



HEALTH, SAFETY & ENVIRONMENTAL MANAGEMENT REPORT

**– South Pemberton Village Hall
New Construction Project**

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1 INTRODUCTION

1.1 Purpose

This report is aiming to produce project-specific information on the health, safety and environmental (HS&E) requirements and actions to ensure that client, principal designer and principal contractor can fulfil their obligations to The Construction (Design and Management) Regulations 2015 (CDM 2015).

Designer risk assessment and construction phase risk assessment is provided in this report; it describes how the hazards can be controlled as cost-effectively as possible.

This report also critically evaluates the Green Roof from a commercial and HS&E perspective and discusses how new technologies can improve communication of health and safety information.

1.2 Roles and Responsibilities

One of the key elements to assuring construction HS&E is appointing the right people at the right time (Health and Safety Executive [HSE], 2015). Each duty holder must understand each role and responsibility and cooperate to secure HS&E. Roles and duties are specified by duty holders: clients, principal designers, designers, principal contractors, contractors, workers ([Appendix A](#)).

2 PROJECT INFORMATION

2.1 Project Overview

Title	South Pemberton Village Hall New Construction
Client	SPVH Trust
Principal designer	ABC Design and Build (Portsmouth) Ltd
Principal contractor	ABC Design and Build (Portsmouth) Ltd
Area	<ul style="list-style-type: none"> Overall land: approximately 6,500 m² Building: 540 m² Parking: approximately 625 m²
Scope of work	<ul style="list-style-type: none"> Multipurpose village hall (36 m x 15 m) (2 halls, 1 kitchen, 2 changes, 3 toilets and stores) Car Park (48 off-street bays and 2 disabled bays) Landscape Road and paving
Special user requirements	<ul style="list-style-type: none"> Green roof Use of natural material (timber frame, wood building fabric)

Table 1. Project description (Client's brief, n. d.)

2.2 Site observation

The project site is currently used as a pasture sloping down from north to south. It is surrounded by the dual carriageway, three-lane Portsmouth Road to the south and a dual carriageway, one-lane street to the west. There are electric poles and cables along the west street. There are houses across the west street ([Appendix B](#)).

3 RISK ASSESSMENT

3.1 Risk assessment methodology

British Standards Institution [BSI] (2019, p. 11) defines the purpose of risk assessment as to help duty holders understand uncertainty and the affiliated risk, for encouraging better-informed plans and actions. The typical method of risk analysis is qualitative risk analysis. It is to devise one axis for the likelihood of the hazard and another for the severity; each hazard are rated on each scale and these ratings are multiplied to give a risk score (Boyle. 2008, p. 43).

Both the design phase and construction phase risk assessment have been carried out using the risk assessment matrix mentioned above. The Risk assessment criteria of each scale for this project is shown in [Appendix C](#).

3.2 Design Phase Risk Assessment & Key Hazard Management Plan

Design phase risk assessment maximises the time available for risk control; early risk identification and actions taken are normally cost-effective (Project Management Institute [PMI], 2019, p. 25). As a result of the design phase risk assessment ([Appendix D](#)), 8 hazards, 5 for the construction phase and 3 for the maintenance phase, were identified and assessed. Among these hazards, two key hazards, which can be adequately managed through the design process taking into account the balance of risk against cost, are highlighted.

First, work at height is a major hazard in the construction phase. Renders of the client's brief reveal that the roof structure is made of timber frames and timber panels as the special user requirements. Unlike concrete roofs, where formwork can be used as a platform, this roof has many open spaces that pose a risk of falling during construction. HSE (n.d.) gives information that roof work which is inevitable work of building construction cause about 20 per cent of deaths in construction work. It is important to minimize the risks of working on the roof from a design point of view as long as it meets user requirements. The Work at Height Regulations 2005 states that work at height should not be executed where it is reasonably and practically avoidable. Designing a one-piece modular roof can eliminate the risk, but is not reasonably practicable in terms of cost and feasibility of transportation and installation. However, the risk of working at height can be reduced by designing a one-piece long span beam and installing the beam and panels that are partially pre-assembled on the ground. Hetreed et al. (2017, p. 341) affirm that Glulam is a natural alternative to concrete or steel long span beams in terms of structural and constructability. It is lightweight, easy to handle and standardized (BSI, 1995). The material cost may increase slightly, but considering the cost of installing the scaffolding and the cost of risk, it is a reasonable alternative to the traditional timber frame. To complete the safety goals of this alternative, the rigging anchors and installation specifications must be indicated in the pre-assembly drawings.

