REBA ANALYSIS FOR CONSTRUCTION WORKERS IN INDONESIA

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ABSTRACT

The rapid development of property in Indonesia has prompted many parties to compete for developing their respective businesses. The development of this property provides significant opportunities for freelance construction workers. However, developers are seldom concerned for the construction workers' health. Construction workers in Indonesia still tend to use traditional work methods and techniques, and this repetitive stress can trigger musculoskeletal disorders. Improper work posture, material overload, and the rush to finish work quickly can all increase the likelihood of musculoskeletal disorders. In this research, REBA (Rapid Entire Body Assessment) analysis is used to analyze construction workers' posture. From the study sample, 80% of construction workers have poor posture and stand a high risk for developing musculoskeletal conditions due to their traditional construction methods and the limited tools they use. After doing the suggested improvements, the workers' REBA scores decreased. The first worker's REBA score decreased 4 points, falling from 8 to 4. The second worker's REBA score decreased 5 points, falling from 11 to 6. And the third worker's REBA score also decreased 5 points, falling from 10 to 5.

Keyword: Musculoskeletal Disorder, REBA, Construction Worker, Property

1. Introduction

The high demand for properties in Indonesia has become a key factor for property developers and entrepreneurs to increase production in an effort to meet the demand. The Commercial Property Report 2016 recorded the property demand index at 127.76, a 0.38% increase compared to the final quarter of 2015 (BI, 2016). The amount of supply and demand in the property sector is spurring developers to find competent human resources in this field, and this is a business opportunity for agents who provide job vacancies for concerned workers. The increase in the number of properties is directly proportional to the increase of construction workers. And the higher the number of workers, the higher the number of occupational accidents. These because of awkward posture of workers whose conducted in long term. Whereas based on Bidin et al (2012) awkward posture is defined as working with various part of the body in a bent, extended or flexed position rather than in a straight or neutral body position. The Ministry of Employment reports that the recorded number of work accidents suffered by construction workers is 31.9%, a relatively high percentage of the total accidents (Republika, 2015). Despite the high number of construction workers in Indonesia, there is little job protection for such workers; therefore, most construction workers encounter occupational health and safety problems.

Health and safety for construction workers is not only an issue in Indonesia but also in other countries. This same problem exists in the Philippines, which has 2 million construction workers (Domingo et al., 2015). From the data obtained, 30% of workplace accidents are due to musculoskeletal disorders suffered by workers when lifting materials (Bureau of Labor and Employment Statistics, 2011). Based on the research done by Domingo et al., (2015), REBA scores for construction workers range from 5 to 11. In Malaysia, industrial workers suffer injuries to the head, neck, shoulder, lower limbs, upper back, and lower back (SOSCO, 2012). The main factors affecting the risk of a negative assessment of posture were keeping the back bent and twisted, keeping the arms raised above the trunk, working in a standing position (Lasota, 2014). Poor occupational health could affect worker psychology. In Western Africa, woman performing heavy physical work that includes carrying loads on their head during pregnancy. This research conducted by Dumas et al (2014) that obtained a result trunk was bent by more than 80◦ at pick-up and set-down and knees were moderately flexed, significantly less than 11^0 Research based on Zein et al., (2015) analysis showed 77.1% of total employees suffered from physical fatigue, with the most frequent injuries occurring to the neck, shoulder, and leg. Due to the number of problems that occur in the Indonesia construction field, REBA scores are used to measure and analyze construction workers' working posture. Torres et al (2012) proofed by using REBA method that in a vaccine production centre warehouse working condition, through the application of general work space design and ergonomics principles. Seven of the eight postures evaluated with REBA had a total score between 8 and 10, meaning a high risk, and only one was at a medium risk level. Sang-Young et al., (2016) performed a REBA assessment on workers along an automotive assembly line for chassis, trim, and finishing. This assessment was done in order to determine the high workloads at workstations and to develop a job rotation schedule. The results showed that workers on the chassis line scored a 6, while the trim line scored a 7, and the finishing line

scored a 5. Serratos-Perez (2015) conducted similar research in an industrial facility in the central region of Mexico. The research used REBA for an ergonomic assessment of workers on a production line who interact with CNC lathes. The workers performed tasks such as handling, visual inspection, compliance testing, machinery adjustments, and setting the finished pieces in containers. Thirty-five separate operations were analyzed, and three operations were classified as very high risk, 14 were classified as high risk, 14 others were classified as medium risk, and 4 were classified as low risk. A research had done for mining industry in Malaysia using REBA method, showed that among mining industry workers all the physical risk factors involved the main body regions such as upper arm, lower arm, wrist, trunk, neck and leg that has been identified associated with WMSDs (Norhidayah, 2016).

