Ergonomics Report

Siemens Warehouse, Vadape, Maharashtra, 421302

Satyajit Upasani

20/7/2015

Introduction:

This presentation includes an ergonomic evaluation of the Inward and Dispatch Sections of the warehouse. Based on data gathered by observing and interviewing workers, areas requiring improvement have been identified and recommendations have been made.

Note:

Each section will be explored individually, with observations typed in white normal text and *suggestions in black Italic text*.

Inward (Receipt) Section

-A majority of workers have to open packages and label items while squatting on the ground, as shown in the picture below. This is likely to cause lower back pain and knee problems. Workers will also tend to get fatigued sooner, resulting in low productivity.

The use of more unpacking tables is recommended. This will prevent squatting and improve working speed.

-The unpacking and labeling tables are 30” tall. This is not enough for the average Indian male, and will cause neck and back bending. A more ergonomic table height is one that is equal to the elbow height of the worker. According to Indian anthropometric tables [1] the average elbow height for an Indian male in the 5th percentile is 945 mm (37”).

The labeling table should be approximately 37” in height, in order to avoid bending in the neck and back. To account for height differences, the best option would be to install multiple scissor-lift tables on which the unpacking can be performed.

-Workers have to bend excessively to unpack items from large boxes, which is very likely to cause lower-back pain. This can be seen in the following picture:

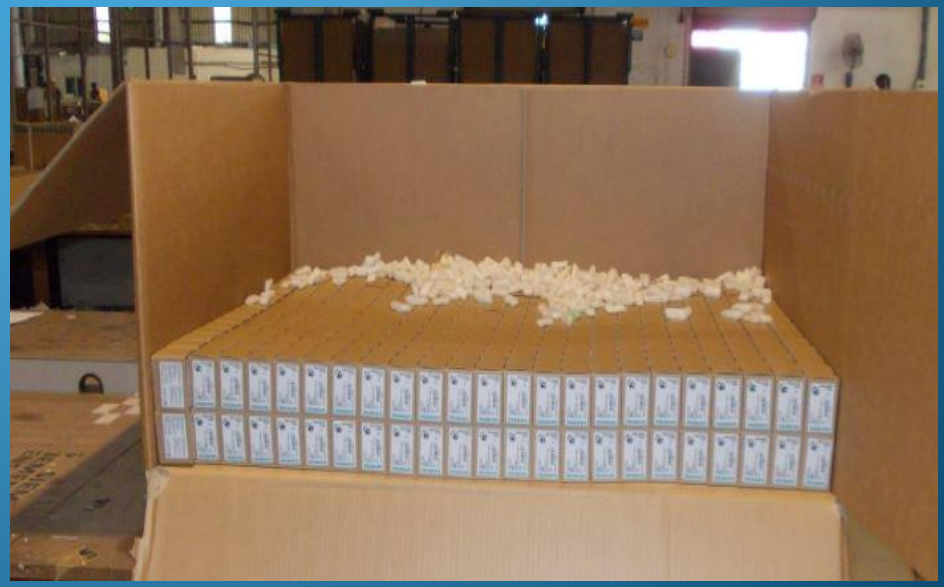
Boxes should be placed and emptied on a table (preferably a scissor lift table), as shown below. The side should be cut open for better accessibility. This will eliminate repetitive bending as well as save process time which would otherwise be wasted in body motions:

-The unpacked items are first labeled on the table, and then placed on the trolleys for shelving. There is travel time lost in shifting the items from one place to another.

An option is to put the individual items directly on the binning trolley and then label them. A table should be used only to unpack the box. This will save much space and decrease travel time.

-It is time consuming to remove packing peanuts from the boxes, and those that fall out also have to be cleared from the floor. Also, the unpacking process cannot begin before the foam has been removed from the box.

A vacuum-blower is highly recommended to collect the packing peanuts. These are actually leaf blowers which also come attached with collection bags so that particles can be collected effectively. Another option is sliding the foam into a large tilting bin in order to reduce collection time.



