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Design and Improvise of High Reach Wire Cutter

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Abstract: High reach wire cutter is an apparatus design using a new mechanical technique of wire cutter without string-pulling or lever mechanism. Galvanized steel wire usually use to bind the advertisement buntings on certain high on street lighting columns in Malaysia side road. Difficulties to dismantle the bunting or leftover rusted wire that need to use a ladder can cause some risk, and it disrupts the scenery of the environment. On the other hand, the old rusted wire is left on the street lighting columns due to the dumping of illegal advertisements in the residential areas. The challenges of ladder perturbation cause the wire is tied at more than 4.0 meters height prompting the workers to snatch the buntings down, leaving the wire fragments on the posts. This study is to design and improvise tools that can reach the higher, speeding the process, low cost, light, adjustable handle and avoided using a ladder to improve safety. The result is successfully developing a high reach wire cutter with a new mechanism with buffer to fill in the gap and column retainer to make it efficiently cut and remove tight wire on the street lighting columns.

Keywords: Ladder Falls, Wire Cutter, High Reach, Safety Standard, Aviation Snips

INTRODUCTION

The bunting workers normally practice manual steps to remove bunting or leftover wire on the street lighting columns by climbing the ladder and use a cutter in Malaysia. Safety of workers in a state of hazard while performing their task on confronting adversity to climb the unsafe ladder (Hanapi, Kamal, Ismail, & Abdullah, 2013) due to ground conditions and can cause fractures, most important injury from ladder falls (Barbat, Partiali, Oska, & Folbe, 2020; Smith et al., 2006). Bunting workers, including workers from advertising companies whereas for government agencies, Local Authorities, universities, occasionally staff, students or the public will be temporary workers. Available imported tools in the market currently using string, or lever mechanism have their limitation to remove wire efficiently, limitation on the range, hefty, non-adjustable and too costly. Level mechanisms use vertical ejector shaft which can be actuated by the lever to (Handa & Verma, 2002) able the cutter workable. String or lever mechanism prevents the long handle cutter to be adjustable. The issue that needs to be addressed is to avoid the use of a ladder and avert ladder perturbation causes (Pliner, Seo, & Beschorner, 2017).

REVIEW

Advertising bunting which is usually seen hanging on street lighting columns is one of the popular advertising methods used throughout the country to this day. Not to mention the location of obstructed street lighting columns such as filled with flowers, roadblocks, drains and uneven ground surfaces will certainly make it adversity to use a ladder while removing wire at the high reach level (Esam et al., 2019). The risk of ladder fall due to the bunting binding wire being tied of more than 4 meters height on the ground surface caused the workers to prefer to snatch the bunting from underneath, resulting in the wire and torn part of the bunting being left on the pole.

Imported cutters available was not effective to remove the tight wire because of the cutter design, fix length that reaches not more than 3.95 meter height and the weight is about 5.8 kg to 6.3 kg are hefty and not ergonomics to the workers. Street lighting columns in Malaysia mainly of the type of galvanized steel with flanged mounted type, planted type with decorative type or tapered polygonal from 6.0 meter to 12 meter height, 13 to 14 cm diameter (Sepang Municipal Council, 2014) and approved by BS EN 40 design standard and BS 729 Galvanizing standard (Malaysia Public Works Department). This is an issue that is closely linked between the risks posed by bunting installers as well as workers throwing discs leftover on columns. Leftover wire could cause corrosion to the column itself in a certain type of column (Alexander & Wood, 2009).

Task at night are at higher risk of electric leakage despite the new column have a quality of coatings used for street lighting columns (Dudek & Goroshko, 2019), because the current begins to be channeled to turn on street lanterns automatically starting at 7.00 pm to 7.00 am. The case of the ladder falls not only involves injuries, fractures, herniated discs, trauma, to the physicality of the employee himself but also the employer has to bear the high medical costs and compensation of the workers. Benchmarking on the method by survey show alike method practices by the respondent responsible in an advertisement in the respected organization in other parts of Malaysia such as Terengganu, Perak, Kuala Lumpur and Subang Jaya, Selangor. This issue is the basis of research and the production of new innovations in overcoming the difficulties of workers involved in lowering bunting or discarding rusted wire left on street lighting columns in Universiti Putra Malaysia (UPM) at Serdang Selangor, Malaysia campus and local housing community.