Based on the problems found in the aforementioned research, and due to construction workers using improper posture during work activities, a REBA assessment is needed to study construction workers in Indonesia.

2. Method

2.1 Research Sample

This study was performed with male subjects between the ages of 21-35. All of the subjects approved the study method. The sample was not limited to specific kinds of work.

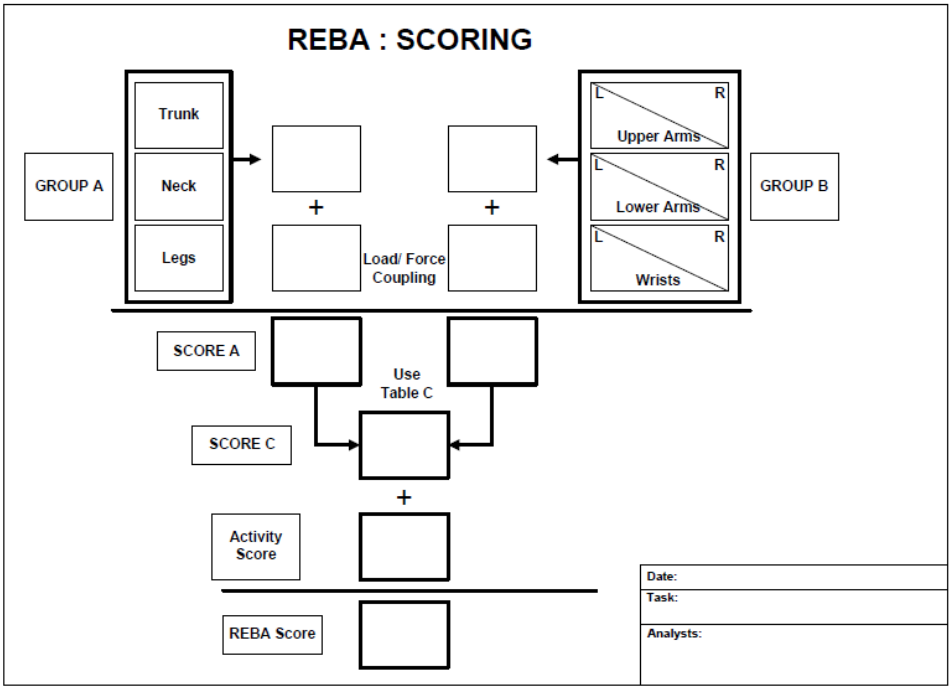
2.2 Data Collecting

This research collected data by taking pictures of workers while they worked. Some positions were taken to analyze the output of their posture. Research was not performed on their natural standing posture but on the natural postures construction workers use while working. The study used only a Nikon D5000 camera and a REBA worksheet.

2.3 REBA Method

REBA method had done by McAtemney and Highnett (1995) to introduced the REBA posture analysis method. REBA scoring is based on the neck, trunk, leg, upper arm, lower arm, and wrist. Furthermore, the coupling factor and external weight also affect the REBA measurement (Highnett and McAtemney, 2000). REBA is the modified version of the Rapid Upper Limb Assessment (RULA), which is a method used to assess the entire body's load (Highnett and McAtemney, 2000). RULA and REBA differ in the values of the codes assigned to body postures and in the system of assessing risk. REBA provides a five-level assessment, with the low risk and medium risk combined into a moderate category, and the high risk and very high risk merged to form a single category (Jones and Kumar, 2010). Here is the REBA scoring method:

Figure 1. REBA scoring



Source: Highnett and McAtemney, 2000

REBA scoring will be categorized by action level, as shown on the table below (Highnett and McAtemney, 2000):

Table 1. Action Level REBA Method

Action Level	REBA Score	Risk Level	Corrective Action
0	1	Can be ignored	Do not need
1	2-3	Low	Probably need
2	4-7	Medium	Need