Second, the movement of vehicles has the highest risk score in the maintenance phase. The existing west street is a dual carriageway with one-lane, which is not sufficient to accommodate traffic flow both village hall users and other public. A single-car incident may cause a bad reputation for the village hall. The extension of the lane of the west street will significantly improve the traffic flow and reduce car crashes compared to the current

concept design of the client's brief. The extension will also prevent the hazard of collision with moving vehicles for pedestrians. There is no proper sidewalk along the west street neither in current condition nor the client's brief. The sidewalk inside the site will provide not only safety but also an opportunity to induce pedestrians to the village hall. It is expected that the local government is willing to approve the west street extension, as it will also help improve local transportation. The street widening can increase cost, however, given that a significant portion of the cost of paving is equipment rental, combining this work with paving the car park can reduce cost increases. Therefore, these control actions are strongly recommended because many benefits are expected and the cost increase can be reduced to some extent as mentioned above.

3.3 Construction Phase Risk Assessment & Key Hazard Management Plan

Among 8 hazards of the construction phase risk assessment ([Appendix E](#)), two main hazards that affect on-site HS&E arrangements are addressed.

The first hazard to deal with is the overhead electricity cables along the west street as it involves many stakeholders, including the regional electric company and residents. This hazard should be reasonably practicably controlled step by step according to the risk control hierarchy. First, it can be eliminated by diverting it away or replacing it with underground cables or switching it off during construction through consultation with the stakeholders mentioned above (HSE, 2013). It may cost high for the compensation. Otherwise, the hazard area can be reduced by switching off the power to the point where it does not disrupt neighbours across the west street. If eliminating or reducing can not be done, then the principal contractor should isolate the west street area with a safety barrier and it is already reflected in the site set-up plan ([Appendix F](#)) as a safeguard. In terms of a balance of cost and benefit, reducing and isolating is the proper control measures.

Fire or explosion is one of the hazards that may cause injury and property damage which link to the project delay. For this project, timber is the main material, which is classified as combustible; it is more vulnerable to fire during construction since a permanent fire safety system is not in place (STA 2017). Fire is a chain reaction between oxygen, fuel and heat (Structural Timber Association [STA], 2014); it can be prevented by removing or isolating one of them (HSE, 2010a). To prevent fire for this project, several isolation and control measures are collectively required; setting up the designated location and barrier of inflammable materials to isolate from ignition source; setting procedure to handle flammable material; limiting the number of workers for hot work by allowing certified person considering competency to reduce ignition source; allowing smoking only in smoking shelter; deploying sufficient fire extinguishers at the site. Although these fire prevention measures are low cost and sufficient, it is necessary to establish a hotline with the local fire station in case of an emergency case (The Regulatory Reform (Fire Safety) Order 2005).

4 SITE SET-UP PLAN

CDM 2015 states that the principal contractor must prepare the site set-up plan during the pre-construction phase. The site setup plan contains management for zoning, traffic, materials and waste, fire, dust and noise control, lighting, security, basic welfare facilities such as first aid, toilet, rest shelter, smoking, canteen (HSE, 2010b). The aforementioned major risk management plan and the rest of the risk assessment control measures during the pre-construction phase were

reflected in the site setup plan ([Appendix F](#)). It is practically planned due to this project's relatively small building coverage: 8 per cent, 540 m² of building area, 6,500 m² of land area. For instance, the west side fences are offset to keep clearance with overhead cables with acoustic barriers to minimise noise. Vehicle routes are drawn up as a one-way system using central reservations with temporary car parks and pedestrians are separated from vehicle routes since segregation is the most effective measure (HSE, 2009).

5 GREEN ROOF

Sutton (2015, p. 5) listed the benefits of a green roof: detaining rainwater, reducing heat island, improving air quality and biodiversity, saving building energy, noise reduction, and beautiful views. Among these, the village hall may take benefit from saving building energy, noise reduction and beautiful view; other benefits have little impact as it is located in the countryside. Meanwhile, Wilkinson & Dixon (2016) outlined technical issues of the green roof: root penetration, waterproofing, drainage blockage, insects, fungi, roof access ([Appendix G](#)). It increases the frequency of maintenance, the risk of work at height and its cost. Especially the village hall is made of wooden material, so constant exposure to moisture, insects and fungi can shorten its lifespan in the long term.

The synthetic green roof can be an alternative to a natural green roof; it provides building energy savings and noise reduction through additional thermal insulation, but also provides beautiful views, low cost of installation and maintenance and safety ([Appendix G](#)). Therefore, an artificial green roof is recommended for this project since it provides similar benefits and less cost and safety risk.

