

A person in a blue suit and tie is shown from the chest down. They are holding a yellow hard hat in their left hand and pointing with their right hand towards a glowing, neon-blue city skyline. The skyline consists of various skyscrapers of different heights and shapes, all outlined in a bright blue light. The background is a dark, textured blue.

SAFETY BY DESIGN

Subhash Bhatt, CMIOSH, FIIRSM RSP
LinkedIn: [linkedin.com/in/bhattsubhash](https://www.linkedin.com/in/bhattsubhash)

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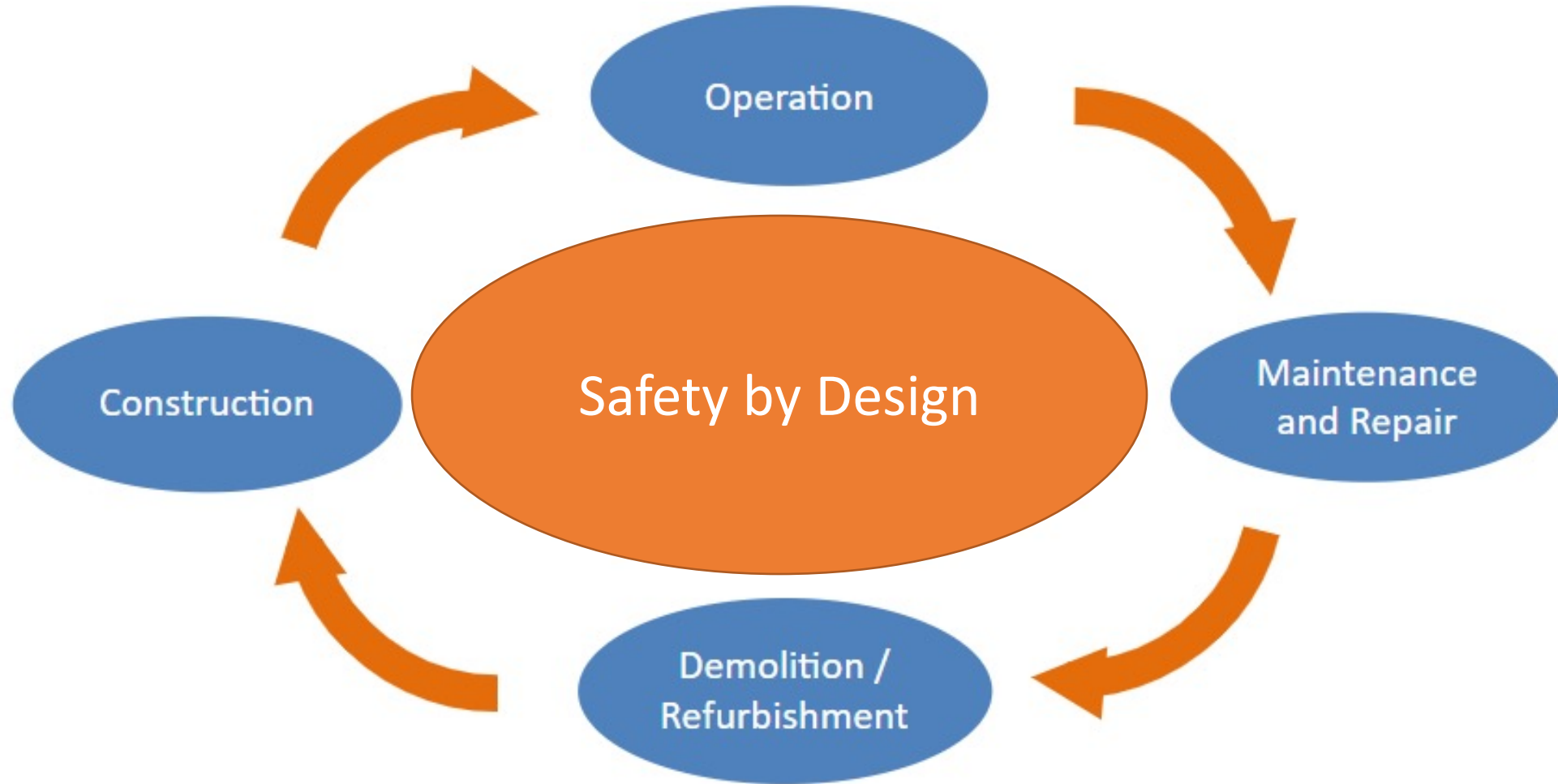
Date: 17 July 2020

