BEM ROADSHOW 2023
Sabah & Sarawak

BEMEngineers
BEM_Engineers

Design Risk Assessment (DRA)

Presented by:

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Assistant Director

Construction Safety Division, DOSH HQ

Session:
5th July 2023 / 6th July 2023

Grand Ballroom,
Le Meridien Hotel, Kota Kinabalu

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Outline of Presentation

- PENGENALAN PENTAKSIRAN RISIKO REKA BENTUK
- PRINSIP AM PEMCEGAHAN
- AMALAN TERBAIK DALAM REKA BENTUK
- BORANG DRA 1, 2 & 3

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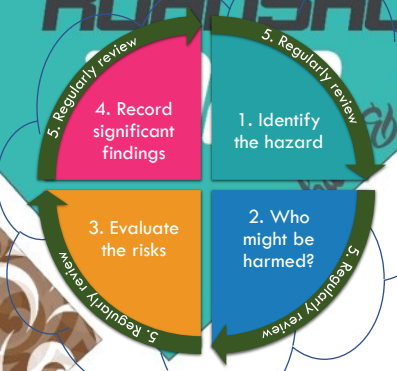
PENTAKSIRAN RISIKO REKA BENTUK

- akan diperkenal bersama Peraturan OSHCIM (CDM)
- akan dikuatkuasakan bersama A1648

BEM ROADSHOW by Sarawak

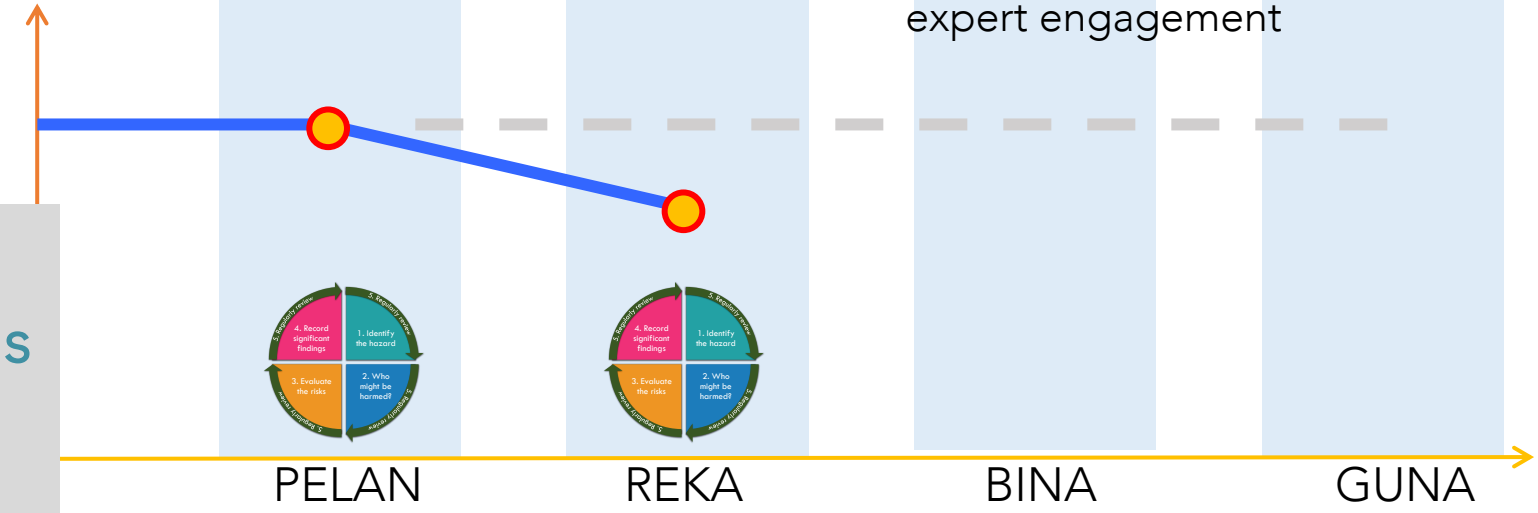


Owner of Project & Designer:

- Identify foreseeable design risks
- Eliminate or reduce them

All involved in project:

- Collectively review design & further eliminate or reduce any foreseeable design risks
  - Design review meetings, workshops, lit. review, expert engagement



OSHCIM ialah bekerjasama mengurus risiko KKP projek seawal mungkin

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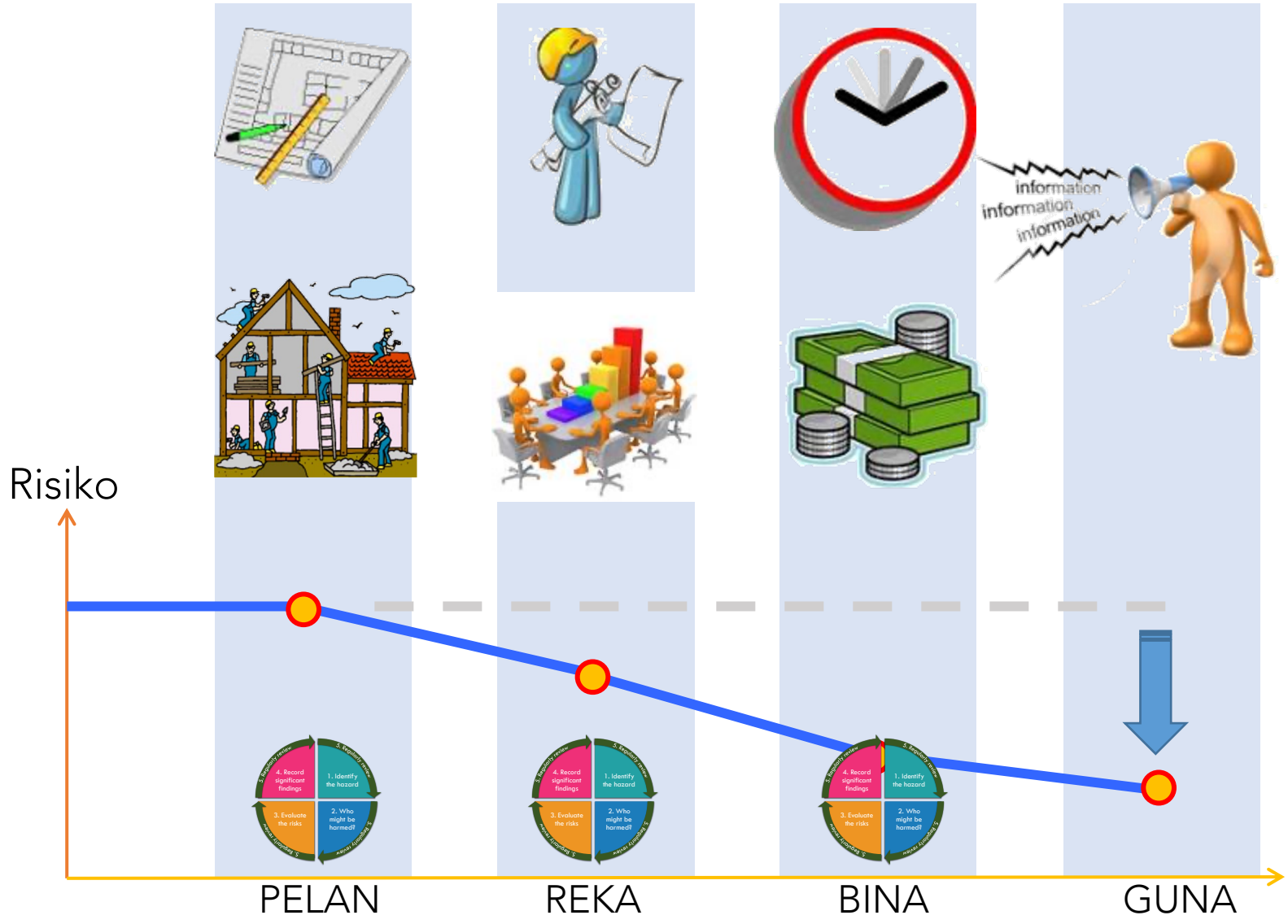
Pasukan projek bersama fokus dlm menghapuskan hazard & mengurangkan risiko kpd pekerja & persekitaran pekerjaan



- Who is involved?
  - Owner, designer, principal designer, principal contractor, contractor
    - a systematic management approach from 'cradle' to 'grave'
    - foreseeable hazards, risk information & risk control - general principles of prevention
- What are the objectives?
  - Protect OSH of people in construction, maintenance, cleaning, etc., and others who may be affected by their activities;
  - Reduce risks by **'safe design'** during construction and throughout the life cycle of the structure;
    - Safe design means the integration of control measures early in the design process to **eliminate** or, if this is not practicable, **reduce or control** risks to safety and health throughout the life of the structure being designed.

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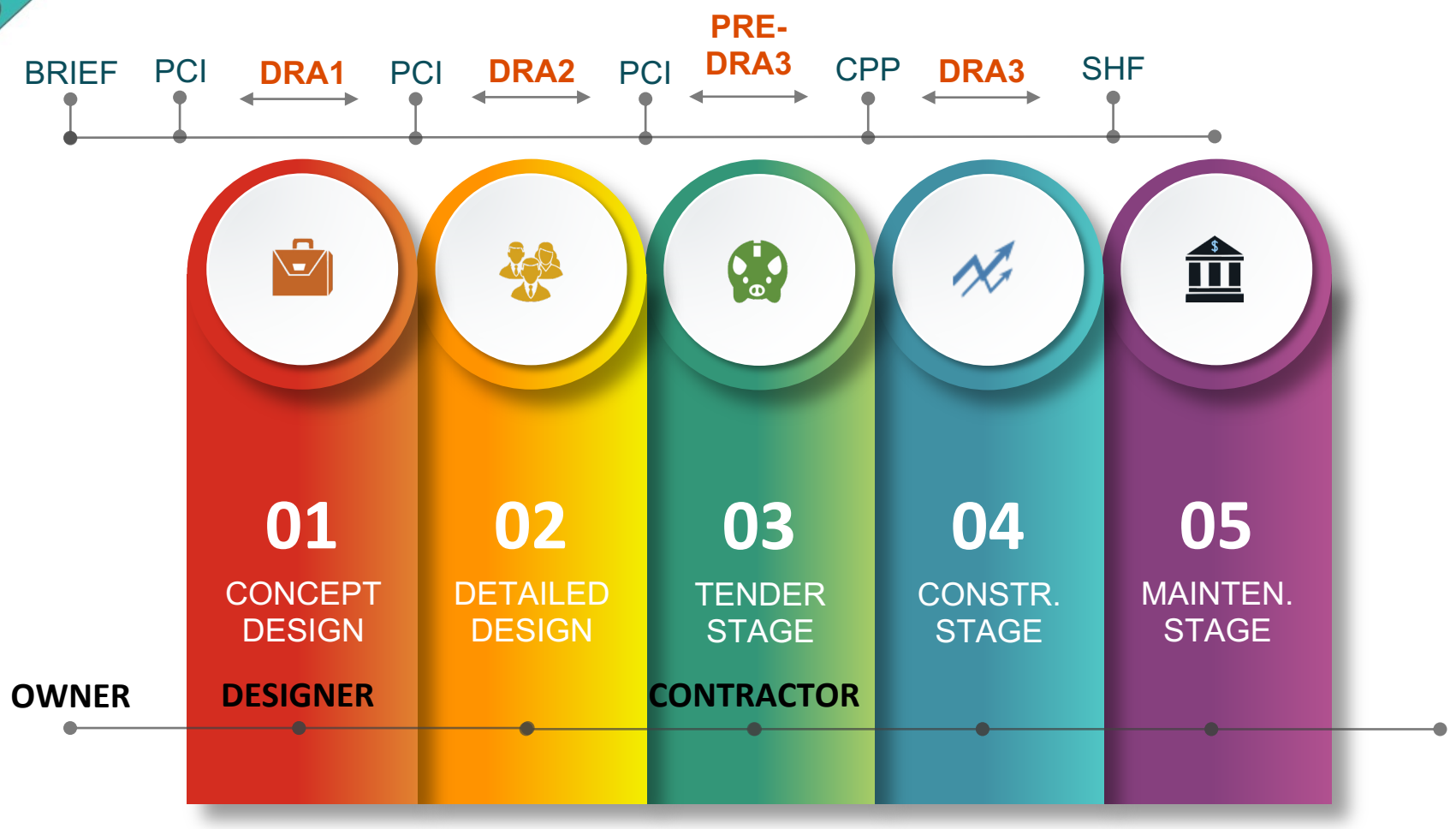

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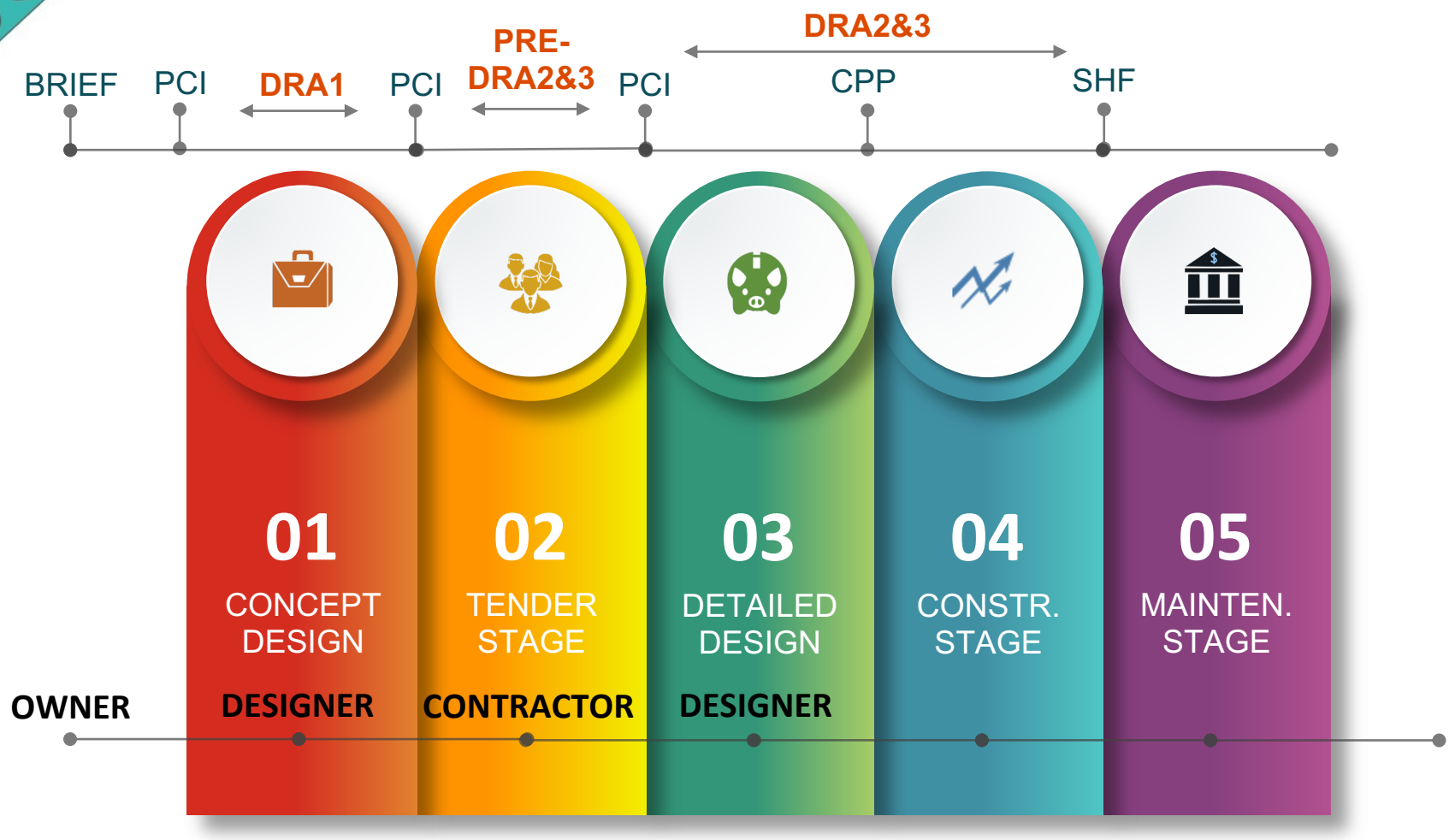

