Development of Work Breakdown Structure (WBS) Standard for Producing the Risk Based Structural Work Safety Plan Of Building

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Abstract. A construction project is inseparable from a series of tasks in the form of activities. Activities that take place on a project can be disrupted due to various reasons, one of the causes of the disruption of project activities are accidents on construction projects. The risk of workplace accidents can be prevented with early identification and analysis of the potential danger that exist in every activity contained in the project's WBS. The need for a standardized WBS in preventing the risk of workplace accidents is very important because it would present a risk assessment, impact and frequency arising from workplace accidents. The aim of this study is to develop a risk-based WBS standard particularly for structural work, by using a qualitative approach. The results of this research are WBS standard for building, source of potentially dangerous risk at structural work,and the development of safety plan using a risk-based WBS that has been standardized, as a form of prevention, reduction or even nullify the risk of workplace accidents (to obtain zero accidents) during construction project implementation.

1 Introduction

Construction industry is a very unique industry and more dangerous than other industries. The construction sites are constantly changing and temporary. Each construction sites involve of many sub contractors and they perform different types of work in close proximity to each other. The safety of workplace is an essential component of efficiency and productivity[6]. Construction workers, both staff and field workers are protected assets in order to work properly and productively until construction is completed without any workplace accident (zero accident). Workers need to be protected against the threat of accidents and health in work. Occupational safety measures are indispensable, both to workers and to corporations and to their production. Workers must follow safety-related regulations, in this case the OSH program, as the OSH program is closely related to the safety of the workers. A comprehensive OSH program and self-awareness of workers is essential to reduce the number of accidents [2].

Work accidents occurring on a project can actually be minimized, if activities on the project are well defined and each job can be placed at a level and level corresponding to a standard WBS, WBS constructing used during the project phase with a basic scope that has been identified. Initially, WBS was created with a restricted formation of scope, however WBS will be reviewed in addition to scope information developed or developed through complete project-to-project analysis. To complete the description of WBS and its application refers based on standard practical guidance according to the principle used so that will get high quality WBS [8], that is easy to determine the amount of activity in project.

Each defined WBS level brings WBS to a more complex level of activity, each activity that has been grouped in a standard WBS, will be easier to identify and mitigate its potential risks, so it is important to develop a standard Work Breakdown Structure (WBS) for the manufacture of safety based risk [11] to obtain output that can be used as a guideline for the implementation of construction.

2 Research Objectives

The objectives of this research are :

1. To develop of building standardized work breakdown structure.
2. To identify a potentially dangerous source of risk for structure work.
3. To develop safety plan using a risk-based WBS that has been standardized.

3 Literature Review

3.1 Work Breakdown Structure

Work Breakdown Structure is a results-oriented analysis of the work covered in a project called the total scope of the project. WBS is a fundamental document in project management as it provides the basis for planning and managing the schedules, costs and changes that occur. WBS serves as a deliverable oriented tool [4]. WBS formulation enables the project to be better in its definition, both in terms of resources and the estimated time required to complete the project to be further enhanced. However, it is important to note that WBS projects change over time, depending on the needs and constraints that the project is experiencing [10].

WBS forms the basis for planning, estimating, scheduling, monitoring, management and control of all project activities. The proposed methods for developing a deliverable are well defined and comprehensive, and the importance of increasing the

probability of project success by ensuring that the best resources applied to the project [12]. A standardized WBS for the project is used to facilitate the preparation of project financing and a standardized WBS is also used to define project activities [1].

The best method of constructing WBS is the hierarchically displayed decomposition of the entire scope that the project team will undertake to complete the project objectives and produce the intended work output. In PMBOK 5th Edition, 2013 The planned work at the bottom of the WBS called work package. (deliverables) and not the activities.

3.2 Risk Management

Risk management is an important part of the decision-making process in construction project management, especially regarding integration, scope, time, cost, quality, human resources, communications and project procurement. Creating hierarchical risk management with RBS can improve future project prospects for identifying uncertainty and probabilities [13]. Risk is considered a negative term, but in the engineering construction industry in managing risks that arise is necessary and implemented in a structured way, knowledge of risk management, can nullify and minimize risks occurring in construction projects [7].