6 NEW TECHNOLOGY AND COMMUNICATION

Information and communication technology can be a tool to intensify communication of HS&E. Roughton et al. (2019, p. 385) state that technology has changed the safety management system. For instance, using an internet-based mobile application with two-way communication allows prompt delivery of HS&E instruction to subcontractors or workers, as well as easy feedback of field information. Afzal & Shafiq (2021) demonstrated that safety hazards could be lowered by job simulation using 4D Building Information Modelling (BIM) and Virtual Reality (VR). During the VR demonstration, the worker can interactively communicate with site management and participate in decision-making about the safe working method. VR also can be used to verify the competency of workers without any safety risk. Further, UK BIM Framework (2021) set out that the health and safety file should incorporate into the asset information model for the purpose of communication in its guidance. Duty holders are advised to remain attentive about improving safety through the introduction of such new technologies.

7 CONCLUSION

Through this report, the roles and responsibilities of the duty holders are clearly defined, and risk assessment was performed in each of the design and construction phases. Based on this assessment, appropriate safety control measures considering cost and efficiency are derived and reflected in the site set-up plan. In addition, an alternative is suggested for the green roof, which is a special user's requirement.

In conclusion, all duty holders must clearly understand the contents of this report to increase their knowledge about HS&E of this project; do their best to endeavour in their respective roles

with their skills, experiences and positive behaviour. By doing so, the project can be successfully completed with zero accidents.

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APPENDICES

Appendix A - Roles and Responsibilities

CDM dutyholders: * Who are they?	Summary of role/main duties
Clients are organisations or individuals for whom a construction project is carried out.	Make suitable arrangements for managing a project. This includes making sure: <ul style="list-style-type: none"> ■ other dutyholders are appointed; ■ sufficient time and resources are allocated. Make sure: <ul style="list-style-type: none"> ■ relevant information is prepared and provided to other dutyholders; ■ the principal designer and principal contractor carry out their duties; ■ welfare facilities are provided.
Domestic clients are people who have construction work carried out on their own home, or the home of a family member that is not done as part of a business, whether for profit or not.	Domestic clients are in scope of CDM 2015, but their duties as a client are normally transferred to: <ul style="list-style-type: none"> ■ the contractor, on a single contractor project; or; ■ the principal contractor, on a project involving more than one contractor. However, the domestic client can choose to have a written agreement with the principal designer to carry out the client duties.
Designers are those, who as part of a business, prepare or modify designs for a building, product or system relating to construction work.	When preparing or modifying designs, to eliminate, reduce or control foreseeable risks that may arise during: <ul style="list-style-type: none"> ■ construction; and ■ the maintenance and use of a building once it is built. Provide information to other members of the project team to help them fulfil their duties.
Principal designers** are designers appointed by the client in projects involving more than one contractor. They can be an organisation or an individual with sufficient knowledge, experience and ability to carry out the role.	Plan, manage, monitor and coordinate health and safety in the pre-construction phase of a project. This includes: <ul style="list-style-type: none"> ■ identifying, eliminating or controlling foreseeable risks; ■ ensuring designers carry out their duties. Prepare and provide relevant information to other dutyholders. Provide relevant information to the principal contractor to help them plan, manage, monitor and coordinate health and safety in the construction phase.
Principal contractors are contractors appointed by the client to coordinate the construction phase of a project where it involves more than one contractor.	Plan, manage, monitor and coordinate health and safety in the construction phase of a project. This includes: <ul style="list-style-type: none"> ■ liaising with the client and principal designer; ■ preparing the construction phase plan; ■ organising cooperation between contractors and coordinating their work. Ensure: <ul style="list-style-type: none"> ■ suitable site inductions are provided; ■ reasonable steps are taken to prevent unauthorised access; ■ workers are consulted and engaged in securing their health and safety; and ■ welfare facilities are provided.
Contractors are those who do the actual construction work and can be either an individual or a company.	Plan, manage and monitor construction work under their control so that it is carried out without risks to health and safety. For projects involving more than one contractor, coordinate their activities with others in the project team – in particular, comply with directions given to them by the principal designer or principal contractor. For single-contractor projects, prepare a construction phase plan.
Workers are the people who work for or under the control of contractors on a construction site.	They must: <ul style="list-style-type: none"> ■ be consulted about matters which affect their health, safety and welfare; ■ take care of their own health and safety and others who may be affected by their actions; ■ report anything they see which is likely to endanger either their own or others' health and safety; ■ cooperate with their employer, fellow workers, contractors and other dutyholders.

*Organisations or individuals can carry out the role of more than one dutyholder, provided they have the skills, knowledge, experience and (if an organisation) the organisational capability to carry out those roles in a way that secures health and safety.