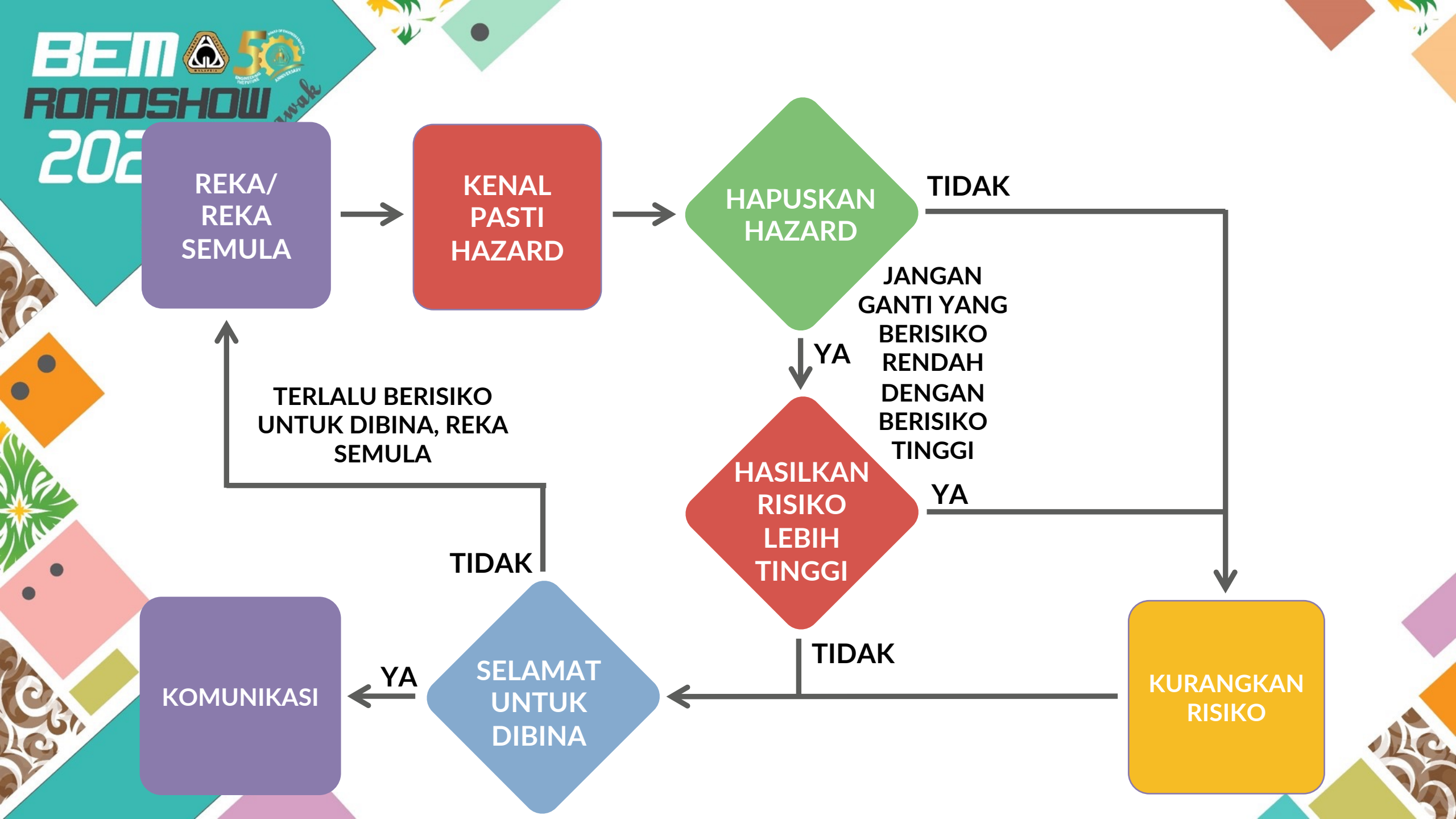
REKA/ REKA SEMULA
KENAL PASTI HAZARD
HAPUSKAN HAZARD
TIDAK
JANGAN GANTI YANG BERISIKO RENDAH DENGAN BERISIKO TINGGI
YA
HASILKAN RISIKO LEBIH TINGGI
YA
KURANGKAN RISIKO
TIDAK
SELAMAT UNTUK DIBINA
YA
KOMUNIKASI
TIDAK
TERLALU BERISIKO UNTUK DIBINA, REKA SEMULA

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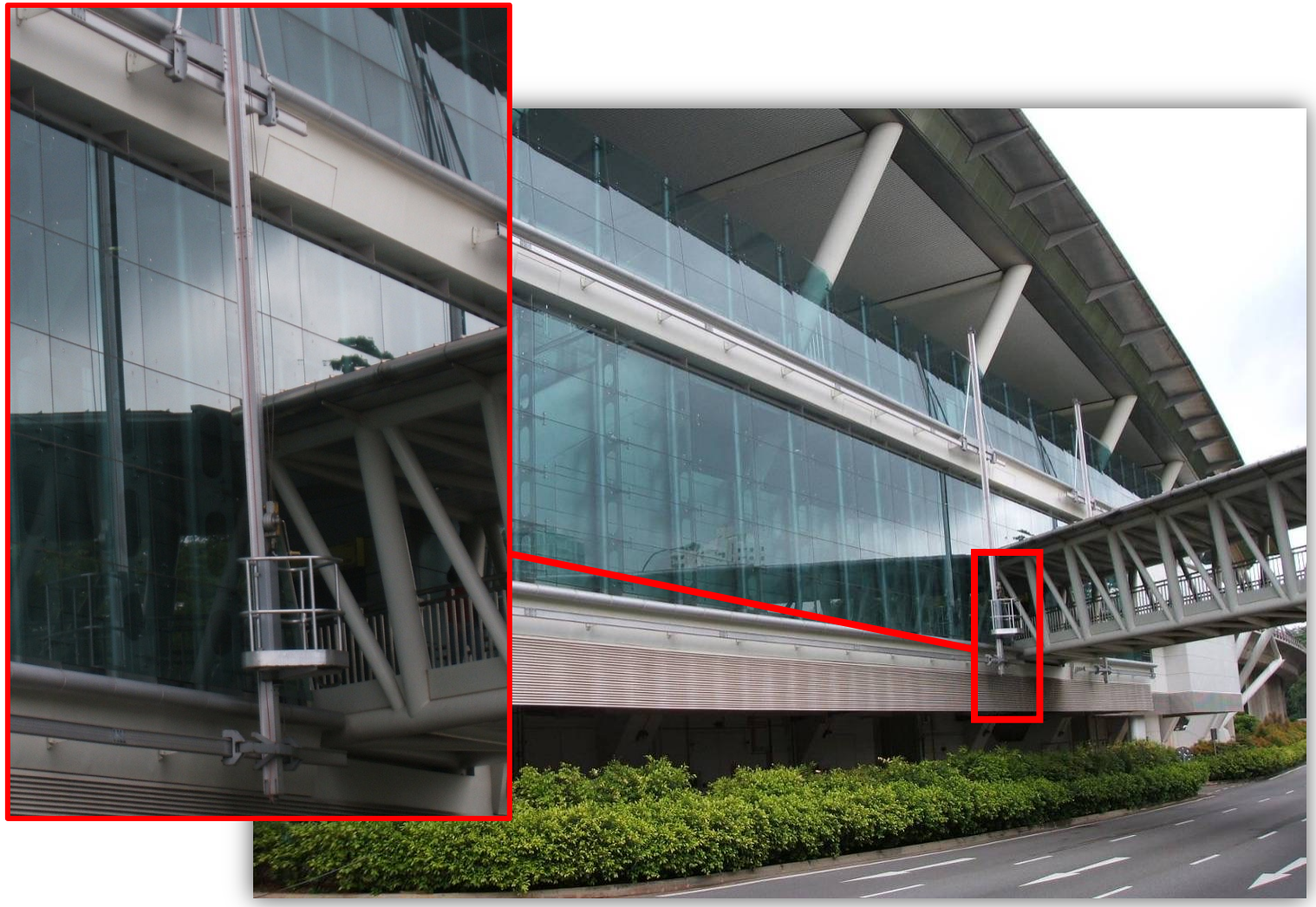
Example that improves safety & reduces costs for facility management of buildings & infrastructures



Dover MRT Station with permanent maintenance gondola

Example for Vertical Greenery

- Provision of safe walkway for access/egress
- ‘Open-able/Rotatable’ green wall panels
- No need for scaffolding works or working at heights

Example: Vertical Greenery - Tree House

- Tree House by CDL – world's largest vertical garden (2289 sq.m.) on a 24-storey condo building

- Skyrise Greenery Awards 2013 : Special Award – Design for Maintenance

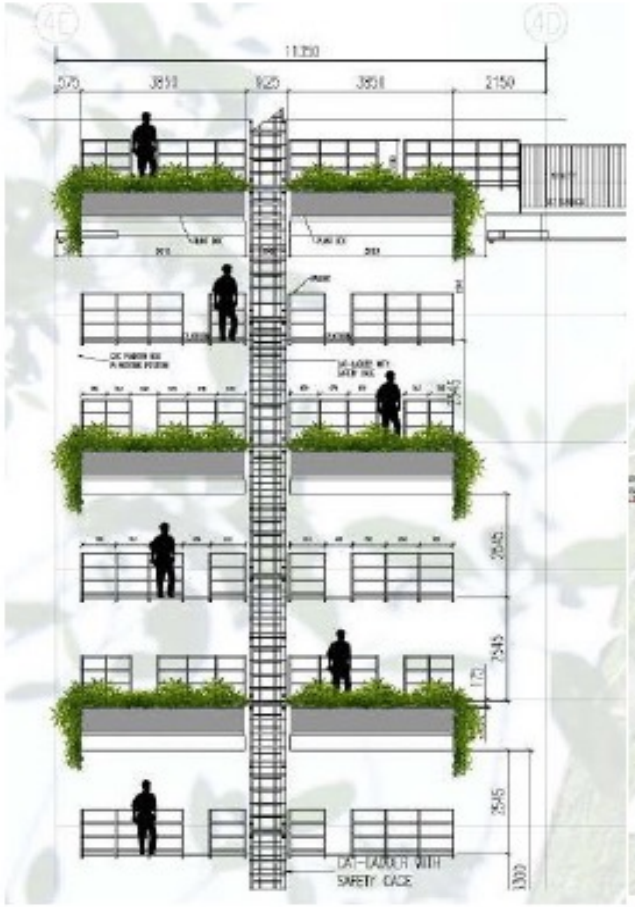
Example: Vertical Greenery - Tree House

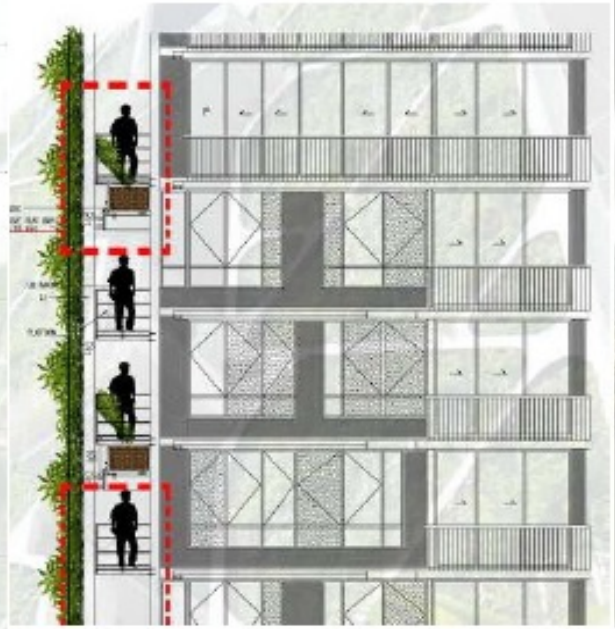
Risk:

- Working at heights for the maintenance of vertical greenery and/or lack of maintenance access