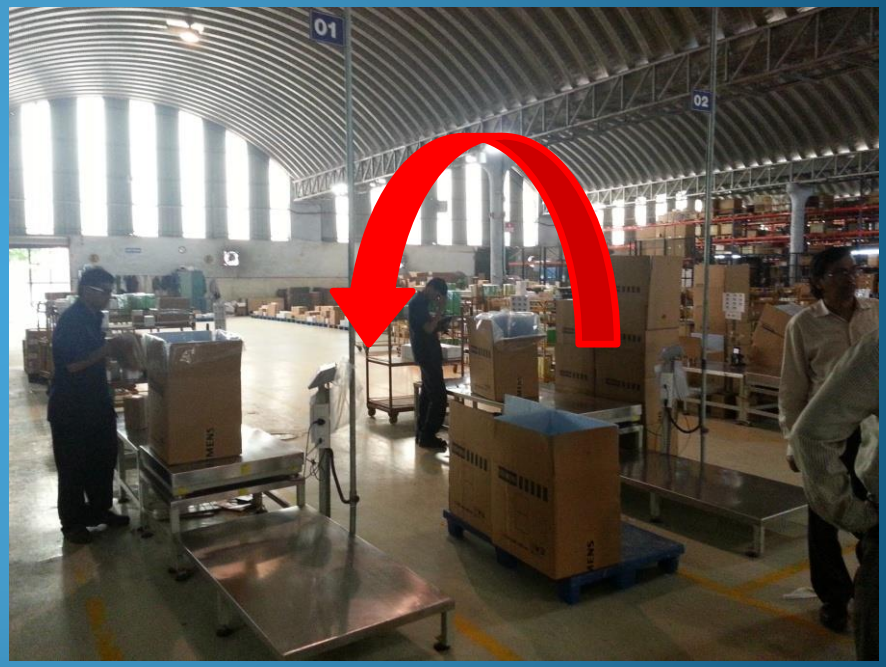
[2]

Packing Section

-The packing table is at knee height and the packer has to scan each item in a position where his neck and back are bent. Even more bending is required to write on the pick-list. Bending also occurs each time the packer puts the material into the box. Lower-back pain has been reported by multiple workers.

The recommended height for the packing table is waist-height to reduce bending and also allow for comfortable scanner use. A scissor-lift table would be the ideal solution. The use of a handheld or mounted writing pad for placing pick-lists is also highly advised.

-Packing boxes are currently being placed in front of the packer. This forces the packer to extend his arms and bend forward in order to remove the box.



-It is advisable to <u>place empty boxes behind</u> the packer so that it is easier to remove them. Also, this will ensure that the entire aisle is reserved for the purposes of that particular packer and his assistant.

-Currently, packed boxes are kept on a low platform next to the weighing machine. In order to proceed towards filling and stapling, the boxes have to be dragged onto a pallet and then picked up by the pallet truck.

Removing this platform will eliminate the step shown by the red arrow

If the platform is removed and the boxes are directly placed on pallets by the packer, it will reduce one whole operating step. In this case, the truck just has to pick up the pallet with the boxes already on it, and take it to the next section.

-Picking is frequently done on pallets. This forces both pickers and packers to stoop excessively, contributing to lower back pain and fatigue.

-*<u>Picking on pallets should be avoided</u>. If trolleys are not available, it is preferable to wait for an empty trolley.*

-Markers used for writing on boxes are not available to all packers at a given time. Two instances of packers asking for a marker from another, or leaving their workstation to procure a marker, were observed in a span of approximately 15 minutes. This would contribute greatly to delays.

-Every packing station should be equipped with a marker at all times, owing to the high usage. Markers should be kept tied to the workstation at an ergonomically suitable point.

Note:

A MOST analysis of the packing section was performed and the related observations and suggestions included in a separate document.

Filling and Stapling Section

-Pneumatic staplers are currently being used, and workers staple boxes with the air supply pipe lying on the ground. This causes problems with mobility. There are a large number of boxes to be stapled, and the workers constantly have to shift the pipe around to be able to staple every box. This leads to time being lost in adjustments.

