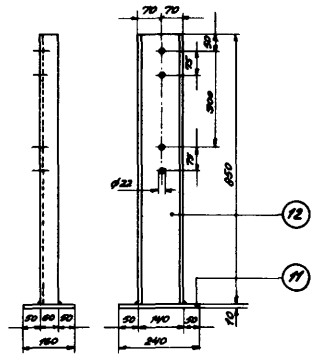
1122/72 e - RCE
ANNEX VII-h

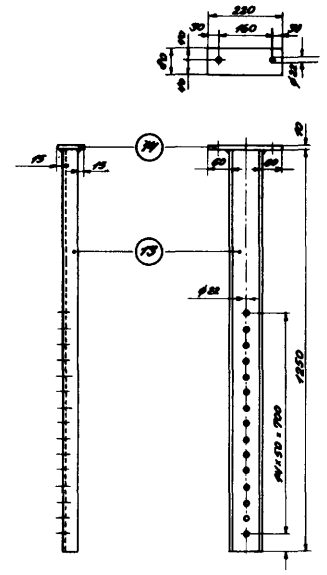


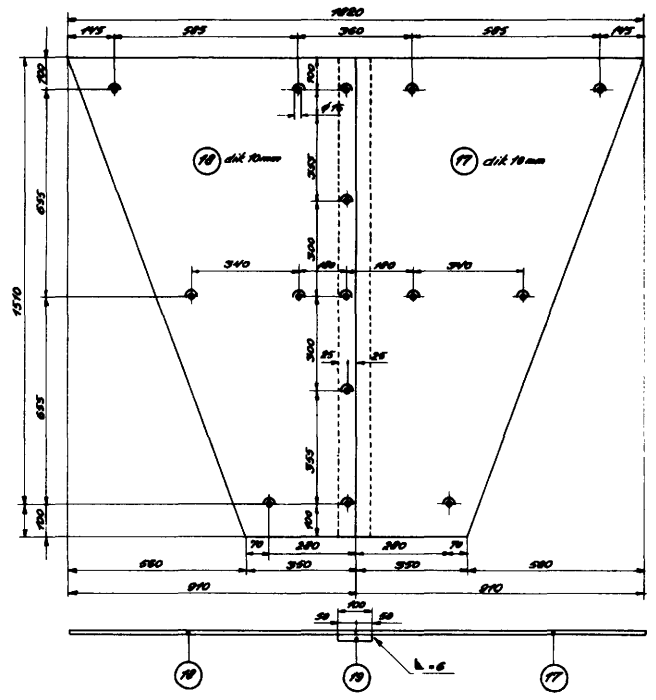
Side view



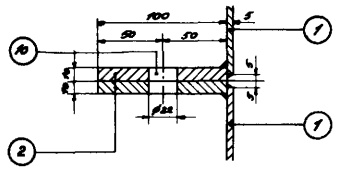
front view