3	8-10	High	Soon
4	11-15	Very High	Highly soon

2.4 Evaluation Process

The evaluation process for work system improvement is done with the participatory concept, which directly involves workers in improving the work system. Participatory ergonomics is an active process that emphasizes ergonomic concerns when considering a holistic approach to ensure that a person is healthy, safe, and efficient and to achieve the highest possible productivity. Nagamachi (1995) stated that, in participatory ergonomics, workers must actively participate in implementing the ergonomic procedures and knowledge in their workplace. The application of participatory ergonomics has proven to improve the health and safety in some workshop training programs in various countries (Kawakami et al., 2004). Participatory ergonomics has three steps (De Jong, 2004):

a. Selection of Participants: At this time, the participants have not fully participated because the selection process is determined by the researchers themselves.
b. Design and Development: This is the design and development stage for innovating systems or products after receiving input from participants.
c. Implementation: Systems or products that have been designed are tested on the participants themselves.

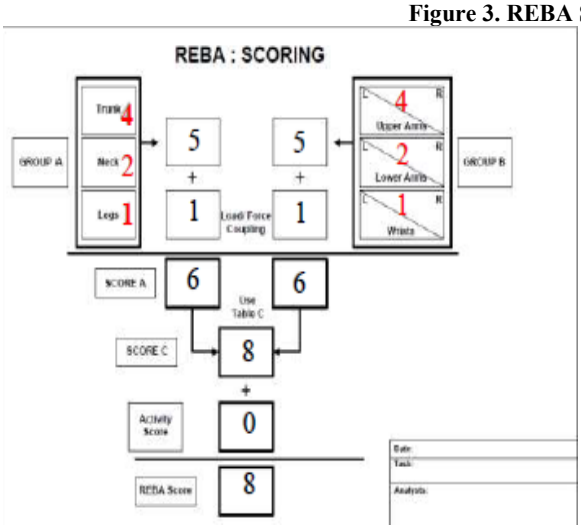
Results And Discussion

3.1 First Assessment

Below is a construction worker who mixes cement and sand into dough. In the figure below, the worker is seen in a standing position:

Figure 2. Work Assessment 1

Figure 3. REBA Scoring 1



Notes:

a. Trunk: 77.5^0 flexion = 4
b. Neck: 13^0 extension = 2
c. Leg: $0^0 = 1$
d. Upper arms: 61.7^0 flexion,
   Shoulder up: 3+1 = 4
e. Lower arms: 25^0 flexion = 2
f. Wrist: $9^0 = 1$
g. Coupling is categorized good enough: 1
   Weight is 5 up to 10 kg: 1

The above figure shows a construction worker who has bad posture due to bending too much, up to 77.5^0. This posture could affect his hip and trunk. Sundari (2011) performed research on ceramic artists and found that 42.47% of their musculoskeletal disorders happened while working in a bending position. In the above analysis, the REBA score is recorded as 8. From the interviews obtained, the worker often feels pain in the lower back, calves, and also in the lower leg after working for a long time in positions such as the one pictured above. Thus, it can be concluded that the worker has a high risk level and needs to take immediate action.

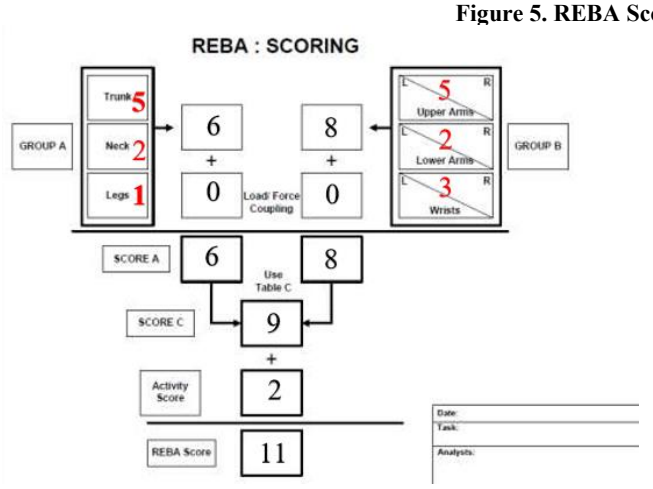
3.2 Second Assessment

Indonesian construction workers who usually install ceramics do not have good posture. Here is an example of a worker installing ceramics:

Figure 4. Work Assessment 2

In the above figure, the construction worker has bad posture due to bending more than 90^0, reaching 122.6^0. His upper arms are at a 134.6^0 angle with flexion, and his shoulder is up. According to Dul and Weerdmeester (1993), a workstation should have a height around 0-15 cm above the elbow height or at least at the same height as the elbow. Bending too much could affected this worker's hip and trunk, while also applying more stress on his leg.