It is highly recommended that overhanging staplers be used (such as in the picture on the right), with spring balancers to ensure efficient and hassle-free operation. Such setups are currently being used at the Siemens location at Kalwa.

-Filling and stapling currently involves a lot of bending and awkward postures, as workers are required to apply pressure to the box from multiple sides in order to staple it properly.

It is recommended that the above activities be performed by keeping the boxes on raised tables. The height of the table should be such that the stapler is held at elbow height (the elbow joint should be at 90 degrees).

-While filling, workers have to pass a roll of bubble wrap to each other. This slows down the process as waiting times are involved. Also, the bubble wrap if kept on the floor is likely to be stepped on and burst, leading to wastage.

A possible solution would be to create an over-the-head open enclosure for bubble wrap from which workers can pull as much as they need, when they need it.

-There is a lot of travel time involved in taking the boxes from the packing station to the stapling section. The worker has to first load the boxes onto the pallet, get the pallet truck and then take the boxes to the stapling section

It would save a lot of time and space if the stapling section were entirely shifted to the end of the packing station. After packing, the boxes can be filled and stapled immediately without taking them to a completely different location. If this is implemented, the overhanging staplers and over-the-head enclosure would prove to be useful.

(NOTE: This suggestion requires further validation using a line balancing study. An alternate recommendation is that the stapling and strapping sections should be joined, which would also have to be validated)

Strapping Section

-The conveyor at the strapping section starts at ground level and goes up to the strapping machine. This causes workers to bend excessively over periods of 40 minutes at a time.

-A solution to this problem is to use a fully horizontal conveyor. The height of the conveyor should be 20 to 40 cm below the elbow height of the worker.[3] Also, in order to use this conveyor, high lift pallet trucks such as the one in the picture above, would be essential.

-Boxes often get stuck on the conveyor and the worker has to stop the process in order to free the boxes. This can be due to various reasons, including the angled setup of the conveyor, poor condition of the conveyor belt, jammed or broken ball bearings on the landing tables, or improper height of the tables. This is shown in the following video:

A horizontal conveyor is highly recommended.
Other solutions are that the landing table should be at a lower height than the top end of the conveyor. Also, the ball bearings on the table should be in a well-oiled condition. The tables which have some ball bearings broken or missing should be repaired or replaced immediately to avoid damage to boxes.

-At times, workers put as many boxes as possible on the conveyor, and then have to push those boxes up the conveyor, as the entire conveyor is not automated.

Workers should be advised to place boxes only on the automated part of the conveyor, so they don't have to expend their own energy in pushing the boxes.

The best solution would be to have a fully automated, horizontal conveyor.

Box-making Section

-Boxes are currently being stapled on the ground, without any support on the underside. This leaves the box incompletely stapled, which decreases structural stability. Also, there is a lot of forward bending involved.

A recommended solution is to use the already existing wooden table to staple the boxes. Also, the boxes should be stapled on a raised platform, which can be achieved by placing two pallets on top of each other. The flat boxes can be placed right in front of the worker in a vertical rack so that the worker can comfortably and quickly pull out the box to be stapled. An overhanging stapler is also suggested to be used at this station.

As the wooden table is preferred to be stationary, plastic or wooden rails can be placed on the ground with the table at one end, so that the boxes can be pushed one after the other into a queue.

Photos of the supporting table, the overhanging stapler, and the proposed method of stapling boxes can be seen on the next two slides.