** Principal designers are not a direct replacement for CDM co-ordinators. The range of duties they carry out is different to those undertaken by CDM co-ordinators under CDM 2007

A summary of roles and duties under CDM 2015 (HSE, 2015)

Appendix B - Site Observation



Site view (Client's brief, n. d.)

Appendix C - Risk Assessment Criteria

Likelihood (L) x Severity (S) = Risk Score		Severity (S)				
		Trivial (1)	Slight harm (2)	Lost time harm (3)	Major harm (4)	Multiple or Extreme harm (5)
Likelihood (L)	Very unlikely (1)	1	2	3	4	5
	Unlikely (2)	2	4	6	8	10
	Probable (3)	3	6	9	12	15
	Most Likely (4)	4	8	12	16	20
	Highly Likely (5)	5	10	15	20	25

Rating Band	Risk	Action Required
1 to 5	Minimal	No Action Required
6 to 10	Low	Ensure control measures are maintained and reviewed as necessary
11 to 16	Medium	Additional control measures needed to reduce risk rating
17 to 25	High	Activity not permitted. Hazard to be avoided or risk to be reduced to tolerable

Risk Control Category Hierarchy		
E	Eliminate	Avoid the source of risk
R	Reduce	Substitute or Reduce the likelihood or severity
I	Isolate	Isolate from the people
C	Control	Organizational and technical controls such as safe systems of work, procedures, etc.
P	Protect	Protect Individuals
D	Discipline	Help people behave properly

Appendix D - Designer Risk Assessment

												Revision		1			
Facilitator		Keuntaek Hong										Date		01-12-2021			
ID	Hazards	Effect	Who	Risk Score			Control							Remarks			
				L	S	R	Category	Owner	Measures				Cost		L	S	RR
■ CONSTRUCTION PHASE																	
DC-01	Work at Height	Fatal or injury by falling from ladders, scaffolds, working platforms and roof	C	4	4	16	E	PD	- Design modular roof installation to remove work at height - Design lights to wall mount type from ceiling pendant type				High	1	4	4	recommended
							R	PD PC	- Design and procure one piece long span beam to reduce assembly work at height - Design partial pre-assembled roof installation to reduce work at height				Moderate	2	4	8	
							I	PC	- Limit the number of worker by allowing certified person considering competency to reduce the exposure to the risk				Low	2	4	8	
							C	PC	- Set procedure to meet the relevant standards and inspect prior to use of scaffolding - Use scissor lift for short duration work and inspect regularly				Low	2	4	8	
							P	PC	- Provide safety harnesses to protect workers				Very Low	4	3	12	
							D	PC	- Manuals shall be provided and trained to workers before the work is implemented at site				Very Low	4	4	16	
DC-02	Fire or explosions	Property damage and injury by fire accident due to the following causes; - flying sparks during the hot work - Smoking near flammable materials - Electrical sparks - Poor fuel storage	C P	3	5	15	E	PD	- Design to use non-combustible building material and non-flammable utility material				High	1	2	2	recommended
							R	PD PC	- Design to reduce usage of flammable utility materials (substitute with less flammable materials) - Set up a plan to minimise the storage of combustible building materials on site				Low	2	2	4	
							I	PC	- Set up the designated location and barrier of inflammable materials to isolate from ignition source				Low	2	4	8	
							C	PC	- Arrange fire fighting equipment such as hydrant and extinguisher to control fire - Set procedure to handle flammable material to control the exposure				Low	3	4	12	
							D	PC	- Deliver regular fire drills - Use signs to warn workers to look out				Very Low	3	5	15	
DC-03	Electricity	Fatal or injury by contacting with existing overhead cables	C	3	4	12	E	PD PC	- Design an underground electric conduit and cable that can replace the existing overhead cables and switch it before the main construction commence to avoid the risk (feasibility need to be reviewed by the Regional Electricity Company)				High	1	4	4	recommended
							R	PD PC	- Switch off the power to the point where it does not disrupt neighbours by the Regional Electricity Company to reduce the hazard area				Low	1	4	4	
							I	PC	- Isolate the area of the west overhead cable during main building construction work (It is not practical for the work of access road and landscaping)				Low	2	4	8	
							C	PC	- Install safe bar for clearance required beneath the overhead cables to control the access - Appoint a competent person for supervision				Low	2	4	8	
							D	PC	- Use signs to warn workers to look out				Very Low	3	4	12	