3.3 Performance Concepts of Occupational Safety and Health

Accidents occurring at construction sites may result in serious physical injuries and accidents such as people falling from altitudes and crashing material or equipment, the cause of occupational accidents may occur due to worker negligence and also undisciplined workers in the project environment, preventive measures against accidents should Implemented and implemented, so that workers and top management will raise awareness in preventing The workplace hazard handling strategy for construction may introduce potential hazards [5] , further investigation of frequent hazards and may result in safety plans in construction projects.

Safety Plan is a plan document containing practical safety that can assist companies in avoiding potential hazards and can control them in the best way when in these hazardous conditions, the importance of safety planning training during the planning, design and implementation phase of a project because it is able to minimize the risk of construction projects and Can improve workers' safety.

4 Methodology

This research is using qualitative approach to achieve formulation of standardised WBS for building construction. A survey and deep interview was also conducted by means of a structured questionnaire to contractor's experts who have had more than 20 years experiences in highrise building construction projects. Here in Figure 1. The Research Flow, there is a sequence of implementation of this study.

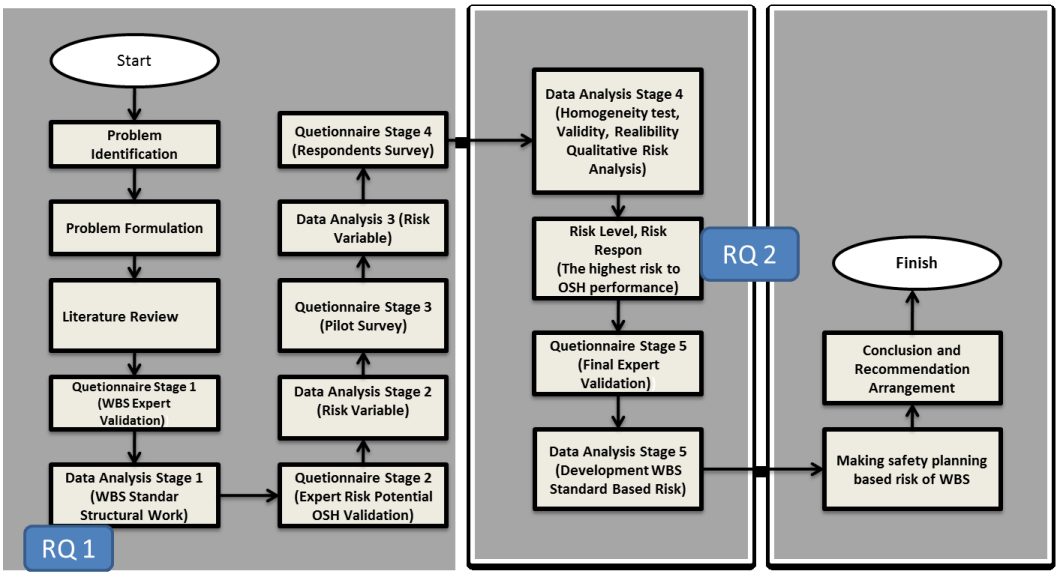

Fig. 1. The Research Flow

4.1 Questionnaire

In this study there are 4 (four) questionnaires to be made: questionnaires in stage I, II, questionnaires in stage III, questionnaire at stage IV, and questionnaire at stage V.

- Questionnaire in phase I is with expert form validation related to standard WBS level will be done variable validation by expert first. There is also the number of experts / experts are 3-5 people with a minimum of 10 years

experiences in the field of high-rise construction and education S1. The validation process contains expert responses to agree / disagree that variable X is an activity in high-rise building.