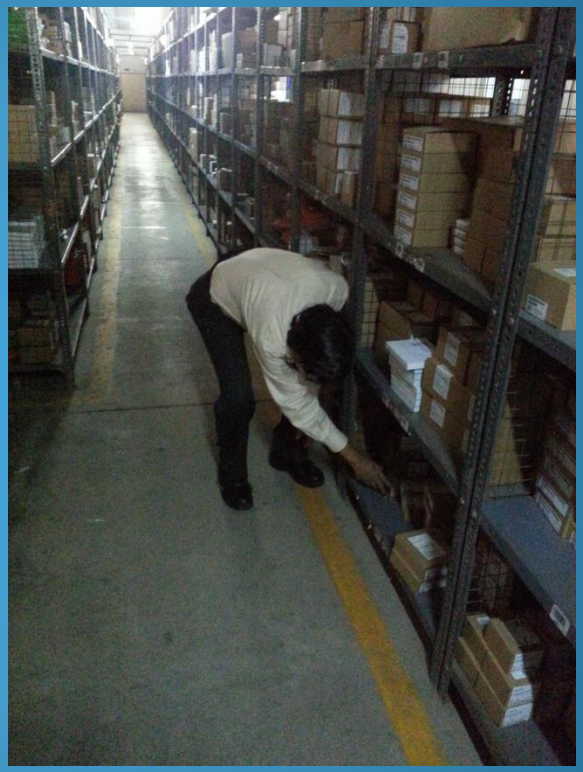

SIEMENS

Binning and Picking Task

-The trolleys currently being used have three racks, the lowest two of which require considerable bending and reaching forward. This puts strain on picking workers.

The use of the bottom rack should be eliminated completely. In case of shortage of space, the lightest and fewest number of items should be put on the bottom rack. Also, the picking worker should move around the trolley, rather than bending and stretching uncomfortably to access the racks. Bending should occur at the knees, and not at the back.

-Shelves are currently organized based on speed of products, with the fastest moving products on the shelves in the body's strike zone (shoulders to knees).



A recommendation is to <u>also consider weight of products</u> while binning. The heaviest material should be placed within the strike zone (shoulders to knees), and lighter material in higher or lower shelves. <u>Portable steps should be available in all aisles</u>, to access material on the highest shelves.

-A portion of the total number of trolleys have side railings that are too high, making it cumbersome to pick items if the rack is fully filled.

The high railings on the sides of the trolley should be cut off to increase accessibility.

-Scanning is currently performed only on the packing station.

It has been recommended that if scanning were to occur during the picking process, it would eliminate the manual checking step, and increase overall process speed.

(This recommendation came from a warehouse employee)

(NOTE: This suggestion was declared invalid, as scanning at the end of the process greatly reduces human error)

General Observations and Recommendations

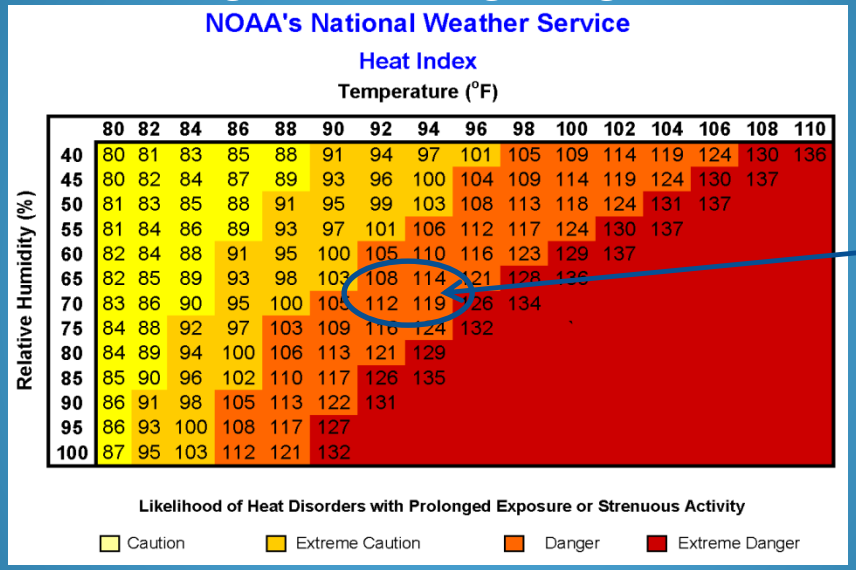
-Workers in the inward, packing and strapping sections spend all of their time standing in a single spot. As a result, leg muscles are not utilized as much as they need to be, leading to bad posture. Over time, this causes musculoskeletal pain.