Example: Vertical Greenery - Tree House

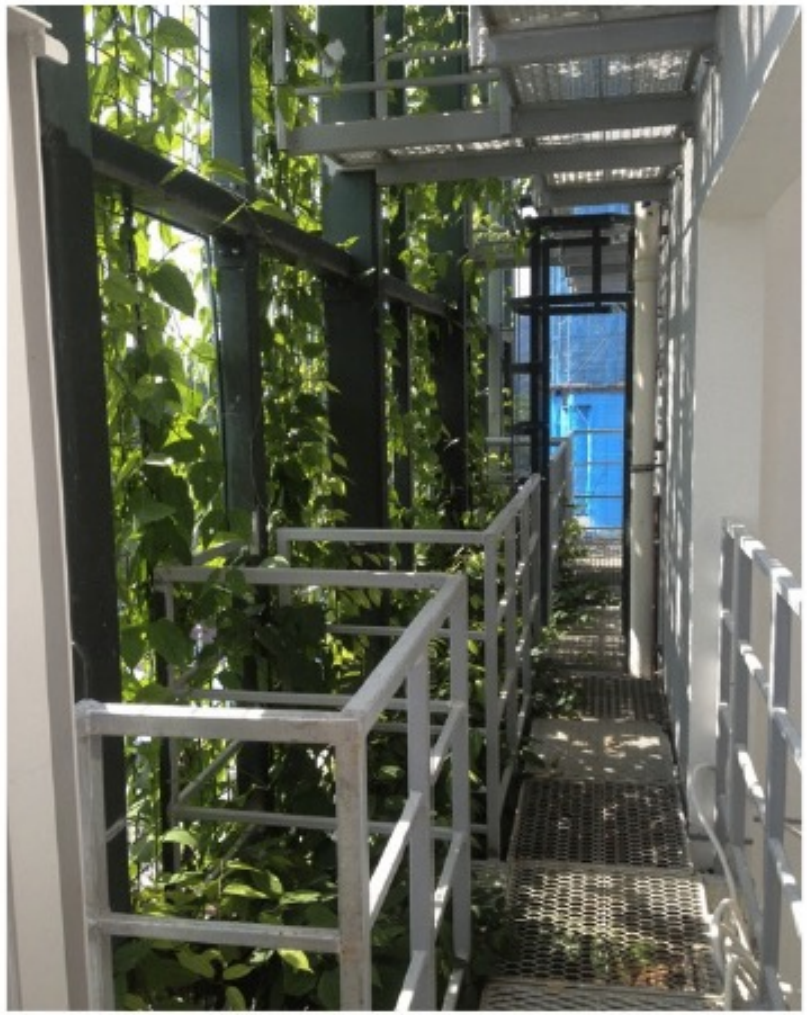
Architectural Concept – Green wall System

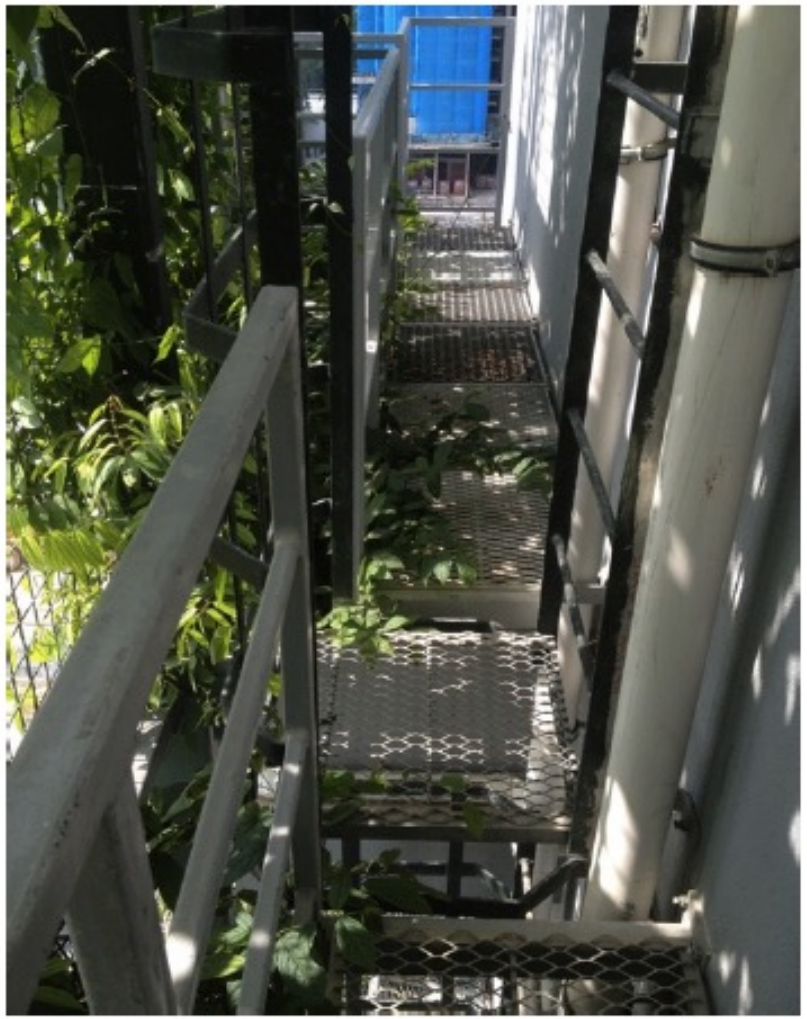




Example: Vertical Greenery - Tree House

Design for Safety and Maintenance





Designers of a retail outlet sourced a unique mesh-type ceiling material that has to be installed in one single sheet to give ripple effect to the ceiling.

As part of risk assessment, design considerations included

- How will it be delivered to the site?
- Will it be difficult to handle?
- Will the metal mesh have jagged edges?
- How will it be fixed to the ceiling frame?
- How will lighting be fixed?
- How will sprinklers be fixed?
- Will it be a fragile surface?
- How will maintenance personnel walk above it to access fittings?
- How will it be cleaned?

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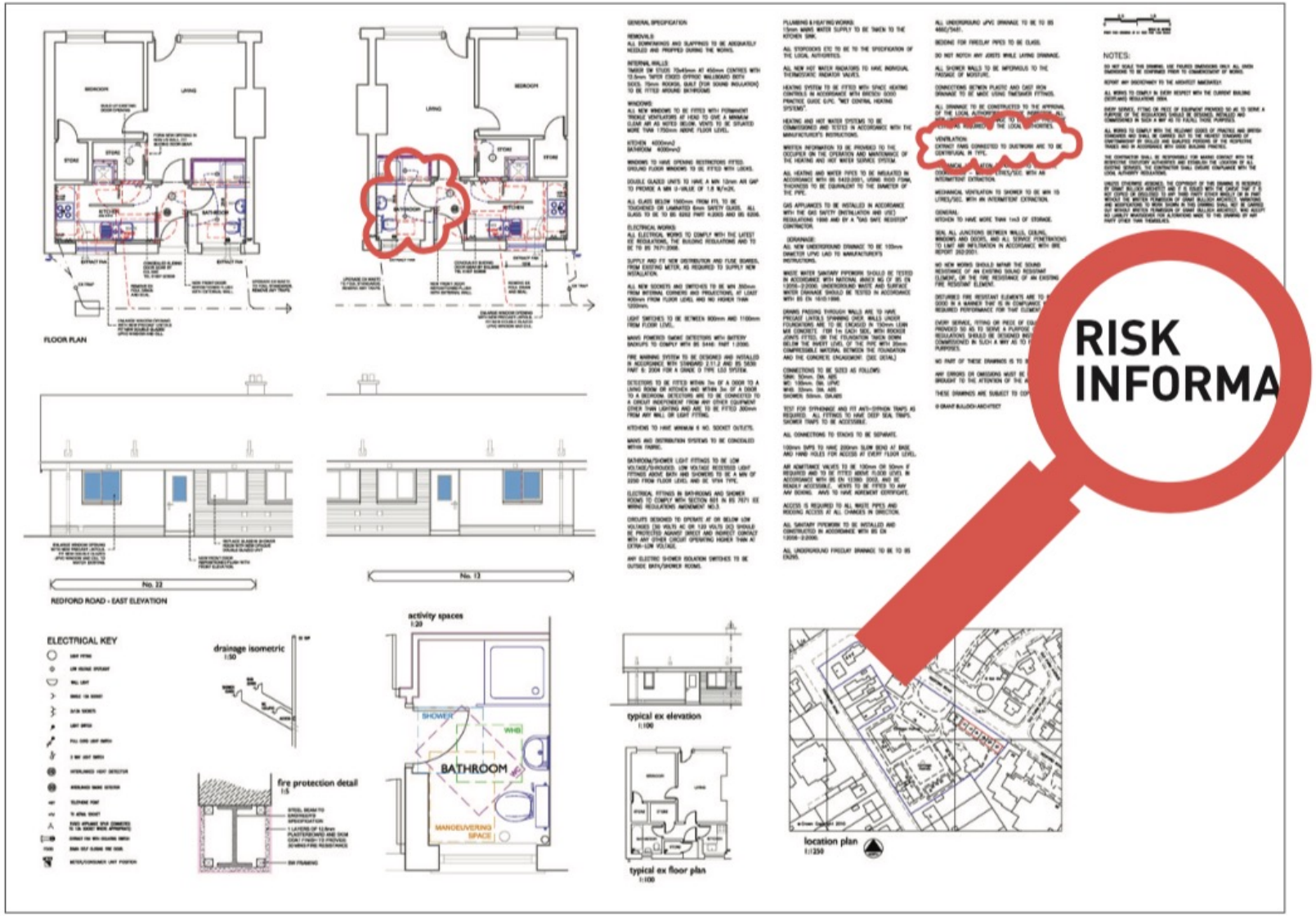
KOMUNIKASI

Penyampaian maklumat pra-pembinaan kepada kontraktor/ petender digalakkan dibuat secara bertulis di atas lukisan reka bentuk



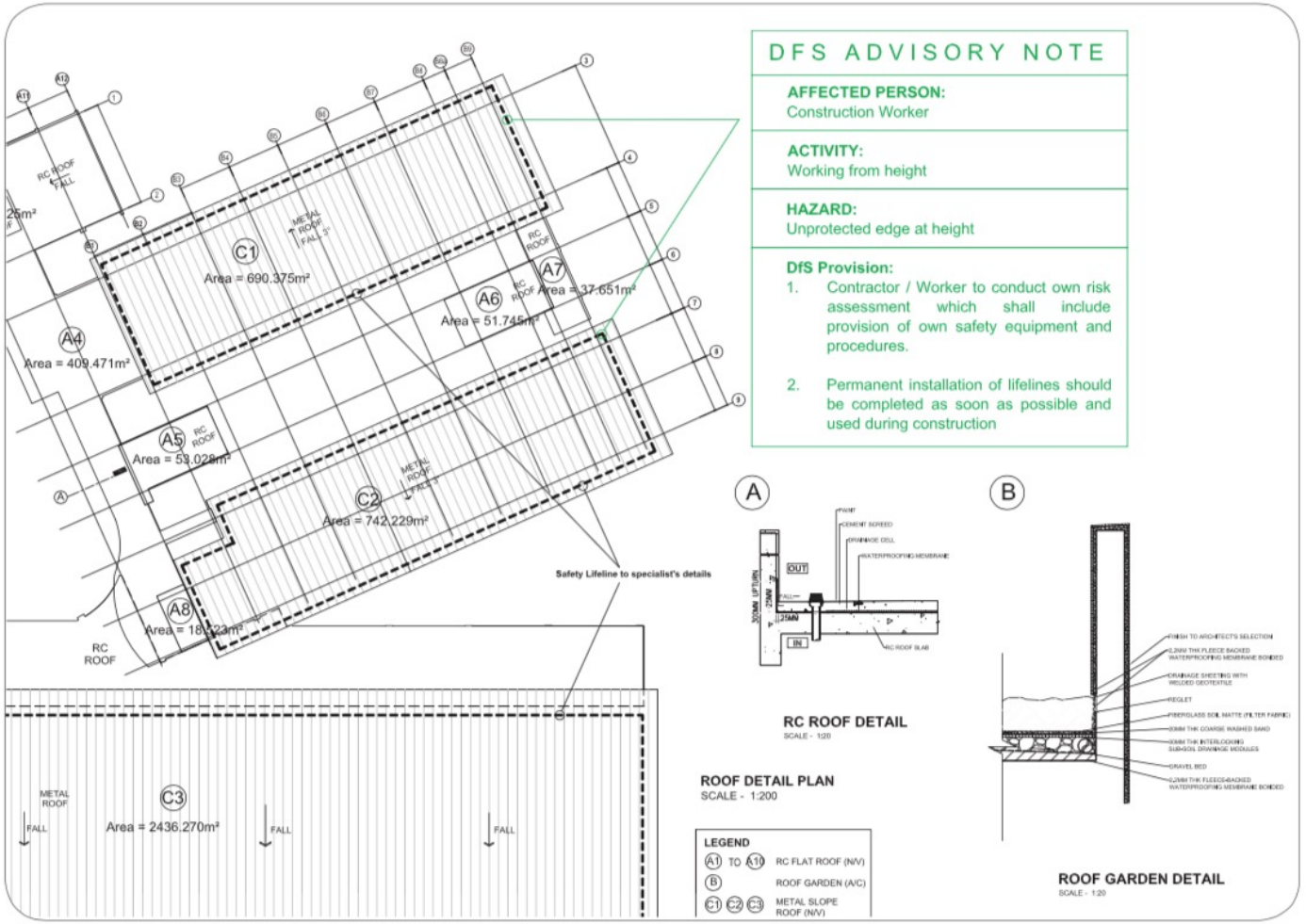
PROSES PENTAKSIRAN REKA BENTUK

KOMUNIKASI

Baki risiko disampaikan melalui *advisory note* dalam

a. dokumen kontrak (*incl. working drawings & details, specifications, preliminaries, etc*). Kontraktor gunakan maklumat untuk menyediakan *shop drawings, method statements*, CPP, etc. yang akan disampaikan kepada pekerja

b. disertakan dalam *Operations and Maintenance Manual* (*incl. as-built drawings*) yang diserahkan kepada pemilik bangunan semasa *handover*



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PRINSIP AM PENCEGAHAN

- akan diperkenal bersama Peraturan Pentaksiran Risiko
- akan dikuatkuasakan bersama A1648
- Rujuk Panduan

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PRINSIP AM PENCEGAHAN[1]

1. Avoid risks
2. Evaluate risks which cannot be avoided
3. Combat the risks at source
4. Adapt the work to the individual
5. Adapt to technical progress
6. Replace dangerous by non-dangerous or less dangerous
7. Develop a coherent overall prevention policy
8. Give collective protective measures priority over individual protective measures
9. Give appropriate instructions to employees

[1] Directive 89/391/EEC, EU | Mgmt Reg., UK | OSHCIM Guidelines

PRINSIP AM PENCEGAHAN[1] & HIERARKI KAWALAN

1. **Avoid risks** 1
2. Evaluate risks which cannot be avoided
3. **Combat the risks at source** 2
4. Adapt the work to the individual
5. Adapt to technical progress
6. **Replace dangerous by non-dangerous or less dangerous** 3
7. **Develop a coherent overall prevention policy** 4
8. **Give collective protective measures priority over individual protective measures** 5 7
9. **Give appropriate instructions to employees** 6

Hierarchy of control (NEBOSH) [2]	Hierarchy of control (HSG65) [2]
Avoidance of risks 1	Eliminate risk by substituting the dangerous by the inherently less dangerous 3 for example: • Use less hazardous substances • Substitute a type of machine which is better guarded to make the same product • Avoid the use of certain processes/ methods/ products
Eliminations of hazards or substitution for something less hazardous 3	
Reducing or limiting the duration of exposure to the hazard	Combat risks at source 2 by engineering controls and giving collective protective measures priority 5, eg: • Separate the operator from the risk of exposure to a known hazardous substance by enclosing the process • Protect the dangerous parts of a machine by guarding • Design process machinery and work activities to minimize the release, of or to suppress or contain, airborne hazards • Design machinery which is remotely operated and to which materials are fed automatically, thus separating the operator from danger areas
Isolation/ segregation	
Engineering controls	
Safe systems of work 4	Minimise risk by: • Designing suitable & sufficient systems of working 4 • Using PPE; this should only be used as a last resort. 7
Training and information 6	
PPE 7	
Welfare	
Monitoring and supervision	

[1] Directive 89/391/EEC, EU | Mgmt Reg., UK | OSHCIM Guidelines; [2] Hughes & Ferret (2008)

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Siapa yang perlu pertimbangkan GPP?