- Questionnaires in phase II will be validated variables by experts in advance related risk factors that affect OSH. There is also the number of experts / experts are 3-5 people with a minimum of 10 years experiences in the field of high-rise construction and education S1.Proses validation contains expert responses upon agree / disagree that the variable X effect on the risk of high building construction OSH.
- After obtained a valid X variable by expert / expert, conducted phase III that is pilot survey to know whether questionnaire made easy understood responder. Pilot survey is in the form of questionnaires to be distributed to 5-10 respondents. Here is an example of a questionnaire in stage III.
- Questionnaires in stage IV are used to obtain the highest risk factors that affect the quality performance of high construction work. This questionnaire will be distributed to respondents who are / have worked in the process of building high-rise project and handling high building construction work with experience of at least 5 years. Here is an example of a stage IV questionnaire.
- Questionnaire at stage V is expert validation aimed at soliciting expert responses related to the results of risk analysis while discussing the causes, preventive actions, impacts, and corrective actions of the highest risk on the process of implementing high-rise building construction work. Here is an example of a stage V questionnaire.

4.2 Respondent

A total of 35 respondents, the profile of respondent is defined in Table 1. Profile of Respondents as follows:

Table 1. Profile of Respondents

No	Description	Total
1	**Position**	
	Staff/Engineering	28
	Manager	6
	> Manager	1
2	**Work Experience**	
	< 5 years	19
	5 - 10 years	7
	> 10 years	9
3	**Education**	
	D3	2
	S1	31
	S2	2

In homogenity test with Krusskal Wallis test, according to position, work experience, and education, the result is ho >0,05.

WBS research variables the standard derived from the archive analysis of the WBS work package from 5 high construction project data from the structural work down to the top structure in the last 5 years there are 31 work packages, and based on expert validation of the potential risks that affect the performance of OSH 173 risk variables. Then the variable is defined in Table 2. Research Variables as follows:

Table 2. Research Variables

WBS LEVEL 6 Activities	RISK VARIABLES INFLUENCING OSH		
Work Package: Land Clearing Method: Conventional (Land Work)			
Clearing	X1	Workers attacked wild animals in the area around land clearing	
	X2	Feet affected by hoe at the time of land clearing	
	X3	Hands exposed to sickle	
Land Alignment	X4	Feet affected by hoe at the time of land clearing	
Work Package: Land Clearing Method: Mechanical			
Clearing	X5	Workers sprinkled or doused with herbicide solution	
	X6	Tools crashing the workers / facilities around (backhoe) at the time of land clearing	
	X7	Slip due to the condition of the steep soil	
Land Alignment	X8	Accidents during machine mobilization	
	X9	Tool crashing into nearby worker / facility (bulldozer	

WBS LEVEL 6 Activities		RISK VARIABLES INFLUENCING OSH	
		and combine harvester) at ground level	
Work Package: Dewatering			
Channel Preparation	X10	Tool hit the worker / facility around(excavator)	
	X11	Struck by a stone as a shade	
	X12	Workers are dropped due to slippery area conditions in the channel preparation	
	X13	Injured by equipment	
Excavation	X14	Excavation crashing the worker / facility around (backhoe)	
Excavation	X15	Worker fell into the excavation	
	X16	Landslide excavation	
Installation of submeasible pumps	X17	Workers are electrocuted from the pumping machine wires	
	X18	Workers fall / slips due to slippery conditions on pump installation	
Making Well Point	X19	Workers exposed to water runoff during the making of well points	
Making Well Test	X20	Workers fall due to slippery areas around the well	
Channel Preparation	X21	Transfer of existing channel	
	X22	Stricken casing	
	X23	Tools hit the workers / facilities around (excavator)	
	X24	Injured because of equipment	
	X25	Affected crane maneuver	
	X26	Hit the mobile crane	