Content

- **What is Safety by Design?**
- **Why is it Important?**
- **Legislative Requirements**
- **Definitions**
- **Risk Management**
- **Hierarchy of Control Measures**
- **Reviewing Control Measures**
- **Principals of Prevention**
- **Design Information**
- **Designer's Risk Record**
- **Hazard Table**
- **Case Study**
- **Example of Good Practice**
- **Q&A**



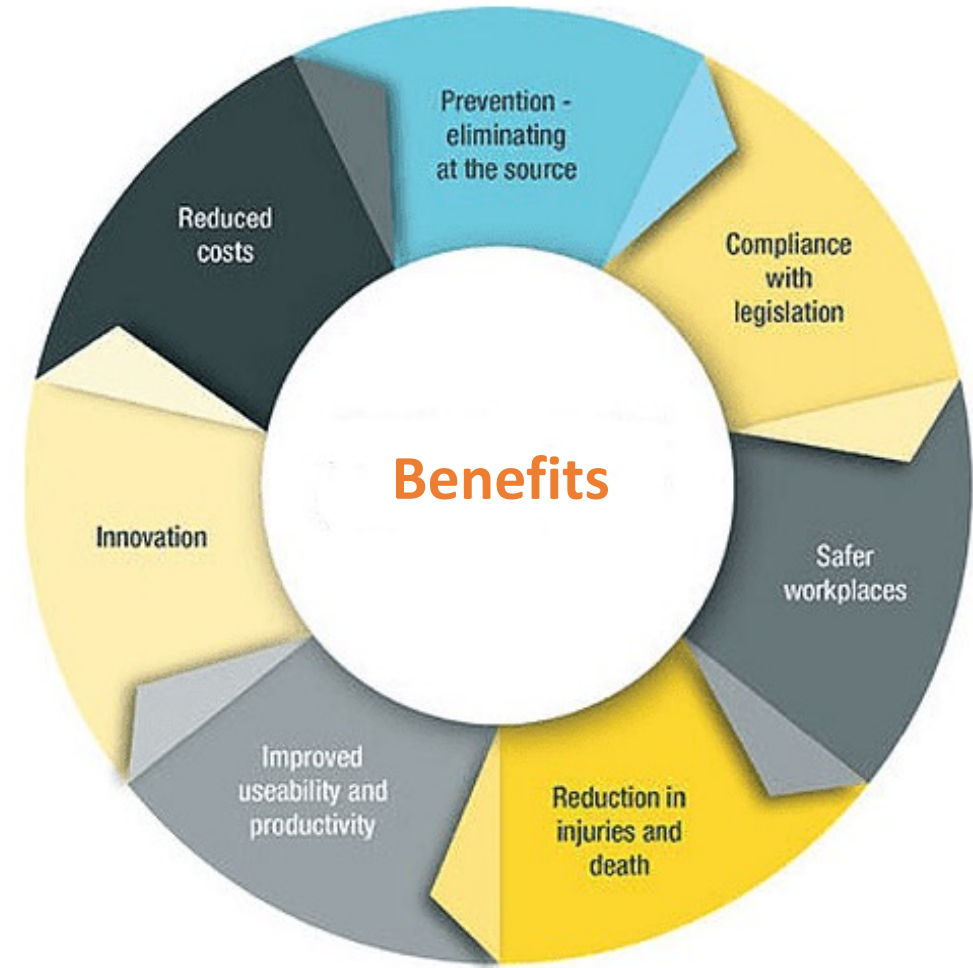
What is Safety by Design?



Why is it important?