ID	Hazards	Effect	Who	Risk Score			Control								Remarks
				L	S	R	Category	Owner	Measures	Cost	L	S	RR		
DC-04	Using sharp hand tools	Injuries caused by bench circular saws that inevitably require the use of wooden building materials	C	4	3	12	E	PD	- Design & procure prefabricated and joinery timber to eliminate use of circular saw	High	1	3	3	recommended	
							R	PD PC	- Design members of wood with standard size to minimise on-site cutting	Moderate	2	3	6		
							I	PC	- Limit the number of worker by allowing certified person considering competency to reduce the exposure to the risk - Barrier off the cutting area to reduce the exposure to the risk	Low	3	3	9		
							C	PC	- Set procedure to instruct the operator to use safe to control circular saw operator - Appoint competent supervisor for this work to control circular saw operator	Low	3	3	9		
							P	PC	- Wear thick leather glove for circular saw operator to protect circular saw operator	Very Low	4	3	12		
							D	PC	- Use signs to warn workers to look out	Very Low	4	3	12		
DC-05	Manual handling	Injury by lifting and moving loads	C	4	2	8	E	PD	- Design rigging anchor for each building timber frame to facilitate machine lifting - Design building fabric with soft wood instead hard wood to avoid heavy load	Low	2	2	4	recommended	
							R	PC	- Locate site storage area near the building to reduce distance of manual handling	Very Low	3	2	6	recommended	
							C	PD	- Review weight of building members and specify the handling methods on the drawings	Very Low	3	2	6	recommended	
							P	PC	- Utilise manual handling aids such as sack truck, trolleys to protect worker	Very Low	4	1	4	recommended	
■ MAINTENANCE PHASE															
DM-01	Movement of vehicles	Fatal or serious injury by car accident such as car crash and collision to pedestrians due to narrow access road and no sidewalk	P	4	5	20	R	PD	- Design expansion of the west street to reduce complex traffic flow	High	1	4	4	recommended	
							I	PD	- Design separate sidewalk along toe west street to isolate pedestrian from vehicles	Low	1	5	5	recommended	
							C	PD	- Design road humps to control the speed of vehicles	Low	2	5	10	recommended	
							D	PD	- Design traffic signage to help drivers to drive slowly	Very Low	4	5	20	recommended	
DM-02	Fire or explosions	Property damage and injury by fire accident due to the following causes; - wooden building materials - fire source from kitchen or smoking or electric spark	M P	2	5	10	E	PD	- Design kitchen without heat source (e.g. gas or electric heating) to eliminate fire source (modification of user requirement required)	Very Low	1	5	5	recommended	
							R	PD	- Design kitchen with alternative heat source to reduce probability of fire (e.g. Induction stove and microwave) - Design wood frame and fabric with fire retardant and fire resistant property to reduce fire spread	Moderate	1	2	2		
							I	PD	- Design fire door on kitchen and sprinkler to isolate fire in the kitchen	Moderate	2	2	4		
							C	PD	- Design fire detection system (e.g. smoke detector and heat detector) to control public to escape early - Design fire fighting equipment such as hydrant and extinguisher to control fire	Low	2	3	6		
							P	PD	- Design oxygen mask to protect personal	Very Low	2	4	8		
							D	PD	- Design fire warning signage to discipline people	Very Low	2	5	10		

ID	Hazards	Effect	Who	Risk Score			Control								Remarks
				L	S	R	Category	Owner	Measures				Cost	L	
DM-03	Work at Height	Fatal or injury by falling from height during green roof repair work due to slope roof without fence	M	2	4	8	E	PD	- Design roof without green roof to avoid maintenance or housekeeping on the roof (modification of user requirement required)	Very Low	1	4	4		
							R	PD	- Design device such as barrier for root penetration, extra water proofing and special drainage layer to reduce green roof maintenance work	Moderate	1	4	4	recommended	
							I	PD	- Design proper anchor point and fences on the roof to reduce the exposure to the risk - Design the lower sloping roof as much as possible to reduce the exposure to the risk	Very Low	2	3	6	recommended	

Key: Who effected: C=Construction workers, M=Maintenance workers, P=General public (anyone not involved directly with construction or maintenance)

In the Risk Control Category, only practicable controls are showing (not showing impractical one).

In the Remarks, recommendation were made in consideration of both benefits and costs through Risk Workshop with duty holders. If multiple actions are recommended, the residual risk score is the lowest number of residual risk score for recommendation.