WBS LEVEL 6 Activities		RISK VARIABLES INFLUENCING OSH	
	X27	Material regardless of the hook / sling mobile crane is broken	
	X28	Tools crashing workers / facilities around	
	X29	Workers fall into the excavation	
	X30	Landslide excavation	
Work Packages: Digging and Landing			
Slope Reinforcement	X31	Landslides/side wall collapse	
	X32	Workers fall due to slope reinforcement activity	
Excavation	X33	Tools crashing workers / facilities around	
	X34	Workers fall into the excavation	
	X35	Landslide excavation	
Landscapes	X36	Workers fell / stumbled while throwing away the soil	
Slope Reinforcement	X37	Landslides / collapse of side walls	
Excavation	X38	Tools crashing workers / facilities around	
	X39	Workers fall into the excavation	
	X40	Landslide excavation	
Landscapes	X41	Workers hit by heavy equipment (backhoe)	
	X42	The leg is exposed to the hoe while doing soil discharges	
	X43	Exposed to dump truck maneuvers	
Work Packages: Stockpiling and Compacting			
Stockpiling and Compacting	X44	Workers fell / clogged due to soil conditions	
	X45	Exposed swing excavator	
	X46	Exposed maneuver dump truck	
Work Package: Anti Termite			

WBS LEVEL 6 Activities		RISK VARIABLES INFLUENCING OSH	
Procurement and Installation of Anti Termite	X47	Sprayed or doused with anti-termite solution	
Work Package: Deepth Foundation (Lower Structure)			
Erection	X48	Worker struck by a stake	
	X49	Worker picked up sling crane	
	X50	Crushed pile during lifting	
	X51	The effect of noise on the surrounding environment	
Pile Linking	X52	Fire due to leaking tube	
	X53	Respiratory disorders due to exposure to welding fumes	
	X54	Workers suffered burns due to burst tubes	
	X55	Irritation to the eye due to smoke (Plunged into the hole during pole connection)	
Making Test Well	X56	Workers fall into the excavation	
	X57	Tools crashing workers / facilities around	
Drilling (Wash Drilling / Dry Drilling)	X58	Workers fall while doing lubrication on the drilling tool	
	X59	Workers fall while refueling the drilling machine	
	X60	Drilling tools crashing into workers / facilities	
	X61	Road dirty / slippery due to spilled soil	
Installation of Casing	X62	Worker struck by reinforcement	
	X63	Worker stricken casing	
Drilling uses mud fluid	X64	Splashed or flushed by fluid	
Cleaning of drill holes	X65	Skin dermatitis due to dust and smoke	
	X66	Eye irritation due to smoke	
Installation of Bored Pile Repetition	X67	Workers puntured iron	
	X68	Worker hands are exposed to an iron	

WBS LEVEL 6 Activities		RISK VARIABLES INFLUENCING OSH	
		cutting machine (bar cutter or bar bender)	
Rebuild with a vacuum	X69	Skin dermatitis due to dust and smoke	
Installation of tremie pipes for casting	X70	Tools crashing into nearby workers / facilities	
	X71	Pipe off / fall into the boring hole casting drill	
Casting drill pole	X72	Traffic congestion due to the truck mixer queue on the drill biting work	
	X73	Tremie pipes jammed so concrete setting with casing	
Withdrawal of the casing	X74	Worker stricken casing when making withdrawal	
Work Package: Test Pile			
Installation of cross beam	X75	Injured by equipment	
Loading	X76	Overwritten material	
Drilling pole	X77	Accident due to boring tool collapsed and overturned on drilling work	
Installation of PDA tools Test	X78	Wounded by equipment	
Work Package: Diaphragm Wall			
Grab soil	X79	Tools crashing workers / facilities around	
	X80	Workers fall into the excavation	
	X81	Landslide excavation	
Landscapes	X82	Workers fall into the pit	
Pouring Slurry Fluid	X83	Eyes splashed or watered solution	
Precast Panel Installation	X84	Overwritten material precast at lifting material	
Spawning	X85	Enlargement Worker hands are exposed to a cut-iron machine (bar cutter or bar bender) during fabrication	
	X86	Working legs	