Duty holders dalam OSHCIM Reg. (Draft)

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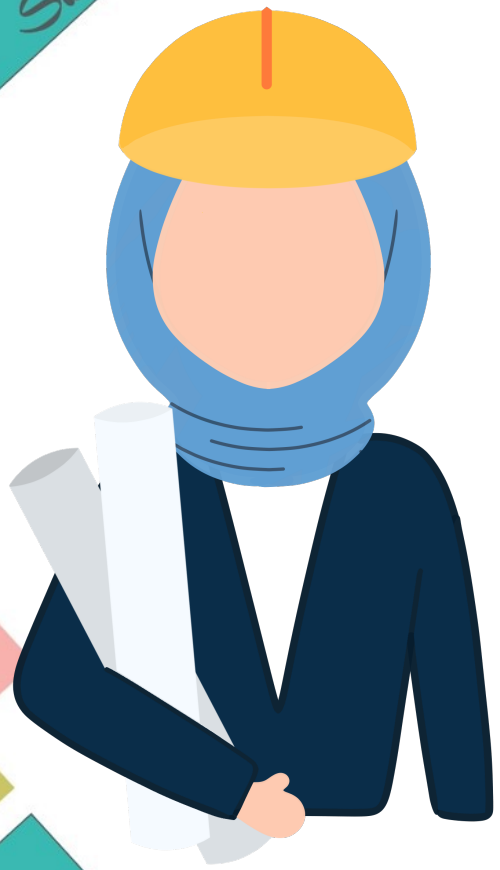
PRINCIPLE DESIGNER`S DUTY



… a principal construction work designer—

(a) shall take into account (*mengambil kira*) the general principles of prevention and, where relevant, the content of any construction phase plan and any safety and health file, and in particular when—

i. the **design, technical and organisational aspects** are required in order to plan;

ii. the various items or **stages of work**, whether simultaneously or in succession; and

iii. the **estimate of the period of time** requires to complete the work or work stages.

OSHCIM Reg. (Draft)

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DESIGNER`S DUTY

When preparing or modifying a design, a construction work designer shall take into account the general principles of prevention and any pre-construction information to eliminate, so far as practicable , foreseeable risks to the safety or health of any person—

(a) carrying out or liable to be affected by any construction work;

(b) maintaining or cleaning a structure; or

(c) using a structure designed as a place of work other than construction site.

OSHCIM Reg. (Draft)

PRINCIPAL CONTRACTOR'S DUTY

... a principal construction work contractor —

(a) shall take into account the general principles of prevention, and in particular when—

i. the design, technical and organisational aspects are required in order to plan for the various items or stages of work which are to take place simultaneously or in succession; and

ii. the estimate of the period of time required to complete the work or work stages;

OSHCIM Reg.

PRINCIPAL CONTRACTOR'S DUTY

... a principal construction work contractor —

(d) shall ensure that employers, and for the protection of any worker and self-employed person—

i. adhere to and comply with, the general principles of prevention as specified under and Part IV; and

OSHCIM Reg.

CONTRACTOR'S DUTY

if there is only one construction work contractor working on the project, shall—

i. take into account of the general principles of prevention when—

A. the design, technical and organisational aspects are being decided in order to plan the various items or stages of work which are to take place simultaneously or in succession; and

B. the estimate of the period of time required to complete the work or work stages

OSHCIM Reg.

EMPLOYER / SELF EMPLOYED & PRINCIPLE?

S18b. (1) Every employer, self-employed person or principal shall conduct a risk assessment in relation to the safety and health risk posed to any person who may be affected by his undertaking at the place of work.

OCCUPATIONAL SAFETY AND HEALTH (AMENDMENT) ACT 2022

“construction work designer ” means any person who in the course or furtherance of a business—

(a) prepares or modifies a design; or

(b) arranges for, or instructs, any person under his control to prepare or modify a design,

relating to a building, structure, product or mechanical or electrical system intended for a particular structure;

“design” means any drawings and its details and includes any specification and bills of quantity ,including specification of any plant or substance, relating to a structure, and any calculation prepared for the purpose of the design;

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Apakah contoh amalan terbaik dalam reka bentuk?

Contoh-contoh applikasi GPP dalam reka bentuk

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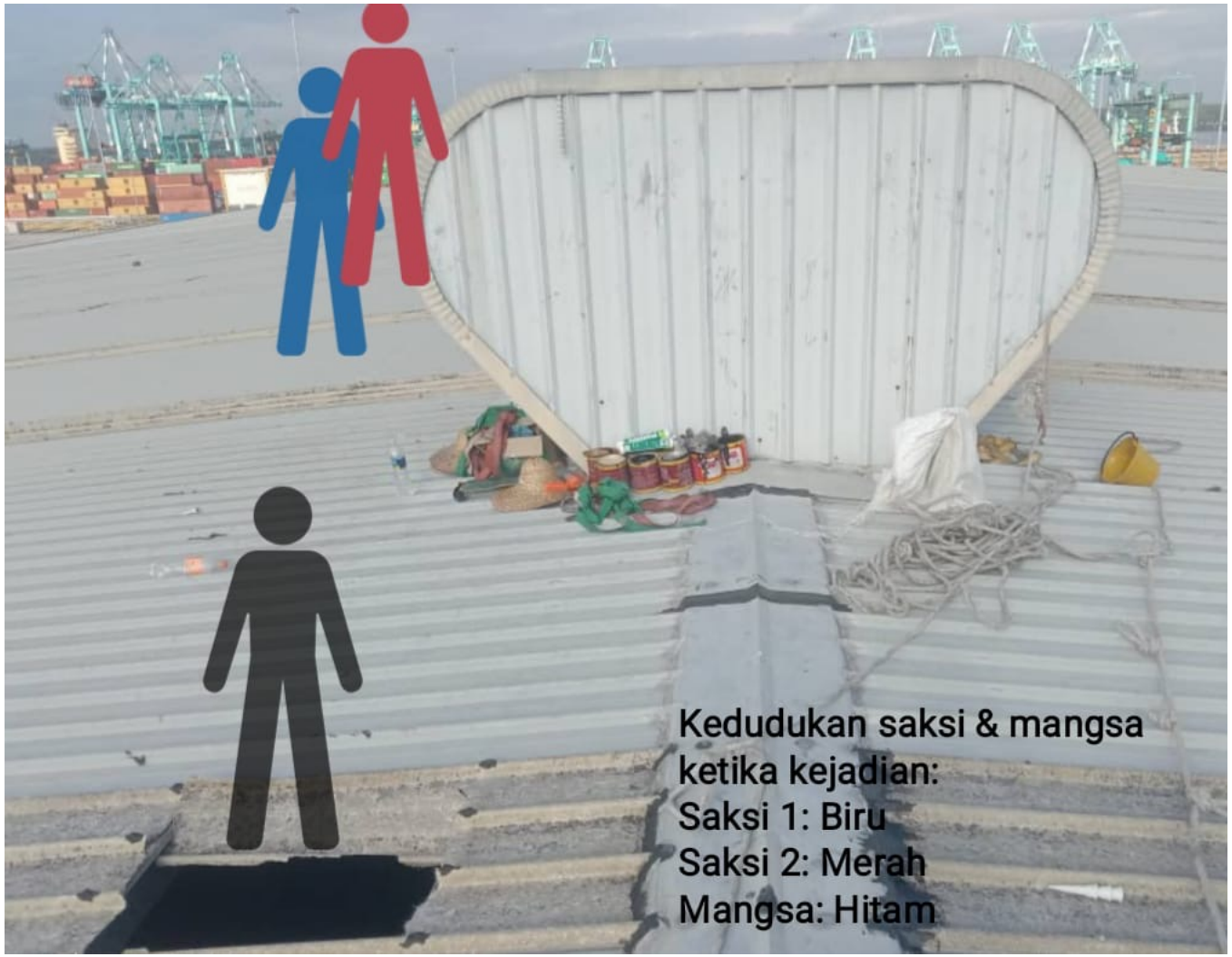


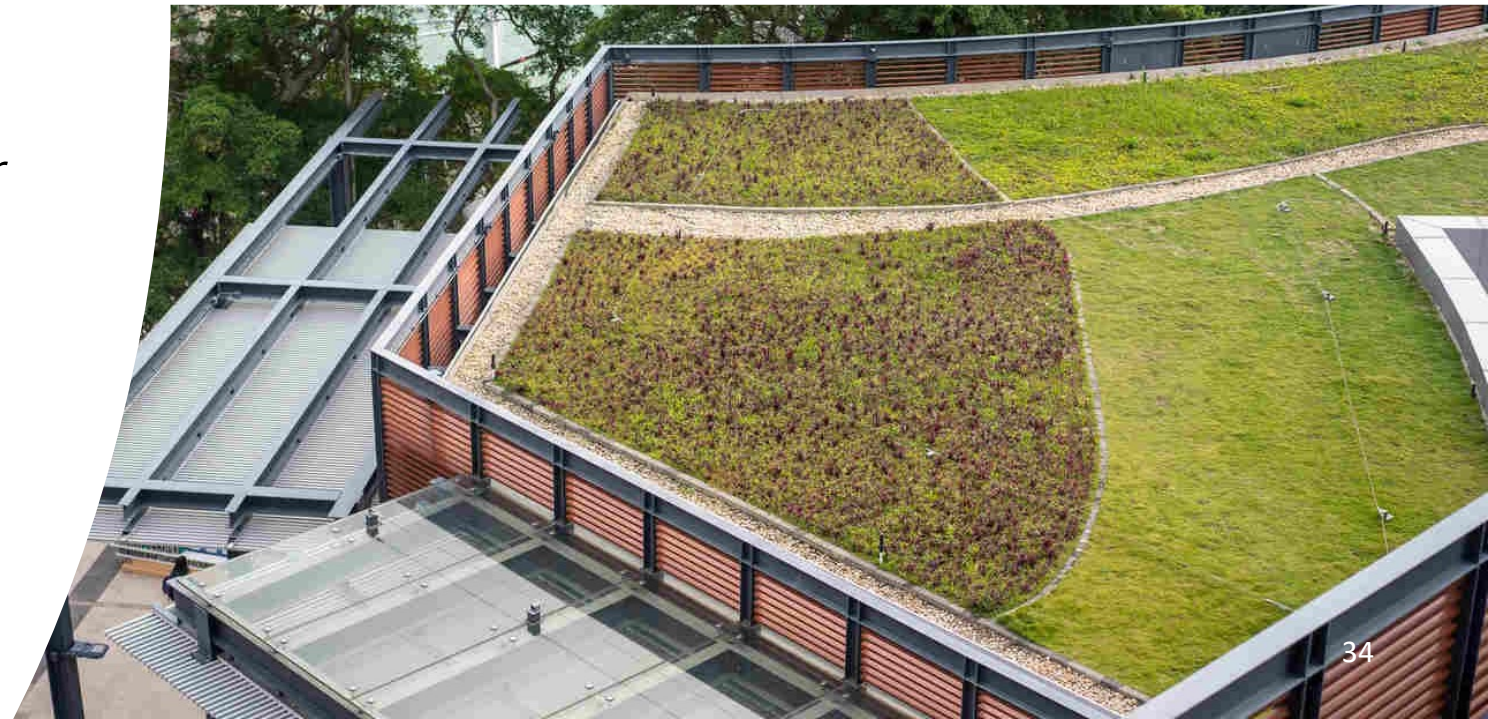
Kedudukan mangsa sedang bekerja

Gambar 1: Kawasan kerja mangsa

Gambar 3: Kawasan atas bumbung di mana mangsa membuat kerja pembersihan

Avoiding risks by asking if you can get rid of the problem (or hazard) altogether.

- *Move air conditioning plant on a roof to ground level, so that work at height is not required for either installation or maintenance.*
- Position a door away from a traffic route.
- *Design a roof with a high parapet to eliminate the risk of falls.*



#1 Avoiding risk

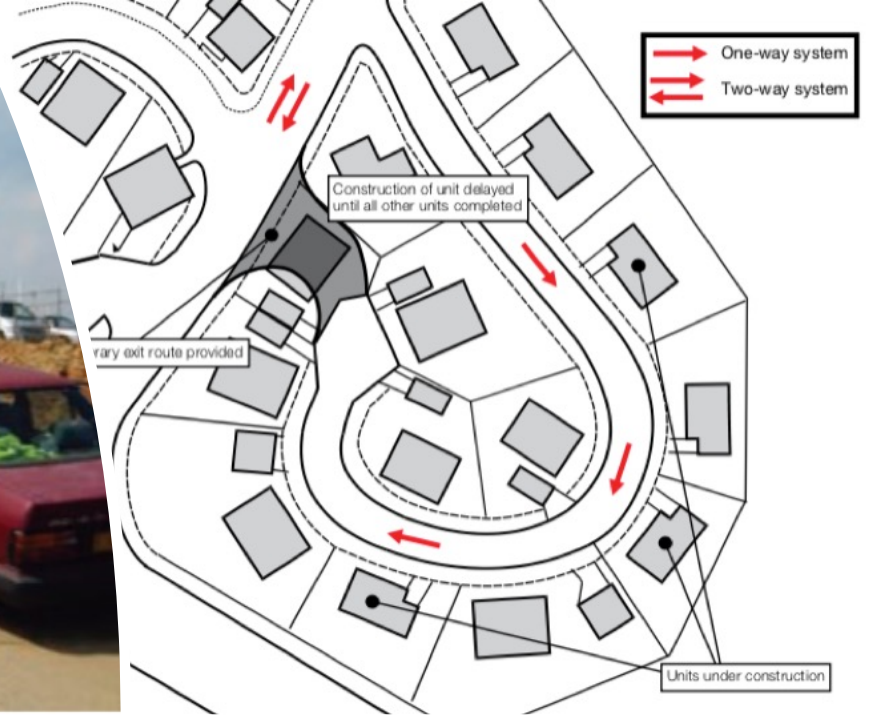
Avoiding work at height during construction or maintenance work	1. Design windows on tall buildings so that they can be cleaned from inside, rather than relying on potentially difficult external access. 2. Move air conditioning outdoor unit at height to ground level. 3. Design accessible flat roof with high perimeter parapet. 4. Early installation of permanent means of access, & prefabricated staircases with hand rails. 5. Provision of edge protection at permanent works where there is a foreseeable risk of falls after handover. 6. Design safe access (eg. barriers) to roof mounted services (for maintenance).