RESEARCH ANALYSIS

I. Long Handle Wire Cutter

The solutions along with strategies have been planned i.e. high-level wire cutting tools with long handle strategies; capable reach more than 4.0 meters height from the ground, light and easy to use. Wire cutting method with single wire cutter cutting strategy using a column as retaining body. This identified strategy is seen to be able to cut, able to reach the height limit, light and is easy to use compared to other methods that are also refined. Features;

- Material - uses light steel iron to be durable but not hefty due to rugged usage
- Adjustable height - able to reach more than 4.0 meters height from the surface and collapsible for effortless storage purposes
- Portable and lightweight - easy to carry with small vehicles and easy to store
- Target guided - hooks to guide the wire cutter right towards the targeted bound wire
- Cut efficiently - able to cut the wire that is firmly wrapped around the street lighting columns with a sharp nozzle
- Low cost using existing materials for the prototype stage that can be used

The device prototype was developed using the new long handle cutting method.

II. Sharp nozzle cutter

Aviation snips wire cutters with sharp nozzle are able to slip in the intermingling wires that are strongly tied on the column. Hook or retainer will be used to increase stability and ensure the wire cutter is accurate to the target wire during the cutting process. Hot condition and sunlight glaring scrapes to the workers to target the cutting points on the wire and that hooks able to reduce the difficulties. The other function of the hook is to prevent the tool from falling to the side during cutting work because of the worker's fatigue hands and concentration after repeatedly task. The hooks bend upside and down to easily remove the debris after the cutting process.

Buffer using hollow metal, with a specific length is an important component attached to the cutter to distribute the impact from the column to the cutter effectively. Buffer function is to fill in the gap between cutter and column that arise during the process because of the shift movement from the cutter and bound wire. The other function is to stabilize the cutter onto the body shape of street lighting columns.

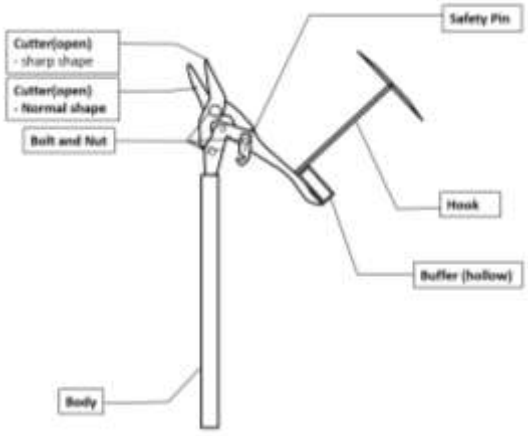

FIGURE 1

UPPER PART OF HIGH REACH CUTTER

III. High reach handle

- High reach wire cutter divide into two part and easily slot in to have a maximum reach up to 5.5 meters from the ground, considering average height of Malaysian men is 165cm (Lim et al., 2000) Single handle with cutter weight of up to able to reach up to 390 cm.
- There striking yellow stripe stick as a caution to the workers handling the sharp tools.
- The connector allows the first handle to be slot in approximately 30 cm to grip the handle.

FIGURE 2

AVIATION SNIPS NOZZLE

FIGURE 3

HIGH REACH CUTTER WITH SLOT IN TWO HANDLE

FIGURE 4

PROTOTYPE WITH EXPANDABLE THREE HANDLE

IV. Cutting Mechanism

- Long handle function as an apparatus for pressing and street lighting columns body itself emerge as a retainer to functionalize scissors mechanism (Escobar, Adelff, & Mariano, 2008). The iron rod will be connected to one of the wire cutter legs which will act to put pressure on the wire cutter points to work.
- Buffer with 2 cm thick attached will make the mechanism effectively workout and fill in the gap because the cutter handle could bend and damages if the gap remains.
- The tight wire wrap on the column will make this mechanism attainable.
- This mechanism allows a different type of long handle mechanisms such as slot in two handles or expandable three handles to achieve the high reach.

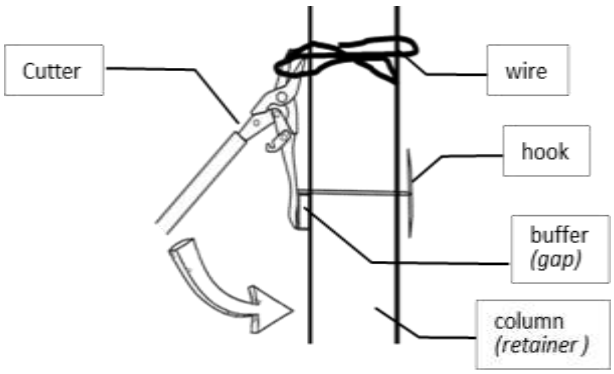

FIGURE 1.5 :

CUTTING MECHANISM

Through the observation of safety aspects through the collection of test high reach cutter data found that the safety of worker can be improved as compared to table 3 below. The data collection was conducted with reference to the inputs that affect the level of work difficulties according to the ladder perturbation and different ground surface conditions of the street lighting columns as Table 1.