Appendix E - Construction Phase Risk Assessment

Facilitator		Keuntaek Hong										Revision		1	
												Date		01-12-2021	
ID	Hazards	Effect	Who	Risk Score			Control								Remarks
				L	S	R	Category	Owner	Measures	Cost	L	S	RR		
CC-01	Movement of vehicles	Fatal or serious injury by car accident such as car crash and collision to worker or pedestrians - all area inside site and access way	C P	4	4	16	R	PC	- Minimise the regular use of vehicle on site (operation bus instead of individual cars) - Order the material with over a certain amount at a time to reduce movement of vehicles	Moderate	1	4	4		
							I	PC	- Prohibit the general public from entering the site to isolate the pedestrian - Separate vehicle movement area and work area to isolate the contact between workers and vehicles - Provide appropriate pedestrian inside and outside of the site	Very Low	1	4	4	recommended	
							C	PC	- Establish the site set-up plan and update according to work progress and site situation - Layout one-way system vehicle route (No reversing) - Keep vehicle route clear and flat with humps	Very Low	2	3	6	recommended	
							P	PC	- Install safety barrier between the vehicle route and the work area - Provide workers with high-visibility jacket	Very Low	3	4	12	recommended	
							D	PC	- Use signs of speed limit and cross-over points to warn - Utilise regular training for vehicle operators	Very Low	4	4	16	recommended	
CC-02	Electricity	Fatal or injury by contacting with electricity - west site: existing overhead cables - all area: any work using electricity	C	3	4	12	E	PC	(overhead cables) - Find out with the Regional Electricity Company if the line can be permanently diverted away from the work area or replaced with underground cables., implement it if possible - Find out with the Regional Electricity Company if the overhead line can be temporarily switched off during access road and landscaping work	High	1	4	4		
							R	PC	(overhead cables) - Switch off the power to the point where it does not disrupt neighbours by the Regional Electricity Company to reduce the hazard area	Low	1	4	4	recommended	
							I	PC	(overhead cables) - Isolate the area of the west overhead cable during main building construction work	Low	2	4	8	recommended	
							C	PC	(overhead cables) - Install safe bar for clearance required beneath the overhead cables to control the access	Low	2	4	8	recommended	

ID	Hazards	Effect	Who	Risk Score			Control								Remarks
				L	S	R	Category	Owner	Measures	Cost	L	S	RR		
			C	3	4	12	P	PC	(Electricity for construction) - Provide electric PPE such as insulated gloves	Low	2	4	8	recommended	
							D	PC	- Use signs to warn workers to look out	Very Low	3	4	12	recommended	
CC-03	Work at Height	Fatal or injury by falling from ladders, scaffolds, working platforms and roof - village hall building area	C	3	4	12	I	PC	- Limit the number of worker by allowing certified person considering competency to reduce the exposure to the risk - block any holes on the roof	Low	2	4	8	recommended	
							C	PC	- Set procedure to meet the relevant standards and Inspect prior to use of scaffolding - Use mobile elevating work platforms for short duration work and inspect regularly - Provide handrails to prevent from falling - Inspect ladders regularly and use properly - Appoint dedicated competent supervisor and rigging signal foreman for roof installation	Low	2	4	8	recommended	
							P	PC	- Provide safety harnesses to protect workers	Very Low	3	3	9	recommended	
							D	PC	- Manuals shall be provided and trained to workers before the work is implemented at site	Very Low	3	4	12	recommended	
CC-04	Fire or explosions	Property damage and injury by fire accident - all area: spark, smoking, electricity, flammable material	C P	3	4	12	R	PC	- Set up a plan to minimise the storage of combustible building materials on site	Low	2	2	4	recommended	
							I	PC	- Set up the designated location and barrier of inflammable materials to isolate from ignition source - Limit the number of worker for hot work by allowing certified person considering competency to reduce the exposure to the risk	Low	2	4	8		
							C	PC	- Set procedure to handle flammable material to control the exposure - Allow Smoking only in smoking shelter - Deploying sufficient fire extinguishers at site - Provide potable fire extinguishers to workers to control initial fire - Set a hot-line with local fire station (Fire alarm will notify to the fire station automatically) - Operate hot work permit system	Low	3	4	12		
							P	PC	- Provide potable fire extinguishers to workers to protect from the initial fire	Low	3	4	12		
							D	PC	- Deliver regular fire drills - Use signs to warn workers to look out	Very Low	3	4	12		
CC-05	Using sharp hand tools	Injuries caused by bench circular saws that inevitably require the use of wooden building materials - site workshop	C	4	3	12	I	PC	- Limit the number of worker by allowing certified person to reduce the exposure to the risk - Barrier off the cutting area to reduce the exposure to the risk	Low	3	3	9	recommended	
							C	PC	- Set procedure to instruct the operator to use safe to control circular saw operator - Appoint competent supervisor for this work to control circular saw operator	Low	3	3	9	recommended	
							P	PC	- Wear thick leather glove for circular saw operator to protect circular saw operator	Very Low	4	3	12	recommended	
							D	PC	- Use signs to warn workers to look out	Very Low	4	3	12	recommended	