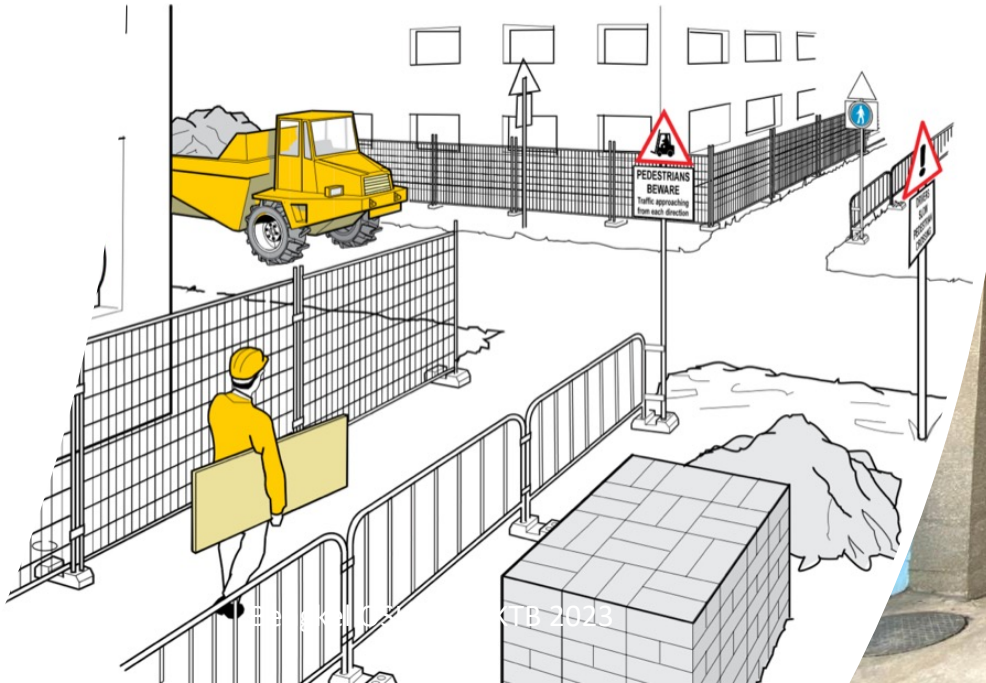
Avoiding work at height during construction or maintenance work

#1 Avoiding risk

Avoiding hit by moving vehicle	1. Position entrance away from traffic route. 2. Adequate access for construction vehicles to minimise reversing requirements (one-way systems & turning radii) 3. Design external manholes away from vehicle access zones.
Avoiding risk to the public	1. Thoughtful location of mechanical and electrical equipment, light fittings, security devices and so on to facilitate access, and placed away from crowded areas. 2. Design internal manholes and inspection chambers away from circulation areas.

Avoiding hit by moving vehicle





#1 Avoiding risk

Avoiding risk relating to concrete work	1. Off-site fabrication & prefabricated elements to minimise on site hazards. 2. Use an expanded metal material to construct the formwork for the stop end mating surfaces to avoid hand-scabbling.
Avoiding processes giving rise to large quantities of dust, fume, suspended particle or harmful substances	1. Specification of concrete products with pre-cast fixings to avoid drilling. 2. Use blocks that can be cut using block splitter techniques rather than mechanical cutting, which produces large amounts of harmful silica dust. 3. Adopt BIM with the implementation Use Common Data Environment (CDE) during design stage to avoid unintended cutting process. 4. Off-site timber treatment if PPA- & CCA-based preservatives are used (boron or copper salts can be used for cut ends on

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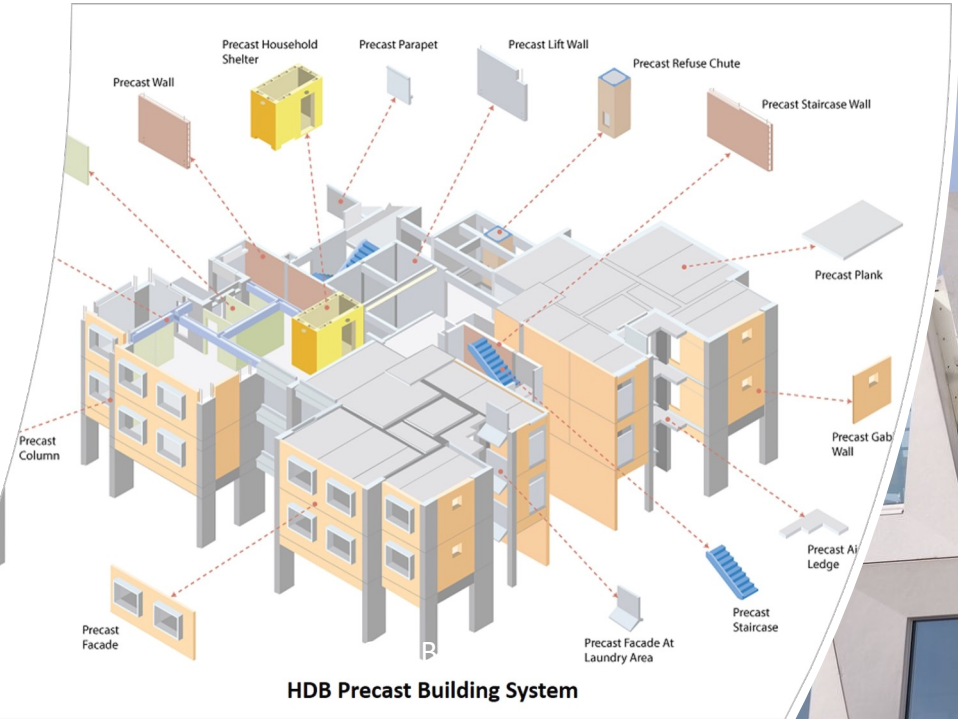
Avoiding risk relating to concrete work



HDB Precast Building System




Avoiding processes giving rise to large quantities of dust, fume, suspended particle or harmful substances

#2

Evaluating the risks that cannot be avoided. Assess unavoidable risks so that control measures may be implemented to reduce risks to an acceptable level.

- *Work out whether the effort and expense of installing a fixed access system is appropriate if an area is only occasionally reached and the work can be done using a MEWP.*

#3

Combating the risks at source. Better to design out or minimize risks where practicable rather than leave them to be dealt with on site.

- Eliminate the cause of the noise rather than providing enclosure for protection
- Cover unprotected floor opening rather than posting up a signage
- Arrange for services to be isolated and diverted away from the work area.
- Design structures that allow for fire containment during construction.

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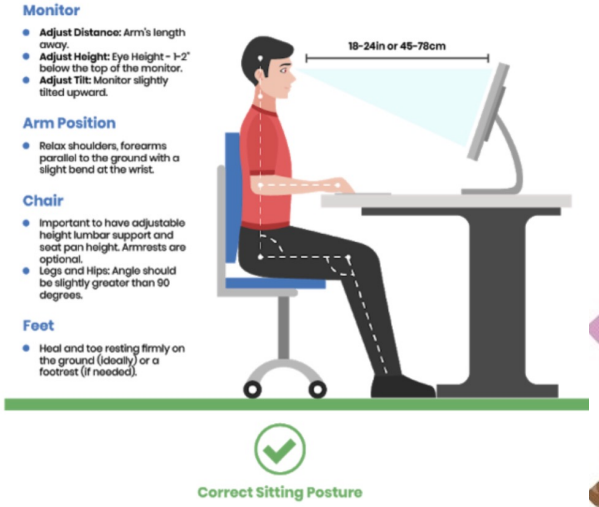
#4

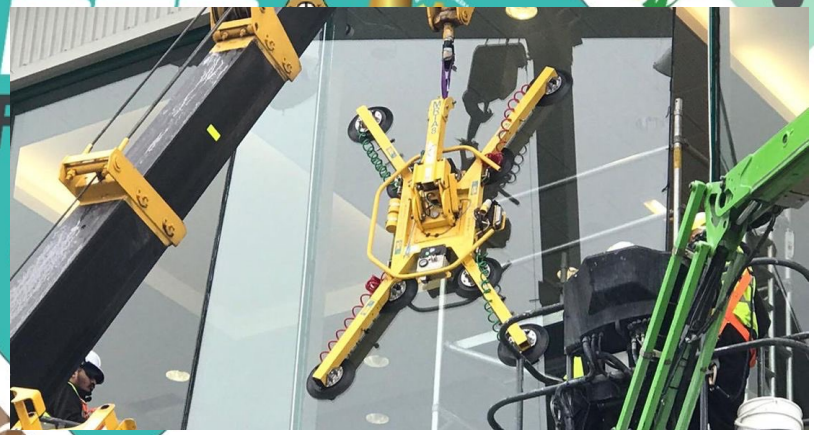
Adapting work to the worker, esp. design of workplaces, type of work equipment & choice of working & production methods, with a view, in particular, to reducing the health effects of monotonous work and work at a predetermined rate.

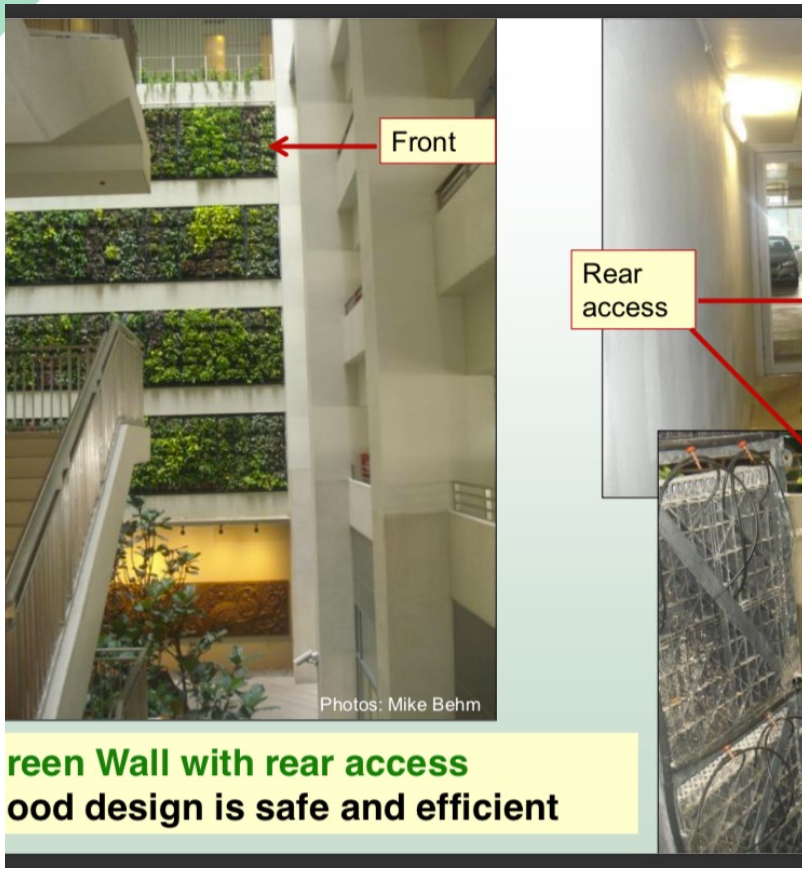
- *Provide workstations at an appropriate height.*
- *Position lighting for easy access during maintenance*, such as by **positioning bulkhead lights on landings** and **not halfway down staircases**.