Figure 5. REBA Scoring 2



Notes:

a. Trunk: 122.6^0 flexion = 4+1 = 5
b. Neck: extension = 2
c. Leg: 15.5^0 = 1
d. Upper arms: 134.6^0 flexion
   Shoulder up: 4+1 = 5
e. Lower arms: 32.3^0 flexion = 2
f. Wrist: 20.8^0 = 2+1 = 3
g. Coupling is categorized as good: 0
   Weight is more than 1 kg: 0

From the worksheet above, the REBA score is 11. Based on the REBA action level, a score between 11-15 is in the very high risk level, which means the worker needs to improve his posture as soon as possible. Based on the picture above, it appears that the worker is experiencing a high load on the lower back. This is consistent with the worker's statement that he often experiences pain in the lower back.

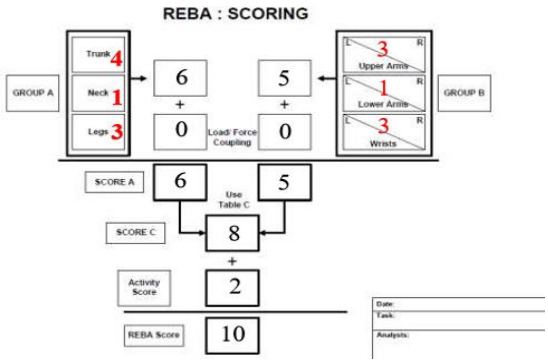
3.3 Third Assessment

The finishing job is also a significant task, and the worker usually performs it while squatting. Even though there are other options available, the construction culture favors squatting. Here is an example of finishing work:

Figure 6. Work Assessment 3

In the above figure, the construction worker has bad posture due to working in a squatting position. He could suffer an injury because his leg is at 135^0. In addition, his wrist is also in a poor posture. By being at a position more than 15^0, his wrist could receive more tension than his arms. Kurnianto and Mulyono (2014) performed research on the squatting posture of welders and found that 92.31% of them complained about disorders from squatting and bending, usually resulting in musculoskeletal disorders in the waist.

Figure 7. REBA scoring 3



Notes:

a. Trunk: 42.3^0 flexion = 4
b. Neck: 1
c. Leg: $135^0 = 3$
d. Upper arms: 56.2^0 flexion = 3
e. Lower arms: 68.5^0 flexion = 1
f. Wrist: $\geq 15^0 = 3$
g. Coupling is categorized as good: 0
h. Weight is less than 1 kg: 0

In the above analysis, group A, which includes the trunk, neck, and legs, has a score of 6. Group B, which consists of the upper arms, lower arms, and wrists, has a score of 5. When combined with the score in group C, which is the activity score, the final REBA score is 10, meaning that this posture is in the high risk level. Workers often need plenty of rest after working in this position. High stress on the legs, particularly the calves, can be the main cause. In accordance with the results of the conducted interviews, workers often experience fatigue in the calves, knees, and feet. Using additional tools or learning correct posture could provide some improvement for these workers. This requires further investigation and a change of posture in order to decrease the weight for his body, particularly his arms and wrists. Posture improvement can be done through the participatory concept with a Focus Group Discussion (FGD), and the entire process should involve three steps:

a. First, hold a FGD with the workers to discuss the problems related to their non-ergonomic work. The FGD was done with 15 workers who performed the same kinds of work.
b. Second, design tools with some stakeholders and involve an ergonomist, an artisan, and a researcher. The design is focused on decreasing any issues in the construction field.
c. Third, when the design is ready, a worker is asked to work in the new posture with use of the additional tools. The researcher will interview workers while they are in the new posture.

3.4 Proposed Improved Posture

After all of the assessments were performed on the various workers, there are some recommended working postures. The recommendations are proposed to decrease any fatigue and permanent injuries. Improvements were designed after interviewing the workers and looking for simple methods to help them work in the specific field.