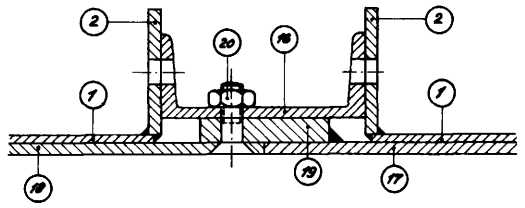




all welded seam ▪3.5

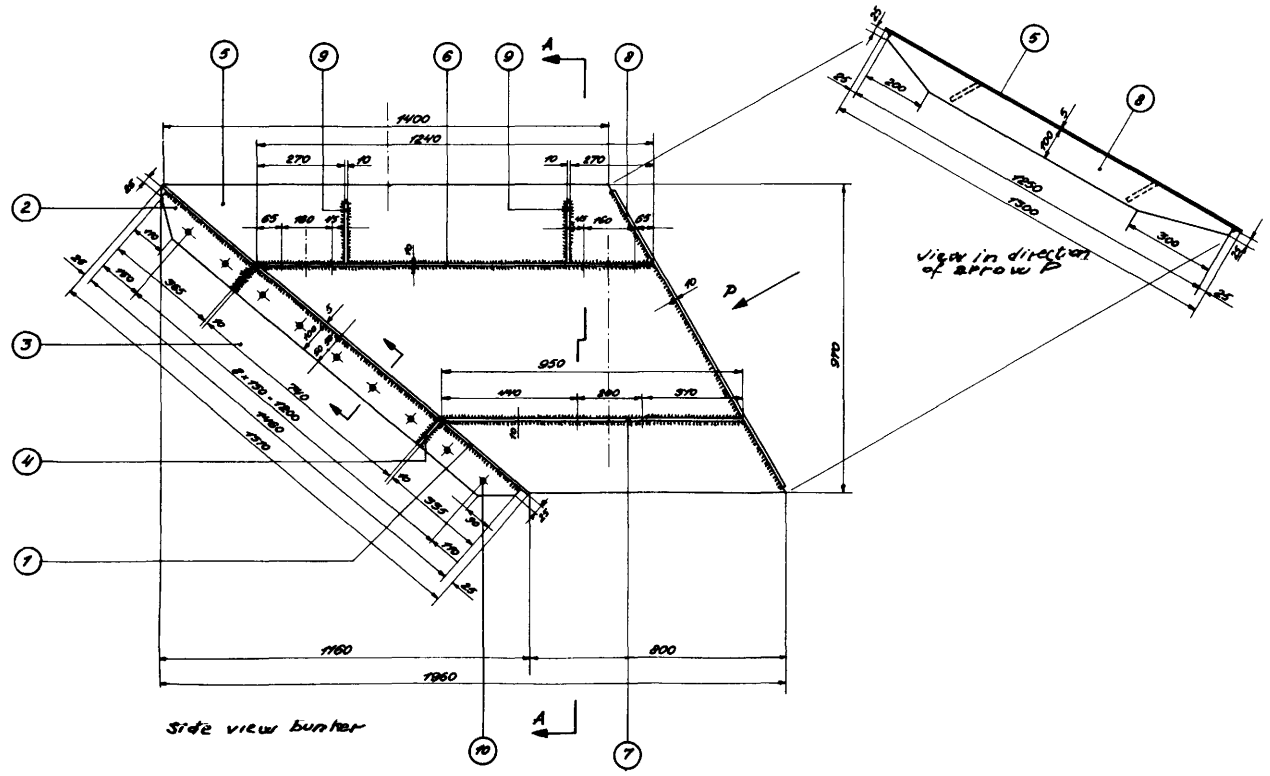


Section B-B



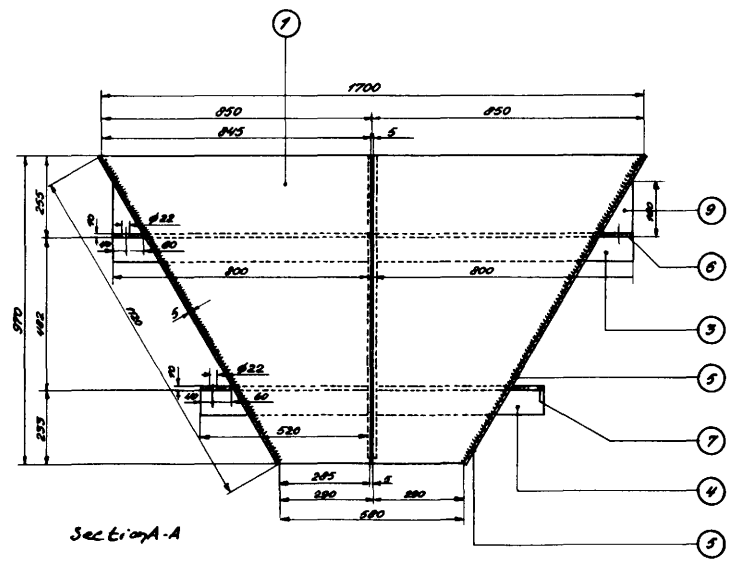
Section D-D
ENP 16-16, sheet 17, sheet 18 } 40" belt only
+19 - schéma N 16 20