Primary Cause of Accident in Construction Industry

- 37% : Management or worker failure
- 35%: Unsafe Design
- 28%: Poor Planning



Other Benefits

- Legal
- Reputation

Over 60% of accidents were due to decisions made BEFORE WORK STARTED!

Legislative Requirements

Examples of legislative frameworks or design standards

- **United Kingdom:** Construction (Design & Management) – CDM2015
- **USA:** National Institute of Occupational Safety and Health - NIOSH's PtD
- **Australia:** Work Health and Safety Regulations
- **Singapore:** Safety and Health Council - WSHC

Design Standards

- **India:** National Building Code
- **United Kingdom:** British Standards Institute - BSI
- **USA:** American National Standards Institution - ANSI
- **Europe:** CE Standards - CEN
- **Singapore:** Singapore Standards Council



Above all else we always need to consider:



The structures to be used as a workplace are safe and without risk to health



That we demonstrate we have approached design with a risk management and whole lifecycle approach



Ensured the designer has the right capabilities to design the specific project



That appropriate consultation, co-operation and co-ordination has occurred



We transfer the right information at the right time

Definitions



Safety is a state of being protected from potential harm or something that has been designed to protect and prevent harm.



A **hazard** is any agent that can cause harm or damage to humans, property, or the environment.



Risk is the possibility or chance of loss, danger or injury.



Severity describes the highest level of damage possible when an accident occurs from a particular hazard.



Likelihood is the state of being probable or chance of a threat occurring.

Risk Management

The application of hazard identification, risk assessment and risk control processes to achieve safe design.

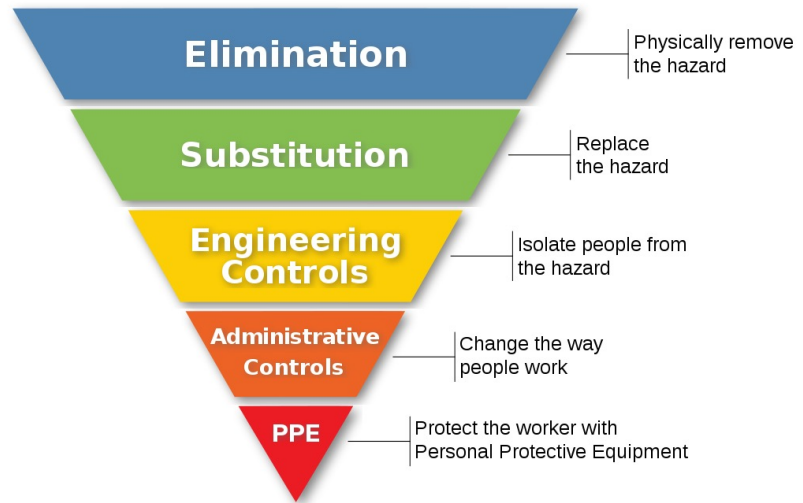
The Designer should:

- Identify the client's main objectives and outcomes for the design.
- Establish the intended and foreseeable uses of the design as well as the complexity of the project.
- Establish the risk management context by identifying the breadth of workplace hazards and relevant applicable: - Legislation - Codes of practice - Design Standards.
- Identify the required design disciplines, skills and competencies
- Identify the roles and responsibilities of stakeholders in relation to the project.
- Establish collaborative relationships with clients and others who influence the design outcome