[4]

Anti-fatigue mats are highly recommended at the above-mentioned sections. These mats are softer than the normal work floor and automatically induce muscle activity in the legs. Statistically, workers report feeling more comfortable when they use these mats. The following link to the 3M website shows possible buying options:

http://solutions.3mindia.co.in/wps/portal/3M/en_IN/Building_Construction_Services/home/Product/matting-traction/Two/

-Interviews with workers revealed that the most persistent and widespread complaint was regarding the hot working environment in the warehouse. Assuming the average May temperature in Bhivandi to be 34 deg.C (93 deg.F) and relative humidity to be 68% [5], if we look at the NWS heat index table, the environment is rated in the high risk / danger region.



Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Region classified as "Danger"

[6]

A recommendation is to install more swiveling fans around the warehouse. Every packing station should have a dedicated fan. The strapping section and filling and stapling section, which are two of the more physically strenuous sections, should be equipped with swiveling fans at all times. Detailed precautions for specific conditions are listed on the OSHA website at: https://www.osha.gov/SLTC/heatillness/heat_index/

-Due to the hot working environment, workers will tend to dehydrate at a faster rate. They also do not have water at hand

Scheduled water breaks are recommended. Workers should be reminded to drink 4 cups of water every hour. Also, the travel time involved in going to the water tank will be reduced dramatically if a water station is provided in every section of the warehouse.

-A scheduled tea break exists for the manual workers. However, tea is not known to replenish vital electrolytes in the body, which are lost due to sweating. In addition, the tea is hot, which does nothing to mitigate the effects of heat.

It is recommended that cold fruit juices be provided in addition to tea in the mid-day break.

-Trolleys currently being used do not have well-lubricated wheels. It requires considerable physical effort to push trolleys for extended periods, such as while binning or picking.

Trolley wheels should be well-lubricated at all times.

-A number of instances of scanners not getting an adequate wi-fi signal were noted. Workers report that such situations occur multiple times every hour. This might be a major cause of slow process times at the packing station.

It is recommended that the cause of poor wi-fi connectivity be determined and dealt with as soon as possible.

-Training sessions for safety and proper handling of materials are held periodically at the warehouse. However, these sessions are entirely comprised of presentations and oral dissemination of information. Multiple instances of attendees not being able to pay attention have been observed.

A recommendation is to instruct workers by engaging in actual physical activities. If workers are asked to do a task as part of the training session and their performance is evaluated immediately, attentiveness will improve and better learning will occur . Training sessions may also include a tour around the warehouse and observing and analyzing activities as they are being performed in real time.
If possible, the sessions should be made available to anyone in the warehouse, including the housekeeping staff.

References

[1] Chakrabarti, D.,1997: Indian Anthropometric Dimensions for Ergonomic design Practice, NID, Ahmedabad, India

[2] http://www.sitebox.ltd.uk/prodimages/boschals25.jpg

[3] http://www.ccohs.ca/oshanswers/ergonomics/conveyor_ergonomics.html

[4]http://www.durablecorp.com/media/catalog/category/diamonddekspongeclose_1.jpg

[5] http://www.myweather2.com/City-Town/India/Bhiwandi/climate-profile.aspx?month=5

[6] http://www.nws.noaa.gov/os/heat/heat_index.shtml

Photos courtesy of:
Mr. Ashok Bandkar, Mr. Ravi Upadhyay, Mr. Satyajit Upasani.

This project was initiated by Mr. Nitin Athalye (Siemens) and the advice and cooperation of the following individuals helped in the formulation of this report:
Mr. Ashok Bandkar
Mr. Akash Bhanushali
Mr. Fabin Roosevelt
Mr. Ravi Upadhyay
Mr. Anant Chavan
Mr. Shankar Katke
Mr. Mayur Kochirkar
Mr. Pankaj Mahadik
Mr. Bipin Parmar
Mr. Prashant Pawar
Mr. Vilas Sajekar