WBS LEVEL 6 Activities		RISK VARIABLES INFLUENCING OSH	
		wedged in iron	
		The hands of the workers is stabbed with wire	
	X87		
	X88	The hands of workers exposed pliers when tying the ring	
	X89	Stumbled iron	
Formwork	X90	Overwritten Formwork	
		Workers are hammered	
	X91		
	X92	Workers fall down due to porous wood	
	X93	Workers are stricken with material	
	X94	Punctured legs of messy material	
	X95	Legs scratched cluttered material	
Concretion	X96	Sprayed or sprayed with concrete	
	X97	The concrete bucket fell off the TC due to the sling severed so that it spilled over the worker underneath	
	X98	Traffic congestion due to truck mixer queue at casting job diapraghma wall	
	X99	Ready mix from concrete pump spilled on workers	
Work Packages: Soldier Pile, Contiguous Pile, Secant Pile			
Drilling for concrete pile on soldier pile	X100	Accident due to boring tool collapsed and overturned on work Soldier Pile, Contiguous Pile, Secant Pile	
Drilling bentonite pile on contiguous pile	X101	Holes filled with bentonite fluid left open not closed sheeting tarpaulin	
Drilling for boneless concrete on secant pile	X102	The drilling mud disposal is not considered	
Work Package: *Ground Anchor*			
Soil drilling	X103	Workers fall while performing lubrication on the drilling tool	
Drilling	X104	Workers fall while refueling the drilling machine	
	X105	Accident due to boring tool collapsed and overturned on ground anchor work	
Work Packages: Raft Foundation, Pile Cap, Tie Beam, Retaining Wall, Ramp, GWT/RWT			
Spawning	X106	The iron scaffolding is not solid	
	X107	Iron material falls when lifting material with TC	
	X108	Slip on the way up the column	
	X109	Worker hands stabbed wire	
	X110	Workers hands hit by pliers while tying the ring	
	X111	Triple iron	
Formwork	X112	Overwritten Formwork	
	X113	Workers are hammered	
	X114	Workers fall down due to porous wood	
	X115	Workers are stricken with material	
	X116	Legs exposed nails dismantling formwork form work	
	X117	Legs scratched cluttered material	
Concretion	X118	Pipe concrete pump clogged then broke and exposed workers	
	X119	Overloaded concrete bucket drops from TC due to slashed sling so it spills over the worker underneath	
	X120	Traffic congestion	
	X121	Due to truck mixer queue at foundry	

WBS LEVEL 6 Activities		RISK VARIABLES INFLUENCING OSH	
		work raft foundation, pile cap, tie beam, retaining wall, ramp, gwt / rwt	
Procurement & Installation of	X122	Ready mix from concrete pump spilled on workers	
Precast Concrete	X123	Hook / sling TC disconnected when transporting precast raft foundation, pile cap, tie beam, retaining wall, ramp, gwt / rwt	
	X124	Form wrok collapse on the installation of precast raft foundation, pile cap, tie beam, retaining wall, ramp, gwt / rwt	
	X125	Workers fall from altitude on the installation of precast raft foundations, piles, tie beam, retaining walls, ramps, gwt / rwt	
Work Packages: Columns, Beams, Plates, Ladders, Core wall / Shear wall (Upper Structure)			
Spawning	X126	Worker hands are exposed to an iron cutting machine (bar cutter or bar bender) when manufacturing iron for upper structure	
	X127	Worker legs wedged in iron	
	X128	Slip on the way up the column	
		Worker hands stabbed wire	
	X129		
	X130	Workers hands hit by tweezers while tying the ring	
	X131	Triple iron	
Formwork	X132	Overwritten Formwork	
	X133	Workers are hammered	
	X134	Workers fall down due to porous wood	
	X135	Workers are stricken with material	
	X136	Feet punctured spikes former dismantling formwork top structures	
	X137	Dropped while installing formwork	
	X138	Hook / sling TC disconnected when transporting material formwork top structure	
	X139	Form work collapse	
	X140	Workers fall from altitudes when block work, columns, plates, and upper structure ladders	
	X141	Formwork / scaffolding falls and affects workers / facilities	
Concretion	X142	Scrubbed or poured concrete	
	X143	Overloaded concrete bucket drops from TC due to slashed sling so it spills over the worker underneath	
	X144	Traffic congestion due to queue mixer queue on top structure foundry work	
	X145	Ready mix of concrete pump spilled on workers	
Procurement & Installation of Precast Concrete	X146	Overwritten precast concrete material	