#4 Adapting work to the worker

- Give workers adequate control over their tasks.
- Reduce the duration of workers have to work at predetermined speeds and in monotonous work.
- Provision of adequate access & headroom for maintenance in plant room, & adequate provision for replacing heavy components.
- Specification of half board sizes for plasterboard sheets to make handling easier.
- Design of environments with consideration of proper lighting, noise, vibration, temperature, wetness, humidity & draughts or chemical and/or biological conditions during use & maintenance operations





Adapting work to the worker

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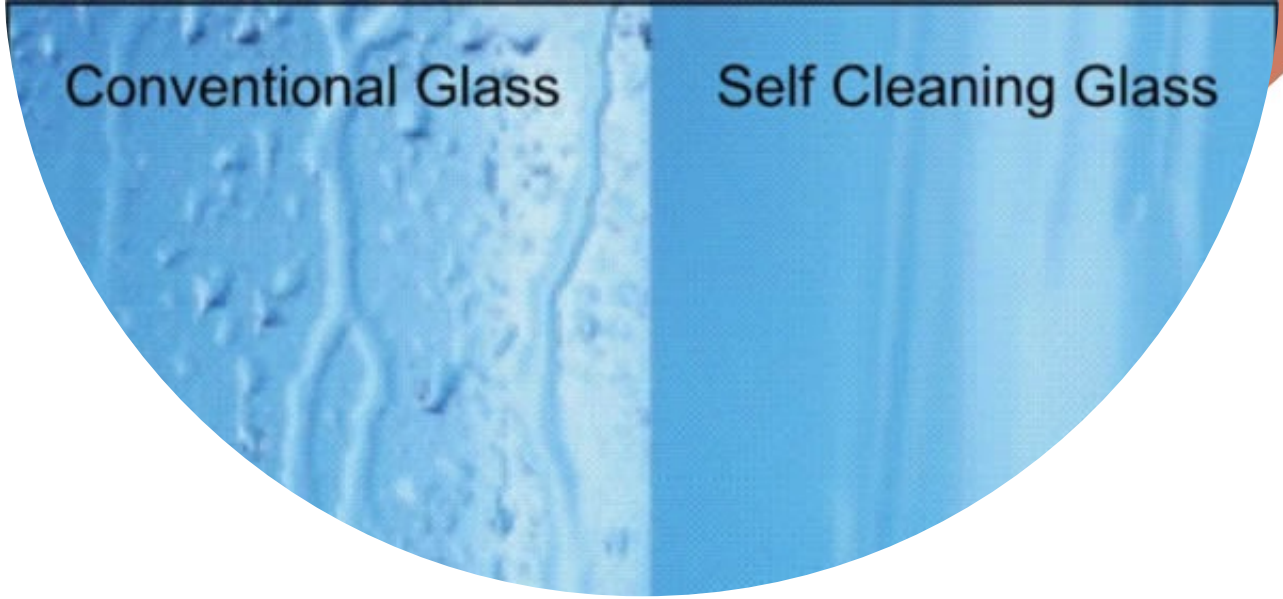
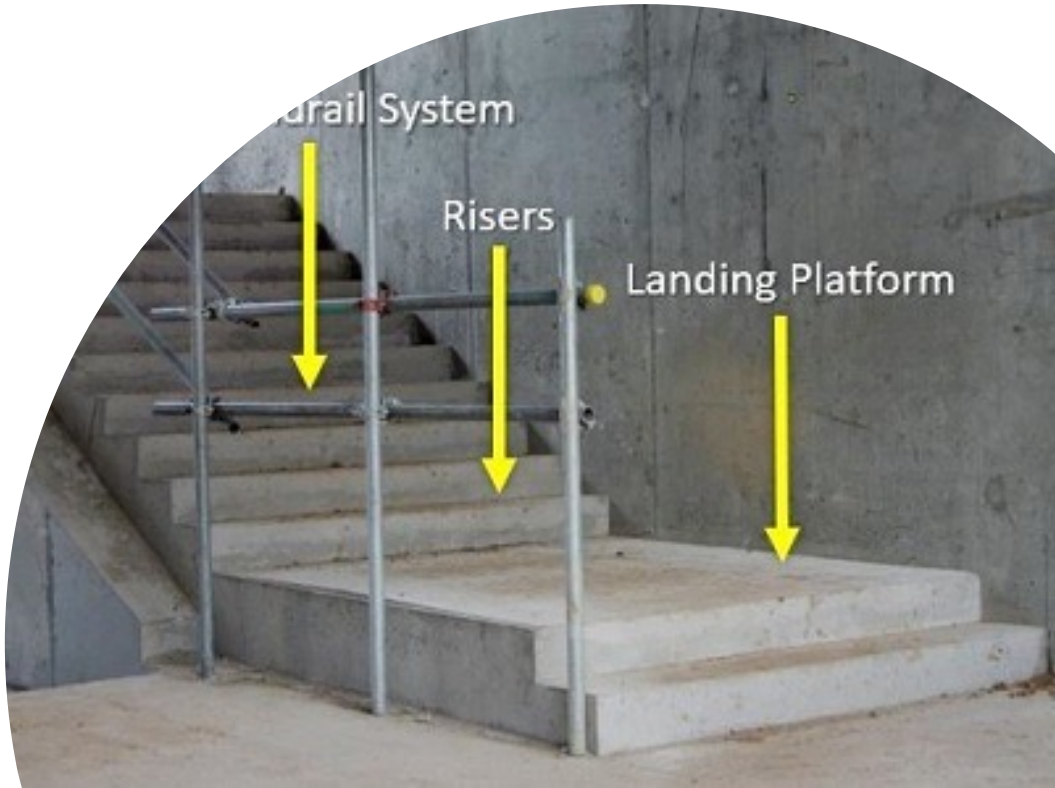
#5



Adapting to technical progress: consider new techniques or technologies. To maintain pace with technical progress in safety.

- *Specify self-cleaning glass.*
- *Prefabricate elements off site.*



#5 Adapting to technical progress

- Install gas-detection equipments to continuously measure and monitor the level of air contaminants in a tunneling work, rather than appointing an authorised gas tester (AGT).
- Equip the measuring equipment with alarms to warn of potential hazards and data logger to keep information electronically.
- Use pre-fabricated building elements.
- Use building information modelling (BIM) on the project.

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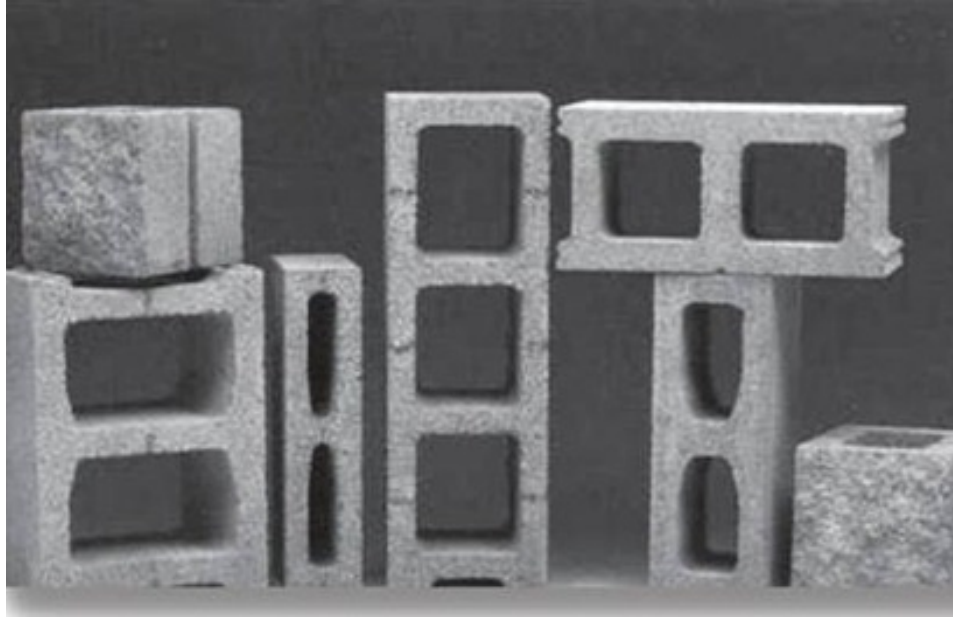
#6



Replacing the dangerous with the non-dangerous or the less dangerous.

- *Switch to using a paving block that is lighter in weight.*
- *Substitute solvent-based products with water-based equivalents.*
- Recycle tyre kerbs instead of using heavy concrete ones.

#6 Replace/ Substitute

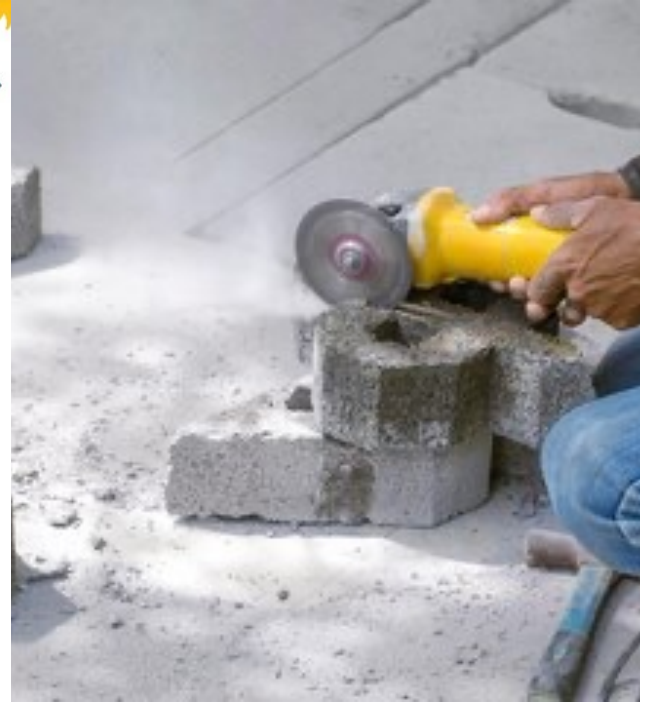
- Substitute chlorinated cleaning solvents by a less toxic material,or if practical, by a non-toxic method.
- Use pile cropping techniques instead of demolition by hand-held breakers of the top sections of concrete piles.
- Using non-slip materials on floor surfaces in areas (entrances, floors, ramps and stairs) exposed to the weather or dedicated wet areas.


#6 Replace/ Substitute

Use pile cropping techniques instead of demolition by hand-held breakers of the top sections of concrete piles.

#6 Replace/ Substitute

Using non-slip materials on floor surfaces in areas exposed to the weather



#7

Developing a coherent overall **prevention policy** which covers technology, systems of work, organisation of work, working conditions, social relationships & the influence of factors relating to the working environment.

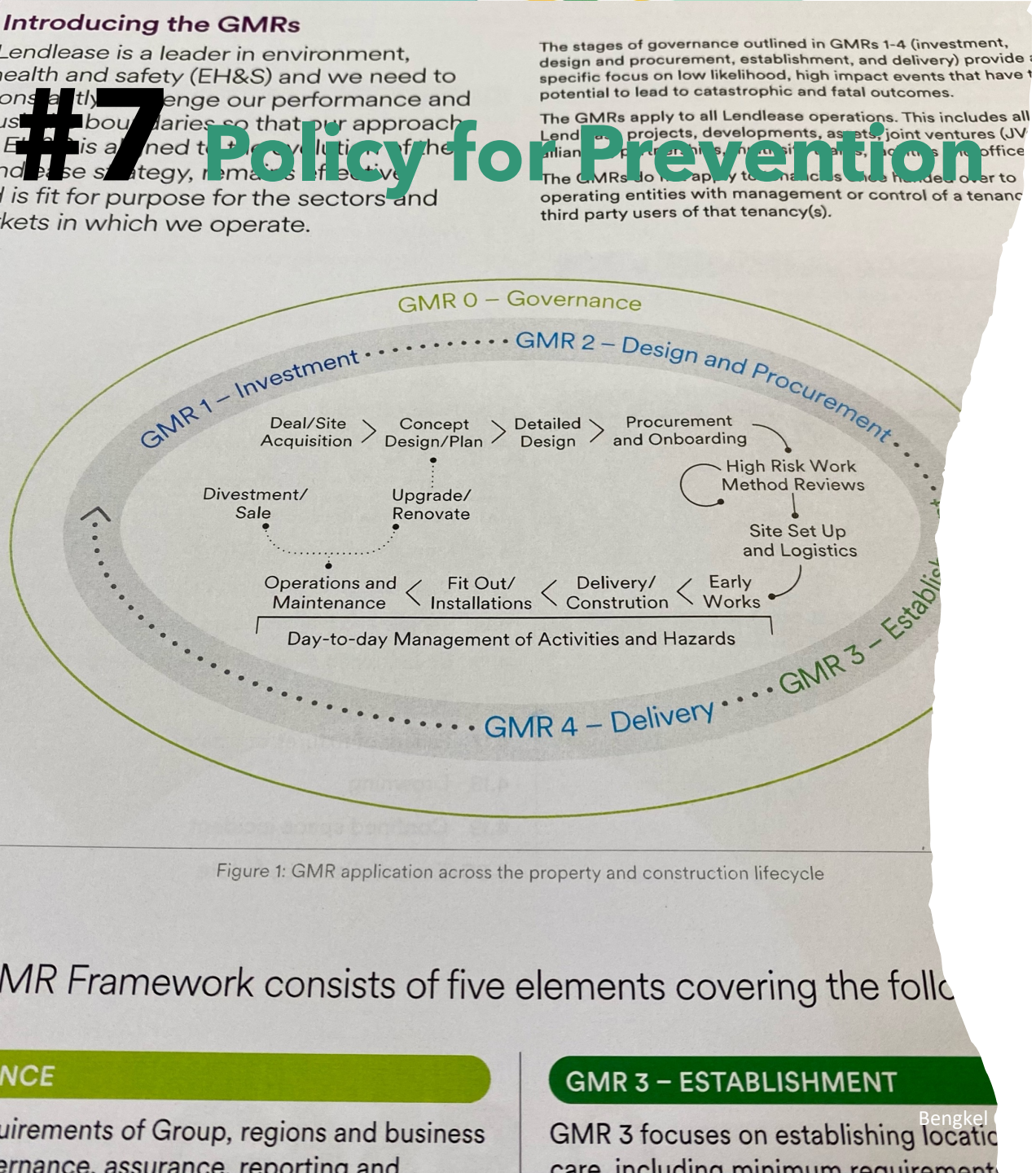
Set standards.

- *Specify that all blocks should be cut using block splitter techniques rather than mechanical cutting, which produces large amounts of harmful silica dust.*

#7 Policy for Prevention

- Be developed by designer (or project organisation's such as client)
- Set clear terms on the project's approach & commitment towards prevention
- Be appropriate to needs, nature & scale of project risks
- Be understood & implemented at all phases of the project
- Be reviewed periodically & amended to ensure sufficient resources are allocated
- Include appointed person with spesific roles, responsibilities & accountabilities

#7 Policy for Prevention


Introducing the GMRs

Lendlease is a leader in environment, health and safety (EH&S) and we need to ...enge our performance and ...boundaries so that our approach ... is aligned to the evolution of the ...ease strategy, remains effective ... is fit for purpose for the sectors and ...kets in which we operate.

The stages of governance outlined in GMRs 1-4 (investment, design and procurement, establishment, and delivery) provide ... specific focus on low likelihood, high impact events that have ... potential to lead to catastrophic and fatal outcomes.

The GMRs apply to all Lendlease operations. This includes all Lend... projects, developments, assets, joint ventures (JV ...illian... partnerships, investments, ... office ...

The GMRs do not apply to ... once handed over to operating entities with management or control of a tenanc... third party users of that tenancy(s).

Figure 1: GMR application across the property and construction lifecycle

...MR Framework consists of five elements covering the follo...

...NCE

...uirements of Group, regions and business ...ernance, assurance, reporting and ...

GMR 3 – ESTABLISHMENT

GMR 3 focuses on establishing locatio... care, including minimum requirement...

This policy should become standard or specification in contract in which designer and contractor used during design and construction phases.