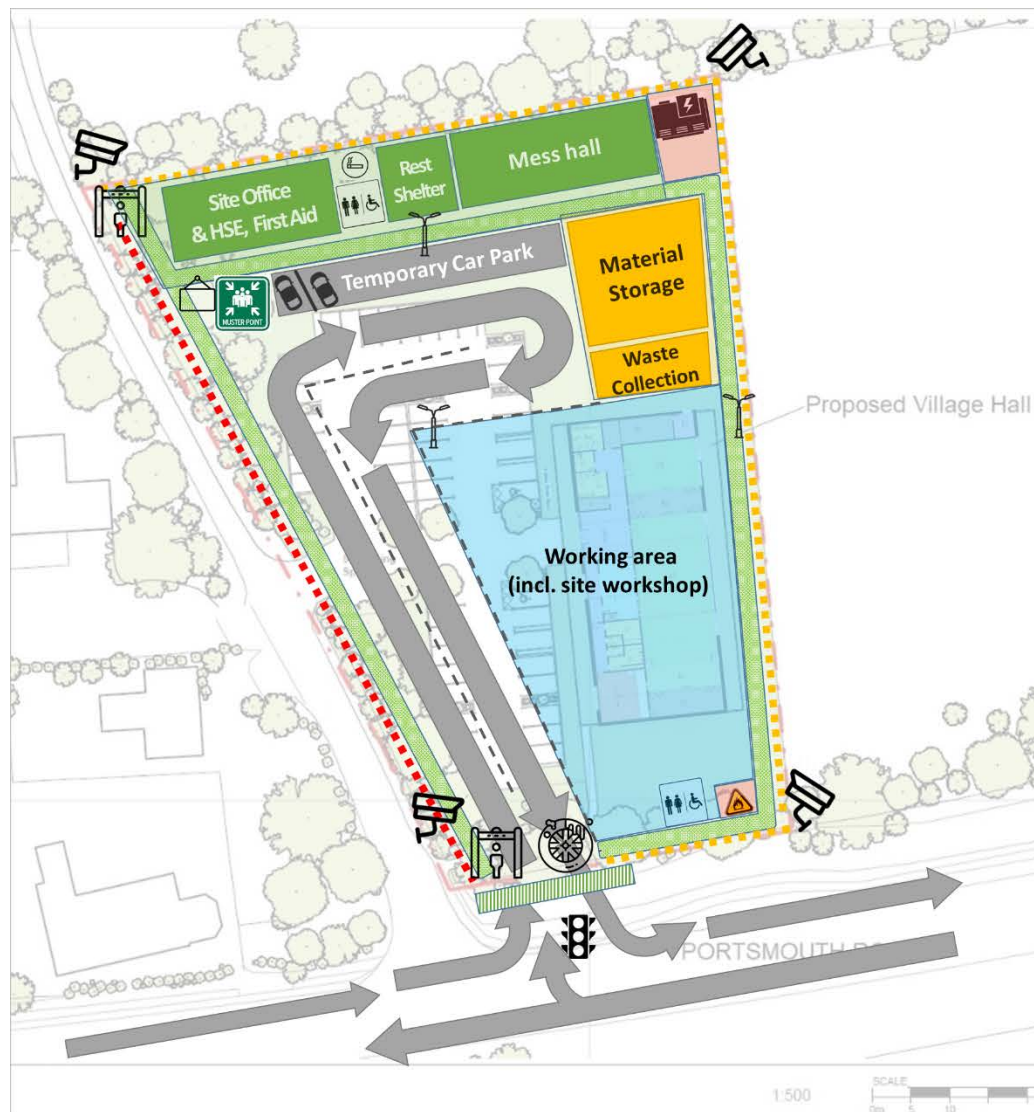
ID	Hazards	Effect	Who	Risk Score			Control								Remarks
				L	S	R	Category	Owner	Measures	Cost	L	S	RR		
CC-06	Manual handling	Injury by lifting and moving loads - material storage area - village hall building area	C	4	2	8	R	PC	- Locate site storage area near the building to reduce distance of manual handling	Very Low	3	2	6	recommended	
							C	PC	- Set the rule to limit the weight and number of manual handling by person - Check the weight of material from drawing or packing list before handling	Very Low	3	2	6	recommended	
							P	PC	- Utilise manual handling aids such as sack truck, trolleys to protect worker	Very Low	4	1	4	recommended	
							D	PC	- Use signs to warn workers to look out	Very Low	4	2	8	recommended	
CC-07	Slips and trips	Injury by slips and trips from or obstacles slippery ground - all area	C	3	2	6	R	PC	- Set up a plan to minimise the storage of building materials on site	Very Low	2	2	4	recommended	
							I	PC	- Set material storage area and waste collection area to isolate obstacles	Very Low	2	2	4	recommended	
							C	PC	- Planning deliveries to minimise the amount of materials on site - Set a rule for house keeping before and after the work - Providing scrap bins where needed	Very Low	2	2	4	recommended	
							P	PC	- Provide non-slip safety shoes to worker	Very Low	2	2	4	recommended	
							D	PC	- Use signs to warn workers to look out	Very Low	2	2	4	recommended	
CC-08	COVID-19	Loss time harm by infection from COVID-19 - all area	C	2	3	6	I	PC	- Isolate the worker with symptoms	Very Low	1	3	3	recommended	
							C	PC	- Control the site access (check fever daily at the gate and vaccine pass)	Low	1	3	3	recommended	
							P	PC	- Wear face mask inside the site - Install individual partition in the mess hall	Very Low	1	3	3	recommended	
							D	PC	- Promote vaccination, physical distancing, hand washing	Very Low	2	3	6	recommended	



