WBS LEVEL 6 Activities		RISK VARIABLES INFLUENCING OSH	
Work Packages: Beams, Plates, Core wall / Shear wall (Roof Structures)			
Spawning	X147	Worker hands are exposed to an iron cutting machine (bar cutter or bar bender) when fabricating iron for roofing structures	
	X148	Worker legs wedged in iron	
	X149	Slipped when corewall firing	
	X150	Worker hands stabbed wire	
	X151	Workers hands hit by pliers while tying the ring	
	X152	Triple iron	
Formwork	X153	Overwritten Formwork	
	X154	Workers are hammered	
	X155	Workers fall down due to the wood formwork porous	
	X156	Workers are stricken with material	
	X157	Feet punctured nail used dismantled formwork roof structure	
	X158	Legs scratched cluttered material	
	X159	Hook / sling TC disconnected while transporting material	
	X160	Form work collapse	
	X161	Workers fall from the height when the work of the beam, and core wall roof structure	
	X162	Formwork / scaffolding falls and affects workers / facilities	
Concretion	X163	Sprayed or sprayed with concrete	
	X164	Overloaded concrete bucket drops from TC due to slashed sling so it spills over the worker underneath	
	X165	Traffic congestion	
	X166	Due to the truck mixer queue at the foundry work of the roof structure	
Procurement & Installation of Precast Concrete	X167	Overwritten precast concrete material	
	X168	Hook / sling TC disconnects when transporting precast roofing material	
	X169	Form work collapse	
	X170	Workers fell from the height during the installation of precast roof structure	
Installation of roof covers	X171	Workers exposed to sunlight while working on the roof structure	
	X172	Workers fall from height during erection of roof steel	
	X173	Workers fall from altitude when helipad plates work	

Data collection was carried out using questionnaire survey to understand the perception of the practitioners to the risk factors. Once the probabilities and impacts are determined, the risk score can be calculated with following :

$$R = P \times I \quad (1)$$

Where R = risk factor, P = probability and I = impact.

The probability and impact matrix or risk level matrix (Table 3 and Table 4) illustrates a risk rating assignment for risk factors.

This analysis is done on the results of questionnaires given to respondents by using Likert measurement scale. The probability value of the occurrence of risk and the impact generated multiplied to produce a number that can be made ranking of risk factors. The risk matrix shows the combination of impact and probability as shown below:

Table 3. Probability Matrix

Grade	1	2	3	4	5
Probability Criteria	Very Low	Low	Moderate	High	Very High
Threats	0,10	0,30	0,50	0,70	0,90

Table 4. Impact Matrix

Grade	1	2	3	4	5
Impact Criteria	No Influential	Less Influential	Quite Influential	Influential	Very Influential
Threats	0,05	0,10	0,20	0,40	0,80

5 Result and Discussion

The results of this study are as follows:

1. To answer RQ 1 found WBS Building Standard Building in Figure 2. WBS Standard For High Rise Building a

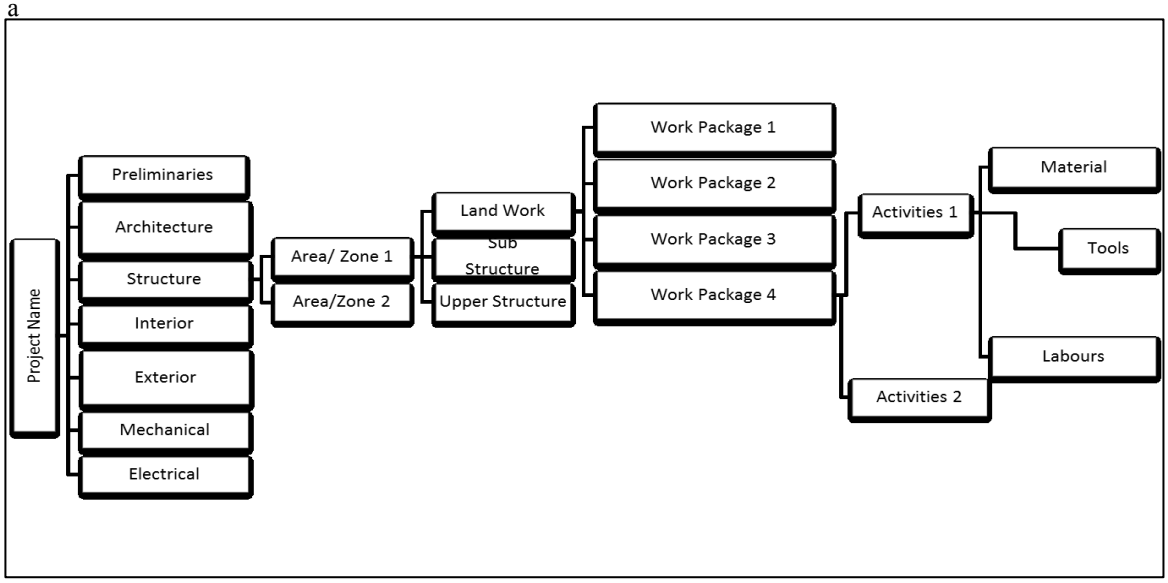

Fig 2. WBS Standard For High Rise Building

Level 1 is for the name of project, level 2 is work sections, preliminaries, structure, architecture, external work, interior, mechanical and electrical works. Level 3 is for area, level 4 are for sub work sections among others soil work, sub structure work, upper structure work, and roof work. Level 5 is for work package, level 6 is for activities, and level 7 is for resources.

2. To answer RQ 2 there is a potentially hazardous source of risk and affect the performance of OSH on Structural Work in Table 5. Dominant Risk as follows:

Table 5. Dominant Risk

No	Risk Variables Influencing OSH		Rank	Level
1	X9	Tool crashing into nearby worker / facility (bulldozer and combine harvester) at ground level	23	H
2	X15	Worker fell into the excavation	13	H
3	X16	Landslide excavation	5	H
4	X27	Material regardless of the hook / sling mobile crane is broken	16	H
5	X123	Hook / sling TC disconnected when transporting precast raft foundation, pile cap, tie beam, retaining wall,	21	H

No	Risk Variables Influencing OSH		Rank	Level
		ramp, gwt / rwt		
6	X124	Form work collapse on the installation of precast raft foundation, pile cap, tie beam, retaining wall, ramp, gwt / rwt	15	H
7	X125	Workers fall from altitude on the installation of precast raft foundations, piles, tie beam, retaining walls, ramps, gwt / rwt	4	H
8	X135	Workers are stricken with material	24	H
9	X139	Form work collapse in uppers structure work	18	H
10	X140	Workers fall from altitudes when block work, columns, plates, and upper structure ladders	1	H
11	X141	Formwork / scaffolding falls and affects workers / facilities	11	H
12	X143	Overloaded concrete bucket drops from TC due to slashed sling so it spills over the worker underneath	19	H
13	X146	Overwritten precast concrete material	17	H
14	X159	Hook / sling TC disconnected while transporting material	9	H
15	X160	Form work collapse	14	H
16	X161	Workers fall from the height when the work of the beam, and core wall roof structure	6	H
17	X162	Formwork / scaffolding falls and affects workers / facilities	3	H
18	X164	Overloaded concrete bucket drops from TC due to slashed sling so it spills over the worker underneath	12	H
19	X167	Overwritten precast concrete material	20	H
20	X168	Hook / sling TC disconnects when transporting precast roofing material	10	H
21	X169	Form work collapse	22	H
22	X170	Workers fell from the height during the installation of precast roof structure	8	H
23	X172	Workers fall from height during erection of roof steel	7	H
24	X173	Workers fall from altitude when helipad plates work	2	H