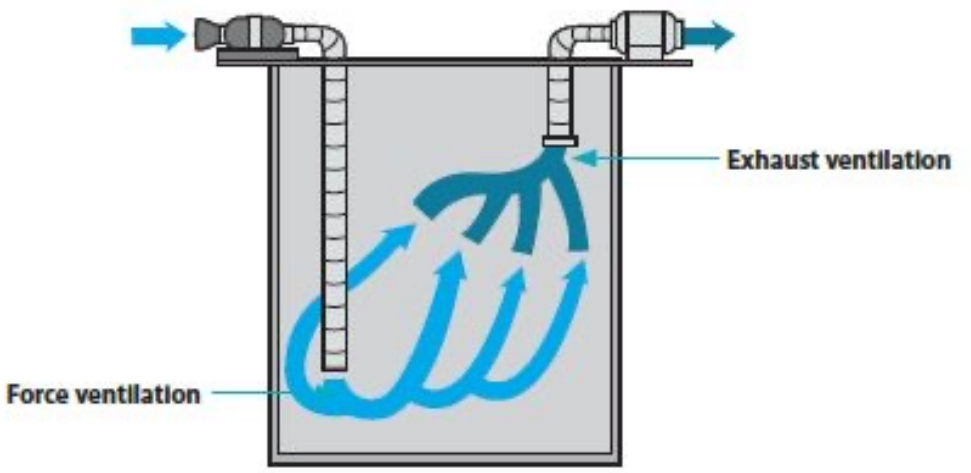
Examples:

- Specify that all blocks be cut using block splitter techniques rather than mechanical cutting, which produces large amounts of harmful silica dust.
- Specify mandatory appointment of temporary works co-ordinator according to BS 5975.
- Specify the use of engineering controls (collective protection) to minimise the use of PPE.
- Specify pre-construction information (eg. asbestos surveys, details of geology, obstructions, services, ground contamination etc.)
- Specify non-fragile roof lights & roofing assemblies.

Giving **collective protective measures** priority over individual protective measures, and making provisions so that the work can be organised to reduce exposure to hazards.

- *Make provision for traffic routes so that barriers can be provided between pedestrians and traffic.*
- *Provide fixed edge protection (barriers) rather than running lines.*

#8 Collective Protection



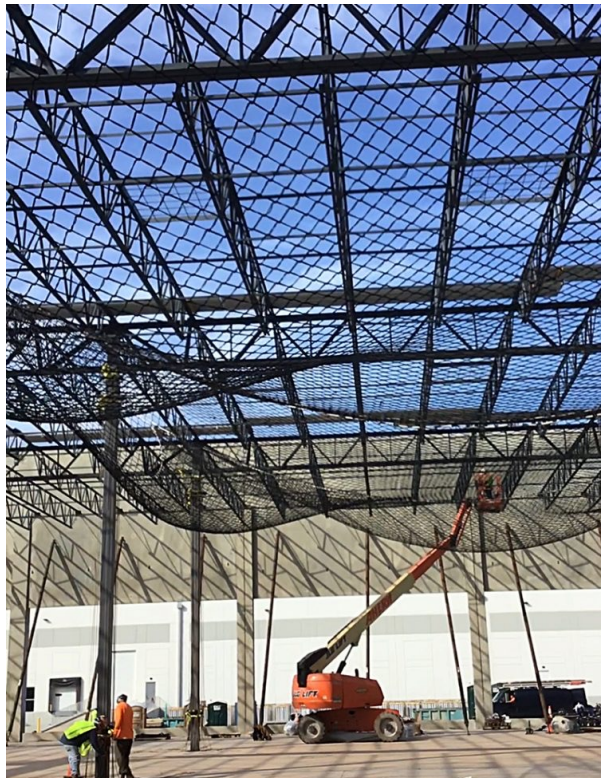
- Collective protective measures refer to risk controls that would give protection to more than one person
- Ensure work can be organized to reduce exposure to hazards
- PPE should be the last option within the control strategy
- PPE may be useful whilst other control measures are being implemented or developed
- PPE should be suitable and appropriate for the job

#8

Collective Protection

Examples:

1. Design structural steelwork roof to accommodate safety nets.
2. Design structural steelwork column to accommodate holes at 500mm and 1000mm above the floor slab (makes it easy to install cable or wire perimeter cables).



Specify holes in columns at 21 and 42 inches above the floor slab. This design feature makes it easy to install cable or wire perimeter cables.

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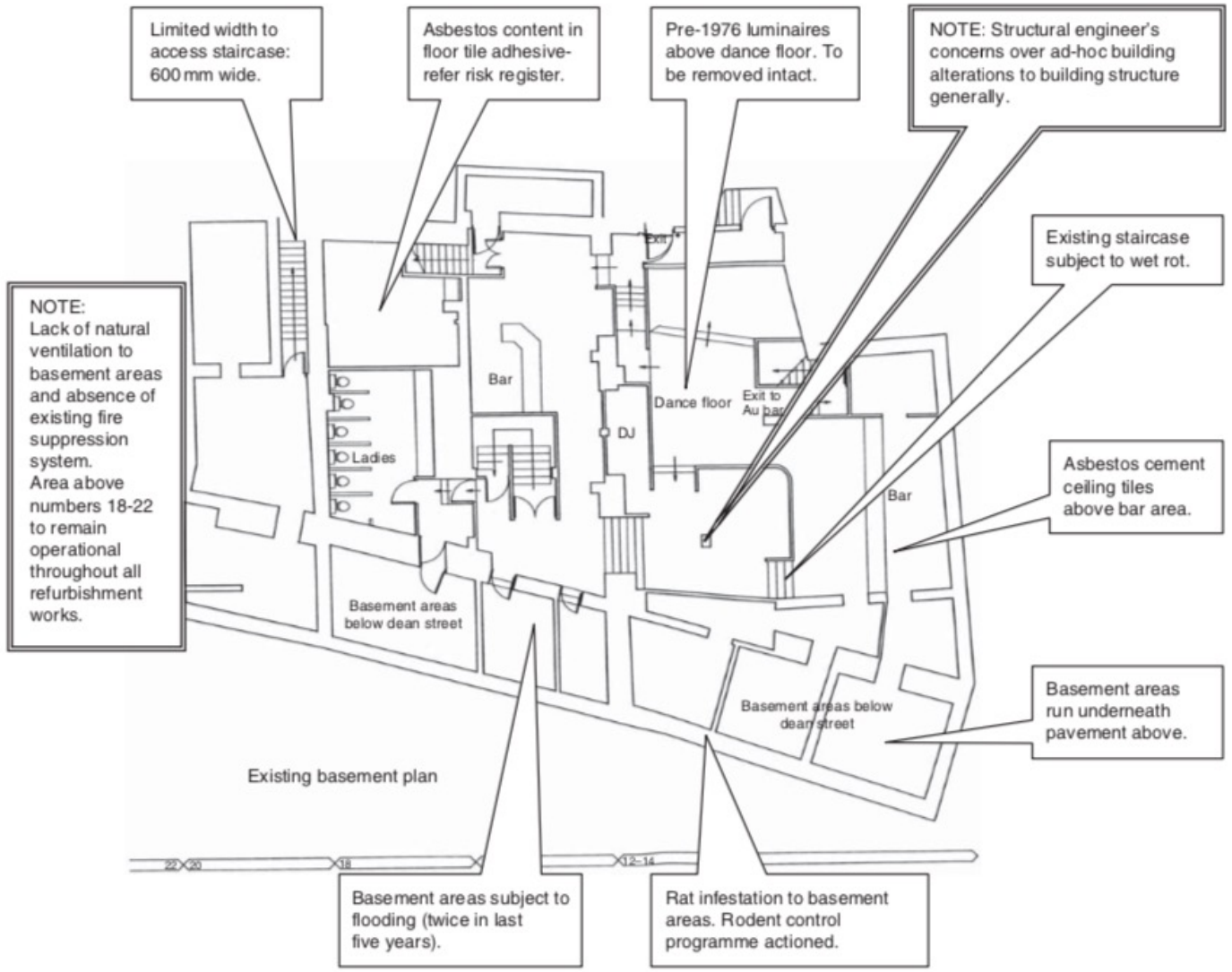
#9

Giving **appropriate instructions** for workers. Give workers appropriate information, instruction, training & supervision

- *Provide information on drawings or instructions, such as* intended sequencing, *hazards during any future cleaning, maintenance, alteration & demolition.*
- *Use BIM*



Observation: annotated drawings/sketches still offer the most potent means of carrying important messages.

DESIGN CONSIDERATION		EXPECTED OUTPUT	
1	**Historical Data**	a.	Any incident occurs previously at the site. (Flood, landslide, fire, etc.)
		b.	Previous building / area purpose or function
2	**Geotechnical**	a.	Stability of soil, that is, is it subject to land slip
		b.	Proximity of bodies of water to project
		c.	Presence of water table
		d.	Slope of the proposed site
		e.	Soil classification/ condition, for example, highly reactive
		f.	Susceptible to flooding
		g.	Landfill
		h.	Susceptible to seismic activities
3	**Existing infrastructure**	a.	Overhead services
		b.	Underground services/ utilities
		c.	Underground communication lines
		d.	Any existing infrastructure/ assets on site, for example buildings, underground tanks
		e.	Access/connection to services/ utilities
		f.	Demolition required
		g.	Fragile surfaces
		h.	Unstable structure
4	**Traffic Management**	a.	Access restrictions
		b.	Disruption to traffic/pedestrian movement
		c.	Additional lighting requirements
		d.	Proximity to major infrastructure
		e.	Ability to erect plant, scaffolding etc
		f.	Disruption to public transport
5	**Site surroundings**	a.	Proximity to adjoining property/ buildings/ plant and equipment
		b.	Protection of adjoining property/ buildings
		c.	Workplace/ site restrictions
		d.	Identification and proximity to other construction sites
		e.	Surrounding occupancies, such as other residential (with respect to risks of noise, dust, working hours etc.)
		f.	Ability to expand the facility in the future
		g.	Restrictions due to surrounding usage, such as proximity to airports
		h.	Negative impact from vegetation
		i.	Dilapidation review of adjoining structures
6	**Security**	a.	Theft/malicious damage
		b.	Trespass
		c.	Isolated location
7	**Hazardous material**	a.	Hazardous materials contained in existing infrastructure/assets
		b.	Soil contamination
		c.	Surrounding hazards, such as proximity to storage tanks associated with a petrol station

DESIGN CONSIDERATION		EXPECTED OUTPUT	
1	**Prefabrication**	a	Can elements such as steel structures be prefabricated, assembled on ground and then lifted to position for installation?
		b	Can the cutting of steel members be done offsite, under controlled conditions to reduce the dust created?
		c	Can site welding be minimised to reduce fire or burn risks?
		d	Can prefabricated nuts and bolts used as connections?
		e	Can prefabricated elements be provided with designed lifting points, and the weight and centre-of-gravity marked on the drawings and prefabricated items?
		f	If the prefabricated structure is required to be temporarily suspended for a period of time before final installation, are there means to ensure the hazards arising this are removed?
		g	Can joints in vertical steel structure members be designed such that bolting can be done on the ground?
		h	Can connections be designed to minimise risk of incorrect assembly (e.g., unique bolt layout for each connection)?
		i	Can clear instructions provided on drawings?
		j	Can the Designer verify if site conditions allow for lifting cranes to be positioned safely before deciding on prefabrication as the method of construction?
2	**Heavy Lifting**	a	Consider the work process and equipment required for heavy lifting. Can the position for parking these equipment be finalised and cordoned off?
		b	Does the lifting equipment need a customised foundation to minimise settlement and failure of support?
		c	Consider the worst case scenario. Can this scenario be prevented or managed to minimise injuries?
3	**Confined Space**	a	Does the design create confined space in the permanent or temporary stage?
		b	Can the confined space be removed from the design?
		c	Can the need to enter the confined space be minimised by removing vital equipment or controls out of the confined space?
4	**Falling from Heights**	a	Can the need to work at heights be removed? For example, removing the need to work at heights when a safe means of access cannot be provided.
		b	Can an early installation of permanent access (e.g., stairs) reduce the use of ladders or scaffolds?
		c	Can fragile roofing materials be removed or can an alternative access route to the roof (e.g., a work platform) be designed?
		d	Can edge protection or other features which allow safe access and construction be designed and installed?
		e	Can anchor points for installation of life-line or safety harnesses be mounted where work platforms cannot be installed?
		f	Can floor openings, if any, be minimised?
5	**Temporary Works and Sequencing**	a	Can a safer means of access or egress, instead of temporary means, be used?
		b	Can the permanent staircase and lifts be completed first so that they can be used during the construction stage?
		c	Will the design affect the work process during construction?
		d	Can temporary works required during construction be planned for earlier? For example, specifying the type and position of temporary works required to ensure that spatial considerations are taken into the account during the design stage.
		e	Are there special construction considerations that need to be highlighted to the Contractor?
		f	Does the sequence of construction create any temporary unstable working platform that requires additional bracing?
		g	Can adequate safety factors be incorporated in the design so that overloading or collapse of the permanent or temporary structure is prevented?
6	**Layout**	a	Can the layout be optimised to prevent any accidents arising from the flow of traffic, pedestrian, equipment, and so on within and around the site during the construction stage?
		b	Consider the flow of traffic, pedestrian, equipment within and around the site during the permanent stage
		c	Can the layout be optimised to prevent accidents?

		d	Is there a need to designate specific material, equipment, vehicle and human traffic flow diagram?
7	**Access for Maintenance**	a	Does the provision of access take into account the safe and efficient movement of maintenance workers and the tools and equipment needed to carry out maintenance work?
		b	Can temporary means of access (e.g., scaffolding, makeshift ladder, etc.) be eliminated by providing workers with permanent safe access to areas requiring regular maintenance?
		c	Does the design incorporate permanent safety lines, anchorage and hoisting points into structures for maintenance work that need to be carried out at height?
		d	Can durable materials that require lower frequency of maintenance be used (e.g., powder-coated aluminium materials versus mild steel materials that require regular repainting)?
		e	Can the maintenance work be carried out at ground level in a safe and productive manner? For example, locating air-conditioning units at ground level, locating luminaires within reachable height.
		f	Does the design create low headroom that reduce the safety and efficiency of workers carrying out the maintenance work?
		g	Does the design minimise the need for maintenance workers to enter ducts and crawlspaces?
		h	Does the design minimise the need for the deconstruction of bulkheads, claddings, casings, and so on, during routine inspection and maintenance?
		i	Does the design allow sufficient space for vehicles (e.g., cranes, cherry-pickers) to operate safely and efficiently during maintenance and operation of the building?
		j	Does the design allow for sufficient working space in M&E rooms and around M&E equipment for inspection, maintenance, repair and replacement of equipment?
		k	Does the design provide maintenance access at every level if there are vertical greenery systems that span a few storeys?
8	**Health Hazards**	a	Can less hazardous materials be used (e.g. Solvent-free or low solvent adhesives and water-based paints?
		b	Can materials that can create significant fire risk be removed?
		c	Can processes that create hazardous fumes, vapours, dust, noise or vibration be avoided? Examples of such process include disturbing existing asbestos, cutting chases in brickwork and concrete, breaking down cast-in-situ piles to level, scabbling concrete, hand-digging tunnels, flame-cutting or sanding areas coated with lead paint or cadmium.
9	**Weather**	a	Is there a possibility of floods happening in the site? If so, how can the hazards be minimised in the temporary and permanent stages?
		b	Is there a possibility of lightning strike happening in the site? If so, how can the hazards be minimised in the temporary and permanent stages?
		c	Are there other adverse weather conditions that can affect workers' safety and health on site?
		d	What are the effects of extreme temperature or humidity on instrumentation?