Section C-C



Side view bunker

View in direction of arrow D

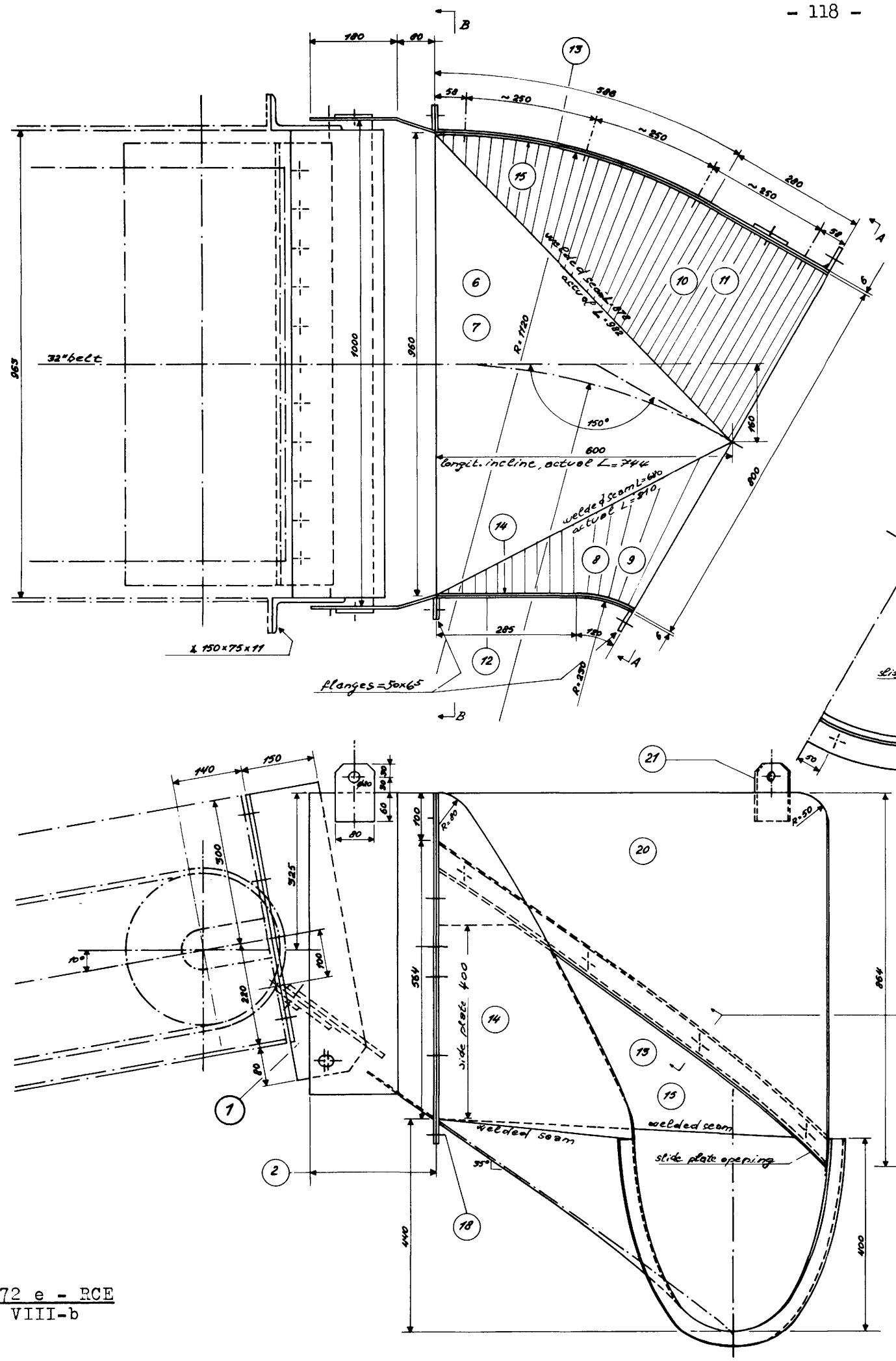


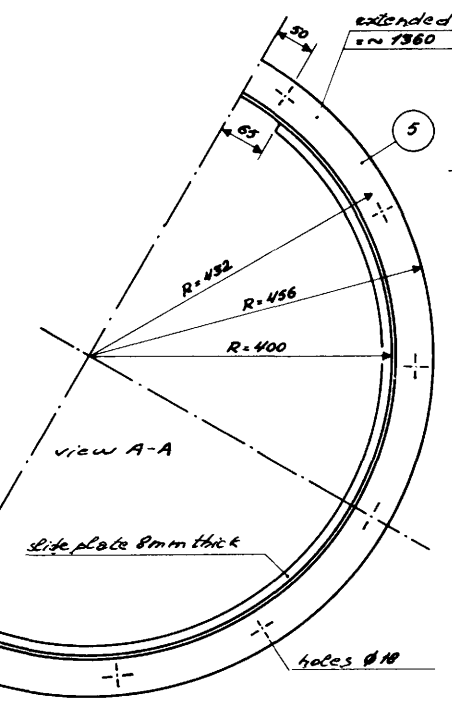
Section A-A

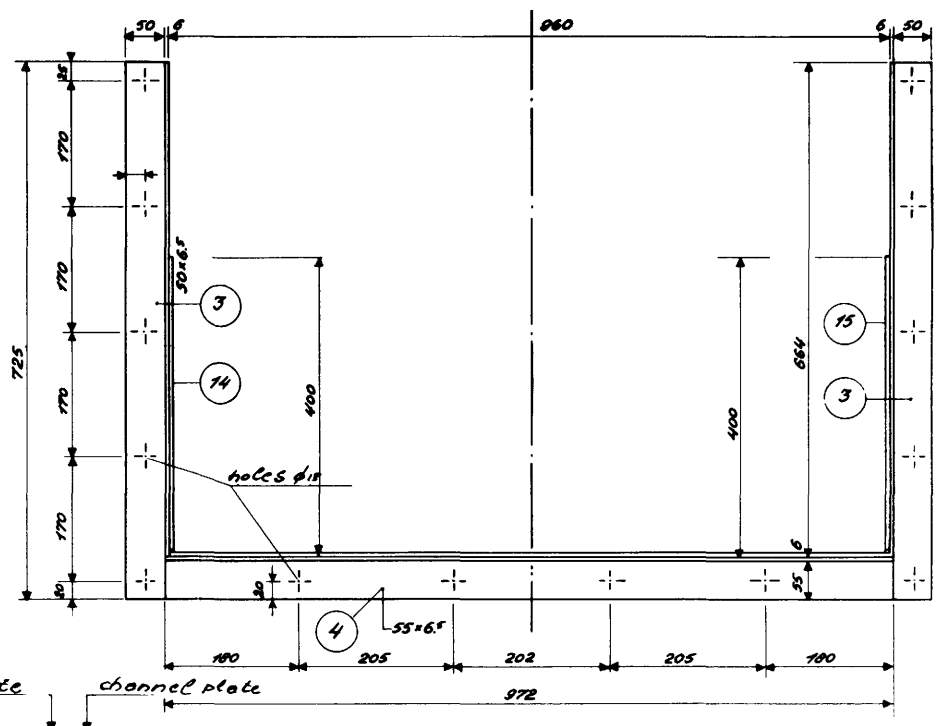
5	20	Countersunk bolt	45	NB DIN 267	60	148	39	nor 40" belt	
1	19	plate 1100 x 30	1170	St 37 DIN 17100	62	11	71	"	
1	18	plate 750 x 10	910	St 37 DIN 17100				"	
1	17	plate 750 x 10	970	St 37 DIN 17100				"	
1	16	CNP 16	1420	St 37 DIN 17100				"	
2	15	plate 280 x 8	285	St 37 DIN 17100					
4	14	plate 80 x 10	220	"					
4	13	CNP 16	1350	"					
4	12	CNP 14	870	"					
4	11	plate 160 x 10	240	"					
28	10	bolt M20	40	NB DIN 267	60	38	74		
4	9	plate 700 x 10	1800	St 37 DIN 17100					
2	8	plate 1100 x 10	1350	"					
2	7	plate 1100 x 10	950	"					
2	6	plate 1100 x 10	1340	"					
2	5	plate 1220 x 5	1980	"					
2	4	plate 700 x 10	320	"					
2	3	plate 700 x 10	800	"					
2	2	plate 1100 x 10	1450	"					
2	1	plate 845 x 5	1870	"					
Qty	Pos. No.	description	length or model	material	G	S	D	Remarks	
					store no.				

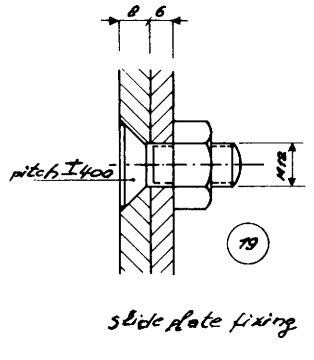