Figure 8. 1st recommendation

Figure 9. 2nd recommendation

Figure 10. 3rd recommendation

The above figure shows three recommendations based on the three previous assessments. In the first recommendation, the worker needs to place the material on a desk, which would prevent him from bending too much. In the second and third recommendations, workers should use a small seat to help them relax and reduce any stress on their calves.

Figure 11. REBA value of 1st recommendation

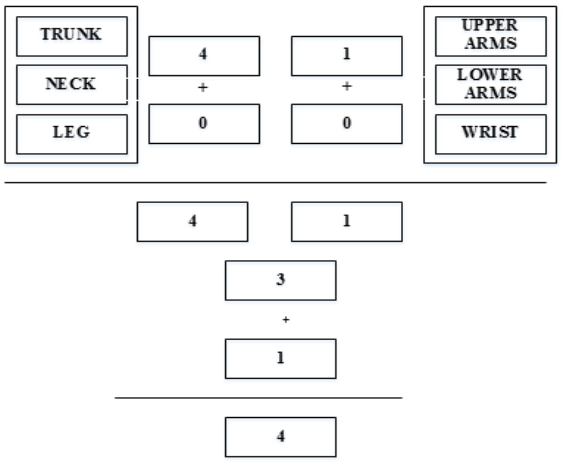


Figure 12. REBA value of 2nd recommendation

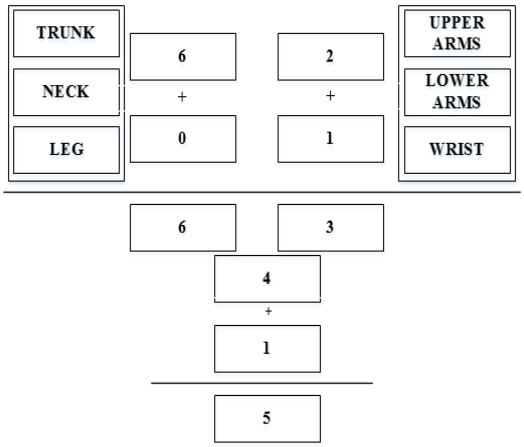
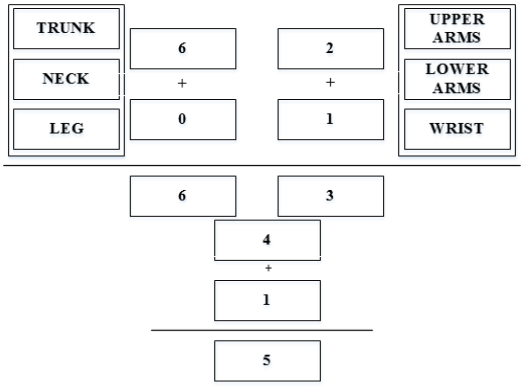


Figure 13. REBA value of 3rd recommendation



After performing the improvements, the REBA scores decreased. The REBA score from the first assessment decreased by 4 points, dropping from 8 up to 4. The REBA score from the second assessment decreased 5 points, dropping from 11 to 6. And the REBA score from the third assessment decreased 5 points, dropping from 10 to 5. Recent studies have shown that back pain has a direct influence on postural strategies in indifferent upright postures (Brumagne et al., 2008; Mientjes and Frank, 1999; Moseley and Hodges, 2005) thus, workers should apply this proposed posture to reduce musculoskeletal disorders. Furthermore, REBA may be more useful if specific ergonomic or biomechanical changes are being implemented to decrease risk of work related injury to determine their effectiveness (Coyle, 2005).

3. Conclusion

From the research, it can be concluded that all three construction workers need to improve their working postures. In the initial assessment, the worker's posture had a REBA score of 8, while the second worker had a REBA score of 11, and the third worker had a REBA score of 10. All three workers were at a high risk for a musculoskeletal disorder and needed to improve their postures immediately. All three postures can be improved by adding simple tools such as a desk or a small seat. After applying these tools and improvements, all of the workers lowered their REBA scores. The first worker's REBA score dropped four points, while the second and third workers' REBA scores each fell five points. The results prove that a simple improvement could reduce the fatigue factor for construction workers. This research result is proposed to Indonesia government to more consent on construction worker posture in order to could increase productivity in properties field. Furthermore, this result could be an improvement for stakeholder to create any simple tools which could applying in cosntruction works.

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