10	**Emergency Route**	a	Is the emergency route for the temporary and permanent stages the shortest and most direct?
		b	Are there adequate lighting, directions, warning and backup power for mass evacuation of people along the emergency routes?
11	**Others**	a	Are there other major hazards that need to be dealt with?
		b	Can sources of substantial stored energy, such as pre- or post-tension cables, be specified in the drawings and highlighted for future demolition?
		c	Can alterations that have significantly changed the building or structure be highlighted?
		d	Can disruptions to existing utilities within occupied buildings be avoided?

DESIGN CONSIDERATION		EXPECTED OUTPUT	
1	**Temporary Works and Sequencing**	a	Can a safer means of access or egress, instead of the temporary means, be used?
		b	Can monitoring instrumentation that provides early warning of possible collapse or ground movements be installed?
		c	Can the permanent staircase and lifts be completed first so that they can be used during the construction stage?
		d	Will the design affect the work process during construction?
		e	Can temporary works required during construction be planned for earlier? For example, specifying the type and position of temporary works required to ensure that spatial considerations are taken into the account during the design stage.
		f	Are there special construction considerations that need to be highlighted to the Contractor?
		g	Does the sequence of construction create temporary unstable stage that requires additional bracing?
		h	Can adequate safety factors be incorporated in the design so that overloading or collapse of the permanent or temporary structure is prevented?
		i	Will there be possible basal heave and piping during excavation?
		j	Will there be settlement due to the proposed project?
		k	Has a proper schedule for monitoring of instrumentation been provided?
		l	Will there be adverse effects on adjacent structures during the removal of temporary works?
		m	Are there alternatives or measures that could reduce or minimise such adverse effects?
2	**Specialist Design**	a	Are there safety concerns on elements of specialist design to be considered by the Contractor?
		b	Can alternative safe work practices be used to mitigate such concerns?
3	**Weather**	a	Is there a possibility of floods happening in the site? If so, how can the hazards be minimised in the temporary and permanent stages?
		b	Is there a possibility of lightning strike happening in the site? If so, how can the hazards be minimised in the temporary and permanent stages?
		c	Are there other adverse weather conditions that can affect workers' safety and health on site?
		d	What are the effects of extreme temperature or humidity on instruments?
4	**Others**	a	Have the risks and hazards identified in DRRULE-1and DRRULE-2 been addressed or mitigated?

AHLI KUMPULAN PENTAKSIR RISKO:	
1.	4.
2.	5.
3.	6.

Keterukan \ Kemungkinan	Tidak dapat dijangka (1)	Jarang sekali (2)	Dapat dijangka (3)	Mungkin (4)	Paling mungkin (5)
Malapetaka (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Sederhana (3)	3	6	9	12	15
Kecil (2)	2	4	6	8	10
Diabaikan (1)	1	2	3	4	5

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HELAIAN KERJA

KOD	PENGENALPASTIAN HAZARD				PENILAIAN RISIKO					KAWALAN RISIKO (PRINSIP AM PENCEGAHAN)									PENILAIAN RISIKO SEMULA			
	ELEMEN REKA BENTUK	AKTIVITI KERJA	RISIKO *(Source/ circumstances with a potential to cause injury & ill health)*	PERISTIWA DAN AKIBAT KEPADA SIAPA	KAWALAN RISIKO JIKA ADA	JUSTIFIKASI KEMUNGKINAN	KEMUNGKINAN	KETERUKAN	NO MATRIK RISIKO	ELAK RISIKO	KAWAL PADA SUMBER	PENGGANTIAN	SESUAIKAN KERJA DENGAN PEKERJA MELALUI PENGUBAHAN REKA BENTUK, PERALATAN, CARA KERJA	SESUAIKAN DENGAN KEMAJUAN TEKNIKAL	MEMBANGUNKAN POLISI PENCEGAHAN	LANGKAH PERLINDUNGAN KOLEKTIF	BERI ARAHAN YANG SESUAI KEPADA PEKERJA	KELENGKAPAN PERLINDUGAN DIRI	KEMUNGKINAN	KETERUKAN	NO MATRIK RISIKO	ORANG YANG DITUGASKAN (TARIKH AKHIR)
D1-1A	Geoteknikal																					
D1-1A	Geotechnical - Tanah gambut	Kerja tanah menggunakan jentera atau kenderaan	Tanah lembut/ mudah mendap	Tanah mendap sekiranya menggunakan jentera berat (Jentolak). Jentolak terbalik akan mencederakan pemandu atau pekerja berhampiran.	Tiada	Paling mungkin berlaku terutama waktu hujan atau beban yang berat	5	5	25	Tidak praktikal	Mampatkan tanah pada laluan jentera	Gantikan tanah gambut dengan batu granit (crusher run)	Tidak praktikal	Tidak praktikal	Menetapkan syarat jalan kerja bagi mencegah bahaya tanah mendap	Tidak praktikal	1. Mengarahkan pemandu agar hanya menggunakan laluan yang dikhaskan. 2. Meletakkan papan tanda amaran dan tanda arah tentang bahaya tanah mendap.		2	4	8	
D1-3A	Site restrictions	Vehicle accident		Injury due to accident			4	5	20	Air transport												
D2-1A	Prefabrication of steel roof truss	Workers working at height over long period of time when bolting up steel sections		Falling off truss when bolting up steel sections			5	5	25			Review and mitigation required Pre-assemble sections into frames before erection				Install permanent access platforms before erecting, bracing, where scaffold access is not possible			5	3	15	
D2-1A	Prefabrication of steel roof truss	Workers working at height over long period of time when bolting up steel sections		Falling off truss when bolting up steel sections			5	3	15			Review and mitigation required Pre-assemble sections into frames before erection				Install permanent access platforms before erecting, bracing, where scaffold access is not possible			5	3	15	
D2-D1-2B	Existing infrastructure - underground services/ utilities	Excavation for foundation	Contact with underground live power line	Semasa kerja pengorekan jentera boleh tersentuh dengan kabel elektrik dan akan menyebabkan renjatan elektrik kepada kontraktor struktur kekal	Pengenalpastian kedudukan kabel bawah tanah melalui laporan siasatan tanah	4	4	5	20	Mereka bentuk semula supaya kerja pengorekan jauh daripada kabel elektrik	1. Memindahkan kabel elektrik keluar kawasan pengorekan 2. Putuskan bekalan elektrik semasa kerja pengorekan											

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FORM A

DRA 1 - Concept Design Review

PROJECT RISK REGISTER:	**JOB NO:**	**PROJECT:**	**SHEET NO.:**	**REVISIONS:**
	PREPARED BY:	**APPROVED BY:**	**DATE:**	

PROJECT LEADER'S COMMENTS:	**S & H MANAGER'S COMMENTS:**	**ISSUED TO PRINCIPLE DESIGNER / CONTRACTOR DATE:**
DATE:	**DATE :**	**ISSUED TO OTHER DESIGNER / CLIENT DATE:**

CODE	ELEMENTS OF DESIGN & REFERENCE DOCUMENT	POSSIBLE HAZARD	WHO AT RISK	ACTION REQUIRED	RISK L	RISK S	RISK R	CLIENT / PD TO INCLUDE IN PCI (Yes or No)	PD / PC TO INCLUDE IN SHF (Yes or No)	DATE RISK OR HAZARD REMOVE FROM LIST & BY WHOM
D1-1A	Geotechnical - stability of soil, proximity of bodies of water, presence of water table, slope	Lack of adequate soil information	Contractors & workers	Conduct geological survey, soil investigation	4	4	16	Yes	Yes	
D1-2B	Existing infrastructure - underground services/ utilities	Lack of adequate information	Contractors, workers & others	Conduct underground utility survey	4	4	16	Yes	Yes	
D1-3D	Traffic management - disruption to public transport	Traffic disruption	Contractors, workers & others	1. Conduct traffic analysis 2. Consult local authority	3	4	12	Yes	No	

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FORM B

DRA 2 - Details Design, Maintenance and Repair Review

PROJECT RISK REGISTER:	**JOB NO:**	**PROJECT:**	**SHEET NO.:**	**REVISIONS:**
	PREPARED BY:	**APPROVED BY:**	**DATE:**	
PROJECT LEADER'S COMMENTS: **DATE:**	**S & H MANAGER'S COMMENTS:** **DATE :**		**ISSUED TO PRINCIPLE DESIGNER / CONTRACTOR** **DATE:** **ISSUED TO OTHER DESIGNER / CLIENT** **DATE:**	

CODE	ELEMENTS OF DESIGN & REFERENCE DOCUMENT	POSSIBLE HAZARD	WHO AT RISK	ACTION REQUIRED	RISK L	RISK S	RISK R	PD/PC TO INCLUDE IN PCI/ CPP (Yes or No)	PD / PC TO INCLUDE IN SHF (Yes or No)	DATE RISK OR HAZARD REMOVE FROM LIST & BY WHOM
D1-1A	Geotechnical - stability of soil, proximity of bodies of water, presence of water table, slope	Lack of adequate soil information	Contractors & workers	1. Access for vehicle and machinery is compacted and supported						
D1-2B	Existing infrastructure - underground services/ utilities	Lack of adequate information	Contractors, workers & others	Conduct underground utility survey	4	4	16	Yes	Yes	
D2-1A	Prefabrication of steel roof truss	Workers working at height over long period of time when bolting up steel sections	Worker (Rigger)	Review and mitigation required Pre-assemble sections into frames before erection Install permanent access platforms before erecting, bracing, where scaffold access is not possible	5	3	15	Yes	No	DRA3 NOV 2021 PROJECT MANAGER, PC
D2-1G	Prefabrication of smaller	Falling objects	Worker &	Minimise weight of truss and	5	2	10	Yes	No	DRA3

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FORM C

DRA 3 - Pre-Construction Review

PROJECT RISK REGISTER:		**JOB NO:**	**PROJECT:**							**SHEET NO.:**	**REVISIONS:**
		PREPARED BY:	**APPROVED BY:**							**DATE:**	
PROJECT LEADER'S COMMENTS:		**S & H MANAGER'S COMMENTS:**							**ISSUED TO PRINCIPLE DESIGNER / CONTRACTOR DATE:**		
DATE:		**DATE :**							**ISSUED TO OTHER DESIGNER / CLIENT DATE:**		
CODE	**ELEMENTS OF DESIGN & REFERENCE DOCUMENT**	**POSSIBLE HAZARD**	**WHO AT RISK**	**ACTION REQUIRED**	**RISK**			**CLIENT / PD TO INCLUDE IN PCI/ CPP (Yes or No)**	**PD / PC TO INCLUDE IN SHF (Yes or No)**	**DATE RISK OR HAZARD REMOVE FROM LIST & BY WHOM**	
					L	**S**	**R**				
D2-1A	Prefabrication of steel roof truss	Workers working at height over long period of time when bolting up steel sections	Worker (Rigger)	Ensure adequate site supervision and riggers are suitably skilled and wear harnesses	3	1	3	NA	No	Risk & hazard removed when installation of steel roof truss is completed PROJECT MANAGER, PC	
D2-1G	Prefabrication of smaller components of steel roof truss Joints of steel roof truss by bolting on the ground	Falling objects Dropping splice plates, hand tools, nuts and bolts.	Worker & Public	Provide safety netting catch small item and reduce impact.				NA	No	Risk & hazard removed when installation of steel roof truss is completed PROJECT MANAGER, PC	

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Rujuk Guidance Booklet

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FORM D

RISKS REGISTER

CODE	ACTIVITY / RISK	WHO AT RISK	CONSEQUENCES	REVIEW & DATE	MITIGATION STAGES & CONTROLS (Record any consequential risk in RISK column)	COST OF MITIGATION	RISK L	RISK S	RISK R	OWNERSHIP (Nominees from relevant disciplines)
D2-1A	Working at Height Falling off truss when bolting up steel sections	Worker (Rigger)	• Injury or death to work • Loss of company image • Banned from tendering	DRA2 JAN 2021	Review and mitigation required Pre-assemble sections into frames before erection Install permanent access platforms before erecting, bracing, where scaffold access is not possible Design anchor point on the steel truss	Minimal	5	3	15	LEAD DESIGNER, PD
				DRA3 NOV 2021	Ensure adequate site supervision and riggers are suitably skilled and wear harnesses Knowing the control proposed by PC, what more can designer do to help? Refer D2-4E		3	1	3	PROJECT MANAGER, PC
D2-1G	Falling objects Dropping splice plates, hand tools, nuts and bolts.	Worker & Public	• Injury or death to public and workers • Damage to adjacent properties • Loss of company image • Banned from tendering	DRA2 FEB 2021	Minimise weight of truss and number of individual small sections. Design steelwork sections to be preassembled in frames for erection in one lift.		5	2	10	LEAD DESIGNER, PD
				DRA3 NOV 2021	Provide safety netting catch small item and reduce impact. Knowing the control proposed by PC, what more can designer do to help? Refer D2-4E		2	2	4	PROJECT MANAGER, PC
	Structural failure Support bearings fail and truss falls off roof onto Main Road. Uplift restraint required during service	Worker & Public	• Injury or death to public and workers • Damage to adjacent properties • Loss of company image	DRA2 FEB 2021	Ensure bearings are correctly specifired and of reliable construction with higher than normal safety factors. Designer's advisory note required on design drawings that bearings must be properly maintained.	Cost of bearings=20% Stringent inspection & Maintenance required	5	5	25	LEAD DESIGNER, PD

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Q & A

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THANK YOU

"Committed To Engineering Excellence"

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