Annex VIII-a 32" belt-product tipper with modification for 40" belt

1122/72 e - RCE
ANNEX VIII-a









	22							
1	21	Suspension eye 8mm	St 33 DIN 17100					
1	20	attachm. plate 4mm	St 33 DIN 17100					
acc	19	countersunk screw with nut M12 L=30			60	100	8	see standard sheet 60-100 A
14	18	bolt with nut M12			60	100	42	see standard sheet 60-100 A
4	17	bolt with nut M 12 L= 35			60	100	27	see standard sheet 60-100 A
1	16	strap 40x65	St 33 DIN 17100					
1	15	slide plate 8mm						
1	14	slide plate 8mm						
1	13	side plate 6mm						
1	12	side plate 6mm						
1	11	slide plate 8mm						in two parts
1	10	side plate 6mm						
1	9	slide plate 8mm						
1	8	side plate 6mm						
1	7	slide plate 8mm						in two parts
1	6	base plate 6mm						
1	5	flange 50x65						cut to get L = 1960
1	4	flange 55x65						cut to get L = 972
2	3	flange 50x65	St 37 DIN 17100					L = 725
1	2	channel section						
1	1	stopper						
No. off	Ref. No.	description and dimensions	Material	Supply instruc	Sub-ass.			Remarks

Annex VIII-b: Product conveyor channel, 150° right