Key: Who effected: C=Construction workers, M=Maintenance workers, P=General public (anyone not involved directly with construction or maintenance)

In the Risk Control Category, only practicable controls are showing (not showing impractical one).

In the Remarks, recommendation were made in consideration of both benefits and costs through Risk Workshop with duty holders. If multiple actions are recommended, the residual risk score is the lowest number of residual risk score for recommendation.

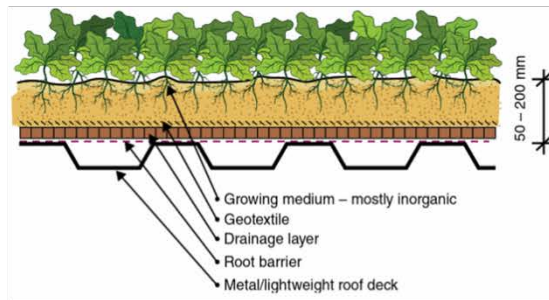
Appendix F - Site Set-up Plan



Safe Zone	Site office, HSE training room, First aid, Mess hall, Shelter, Sidewalk, Smoking area
Material Zone	Material storage, Waste collection
Working Zone	Village hall site, Site workshop
Danger Zone	Power generator, Flammable material storage
	Safe barrier of overhead power line & Acoustic barrier
	Fire wall & Safety fence
	Pedestrian routes & Emergency routes
	Vehicle routes
	Security control of worker entrance
	Traffic control for main gate
	Power generator
	Toilet
	Muster Point
	Reservation (Vehicle Barrier)
	Flood lighting
	Pedestrian crossing
	Temporary car park
	CCTV with flood lighting
	Wheel washing machine
	Flammable material storage
	Smoking shelter
	HSE instruction board

Appendix G - Green Roof

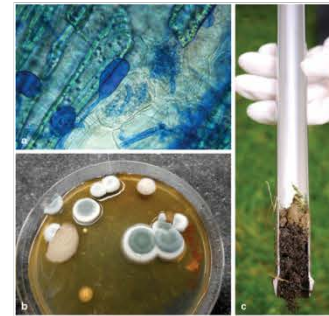
Natural green roof



Typical green roof layer (Wilkinson & Dixon, 2016)



Root penetration (Sutton, 2015)

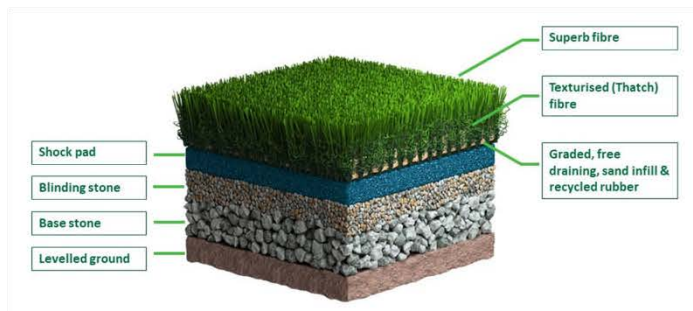


Fungi on the green roof (Sutton, 2015)



Ant on the green roof (Sutton, 2015)

Synthetic green roof



Royal grass (n.d.). *The royal grass*. <https://www.royalgrass.co.uk/>