In the next discussion, we will answer the formulation of the second problem in this study that is the source of any risks that are potentially dangerous on the work of building structures. Based on 173 risk factors, there are 24 dominant risk factors in every activity step which have an effect on OSH performance in construction project especially high rise building construction project. Where from 24 indicator variables belonging to high level of risk dominant happened at Upper Structure and Roof Structure that can decrease OSH performance in similar project, while 111 indicator of variable of medium risk level, and 38 indicator of variable belong to low category. From some of the above dominant risk events with a high level of risk level if related to the literature that has been obtained the author is as follows:

a. The variable risk events X125, X140, X161, X170, X172, and X173, are risk factors for accidents falling from a height or mired in a perforated place. The opinion by Expert who thinks that workers are still less aware of the importance of occupational safety when working at high altitude and there are also workers who are still violating the rules to wear PPE (Personal Protective Equipment) such as helmets, glasses, safety shoes , full body safety harness.
b. The variable risk events X141 and X162 are risk factors formwork / scaffolding fall and override workers / facilities on the work of the roof structure. The following analysis of possible causes of collapse from the use of scaffolding is the inability to accept the load to obtain maximum

results in accordance with the designed, then the use of raw materials with good quality becomes absolutely necessary.

c. The risk event X 135 on the installation of the hazard formwork fell from a height according to Expert, the control measures undertaken were SOPs to work at altitudes, then creating a solid platform for workers, using rubber boots for workers To avoid slipping while climbing the formwork and monitoring the workers working at altitude.

d. In the work involving Tower Crane on X27, X123, X143, X159, X164, and X168 the dangers of material falling according to Expert shall be made of operational SOP tower crane, inspection SOP, use, and maintenance of sling. the riggers provide precise directions to the TC operator to lower the material appropriately.

3. To answer RQ 3 Preparation of Safety Plan using WBS standard is as follows, based on ROSHK in attachment of Ministerial Regulation 05 / PRT / M / 2014, and has been added with WBS level taken sample at some risk with high potential value in Table 6 Work Safety Plan Structure and taken 3 highest risk for example as follow:

Table 6. Safety Plan For Structural Work

NO	WBS Level 5 (WP)	WBS Level 6 (Activities)	Hazard Identification	Probability	Impact	Risk Level	Safety Risk Control
X140	Upper Structure Works (Column, beam, plate, core wall, stairs)	Formwork on Upper Structure	Workers fall from altitude when block work, column, plates, and upper structure ladders.	0,35	0,55	0,288 High	Complete PPE for each worker Installing OSH signs Make SOP pairs formwork upper structure Socializing OSH Program
X173	Roof Structure Works Beams, Plates, Core wall / Shear wall	Roof Structure	Workers fall from the heights when the helipad plates work	0,297	0, 605	0,264 High	Complete safety equipment for each worker Installing OSH signs
X162	Roof Structure Works Beams, Plates, Core wall / Shear wall	Roof Structure Works Beams, Plates, Core wall / Shear wall	Formwork / scaffolding falls and affects workers / facilities on roof structure work	0,314	0,25	0,25 High	Check the installation of formwork Make SOP pairs of roof structure

6 Conclusion

Based on the results of testing and analysis that has been done then it can be concluded as follows:

a. Creating WBS building standards divided into 7 levels, Level 1: Project Name, Level 2: Work Section, Level 3: Zoning Area / Location, Level 4: Sub Work Section, Level 5: Work Packages, Level 6: Activity, and Level 7: Resources. WBS structural work standards can be established according to the classified level after collecting and analyzing data / archives based on BOQ and RKS projects and have been validated by related experts.

b. Identify potentially hazardous sources of risk on structural work. There are 24 high risk risk event variables (X9, X15, X16, X27, X123, X124, X125, X135, X139, X149, X141, X161, X162, X164 and X167, X168, X169 , X170, X172, X173)

are identified to be the dominant risk in every stage of the high rise building development process. Having obtained the risk event variable is also equipped with the risk response of each variable so that the potential danger can be prevented / mitigated.

c. Preparation of safety plan by using risk based WBS standard is completed and developed according to document of safety planning / ROSHK Government Regulation PU 05 / PRT / M / 2014 at occupational safety planning section for building construction work which can be used either as assessment material of service provider auction process and also as guide for contractors in the preparation of safety planning.

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