TABLE I:

SAFETY OBSERVATION WORKERS DATA

Test	***Location conditions***	***Safety Observation –ladder***	***Safety Observation –high reach***
L1	- Barrier of flowers under street lighting column - Busy traffic	Ladder unstable swaying on column, -Damaged flowers by the ladder	- Flowers intact and can be avoided - Controlled conditions and safe
L2	Large drain, roadblocks uneven surface	Ladder blocked by roadblocks and need to be assist by 2 other workers. -Dangerous.	- Roadblocks can be avoided - Controlled and safe conditions.
L3	Good condition, flat and wide ground (controlled)	- Ladder use firmly - Controlled and harmless conditions - Controlled and safe conditions	Controlled and safe conditions for workers
L4	- Narrow space to place ladder - Busy traffic	- Difficult to positioning the ladder feet - Ladder leaning against a swaying pole /unstable.	Worker able to stand firmly - Controlled and safe conditions for workers
L5	Narrow street space – road barrier parking area, uneven steep	Difficult to position the ladder and less stable - The situation is perilous	Worker able to stand firmly - Controlled and safe conditions for workers

The average manpower required with the manual method to removing the wire using a wire cutter and ladder is between two (2) to three (3) workers. The installation time duration is between three (3) to five (5) minutes starting from withdrawing the ladder from the transportation.

TABLE- II

OVERALL OPERATIONAL OBSERVATION DATA

Test	***Ladder and Cutter***		***High reach wire cutter***	
	Number of worker (person)	***Wire disposal time (second)***	***Number of worker (person)***	***Wire disposal time (second)***
L1	3	93	1	13
L2	3	121	1	15
L3	2	85	1	12
L4	2	74	1	10
L5	3	79	1	21
Total	**13**	**452**	**5**	**71**
Result (Average Decrease)			61. 5%	84%

Comparison of tools is also implemented with local authority innovation tools and imported tools such as lever type wire cutter marketed in the USA, India and Africa, but some variations of this tool have limited reach of up to 3.95 meters and 5.8 kg to 6.3 kg weight, albeit there are wires leftover 4.0 meter to 5.0 meter height and above. Other innovation tools and import tools could not adjustable the length of the tool due to the use of pulleys or string wire methods that are needed to enable wire cutting points to function. The longer handle has difficulties on the logistic issue to the side.

RESULT

The result shows the distinguish the high reach wire cutter which is adjustable to the length of the tool due to the use of a single rod allowing the tool to produce pressure impacted the body of the column acts as a retainer to enable the wire cutter to work. The cutter is able to cut the range between 12 gauge to 24 gauge wire, the frequently used to tie up on the column. The high reach wire cutter details component describes as below ;

Material	Steel iron
Heights	411cm
First Rod + cutter	228 cm
Second Rod + connector	213cm
Handle Diameter	2 cm
Maximum reach	5.5 meters
Weight First Rod + cutter	1.7kg
Weight Second Rod	1.7kg
Overall Weight	3.4kg

Based on the demonstration evaluation by the Occupational Safety and Health Management Office, Universiti Putra Malaysia, the results are the high reach wire cutter can eliminate hazardous working on the higher place without any use of the ladder. The weight of the tools 1.7 kg for normal use is suitable to be handle by the workers that have average operation 90 times to remove the wire or remove the bunting. Nevertheless, the operation still is not advisable to be performed in a strong windy situation. This tool can be performed safely in any ground circumstances, uneven surface, and avoid using a ladder that has a risk of fall severity in a climbing direction (Pliner et al., 2017).

CONCLUSION

Overall, the design and improvising of apparatus to cut the wire on the high reach has been successfully done. The new mechanism using a hollow buffer concede the long handle to be expandable and benefit the user. The problem for which the solution in the form of this project is given was to develop light, portable, expandable tools to help the workers more safety to take out the rusted wire on the street lighting columns in any ground circumstances condition, confront presence blazing of the sun to minimize, reduce and eliminate hazards that occur due to any obstacle, and ladder perturbation.

As a group of researchers and practitioners, we are benefiting from the usefulness of the tools for such situations and conditions. In conclusion, the project to design a simple method to replace the hefty and long ladder to remove the rusted wire advertisement bunting or illegal advertisement has achieved its aim and objectives successfully.

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