Hierarchy of Control Measures

Most effective
Least effective

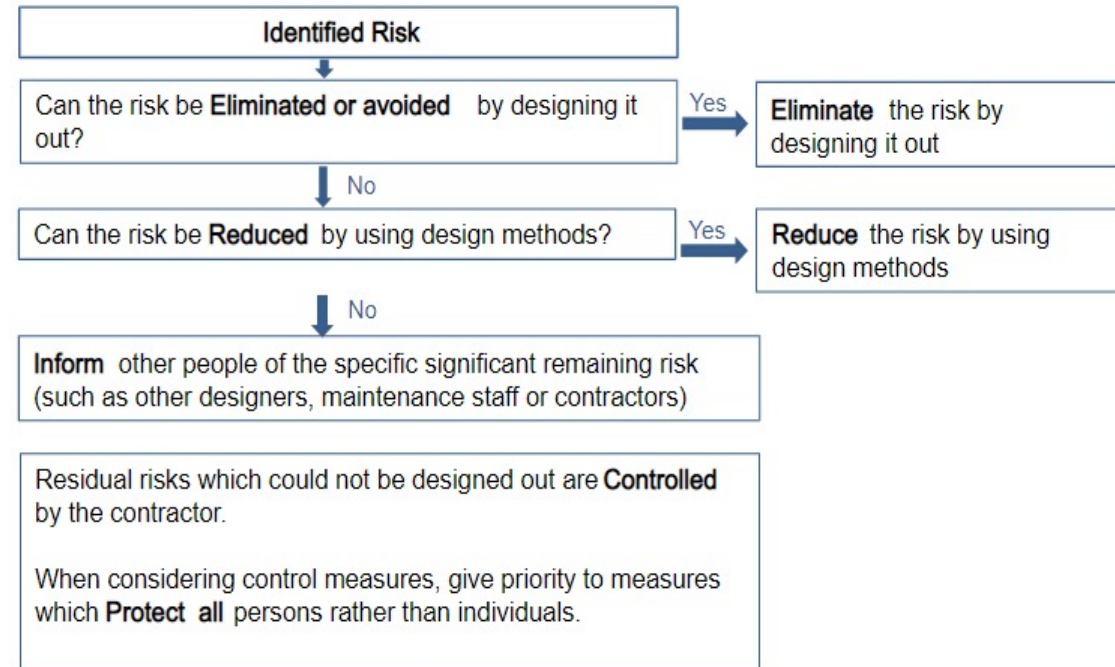


OR

ERICPD

Eliminate the hazard
Reduce the hazard
Isolate the hazard
Control the hazard
Personal Protective Equipment
Discipline

Design Process
Construction



RED

Hazardous procedures, products and processes that should be eliminated from the project where possible.

- ▼ Lack of adequate pre-construction information (such as asbestos surveys).
- ▼ Details of geology, obstructions, services, ground contamination and so on
- ▼ Hand-scabbling of concrete (such as 'stop ends')
- ▼ Demolition by hand-held breakers of the top sections of concrete piles (pile cropping techniques are available)
- ▼ Specification of fragile roof lights and roofing assemblies
- ▼ Processes giving rise to large quantities of dust (such as dry cutting, blasting and so on)
- ▼ On-site spraying of harmful substances
- ▼ Specification of structural steelwork which is not purposely designed to accommodate safety nets
- ▼ Design of roof mounted services that require access (for maintenance and so on), without provision for safe access (such as barriers)
- ▼ Glazing that cannot be accessed safely.
- ▼ Entrances, floors, ramps, stairs and escalators not specifically designed to avoid slips and trips during use and maintenance
- ▼ Design of environments involving adverse lighting, noise, vibration, temperature, humidity and draughts during use and maintenance operations.
- ▼ Designs of structures that do not allow for fire containment during construction.

AMBER

Products, processes and procedures to be eliminated or reduced as far as possible and only specified or allowed if unavoidable. Including amber items would always lead to the provision of information to the principal contractor.

- ▼ Internal manholes and inspection chambers in circulation areas
- ▼ External manholes in heavily used vehicle access zones
- ▼ Specification of 'lip' details (such as trip hazards) at the tops of pre-cast concrete staircases
- ▼ Specification of small steps (such as risers) in external paved areas
- ▼ Specification of heavy lintels. (Slim metal of hollow concrete lintels are better alternatives)
- ▼ Large and heavy glass panels
- ▼ Chasing out concrete, brick or blockwork walls or floors for the installation of services.
- ▼ Specification of heavy building blocks (such as those weighing more than 20 kgs)
- ▼ Specification of solvent-based paints and thinners, or isocyanates, particularly for use in confined areas.
- ▼ Specification of curtain wall or panel systems without provision for tying or raking scaffolds.
- ▼ Specification of a blockwork wall more than 3.5 metres high using retarded mortar mixes.
- ▼ Site traffic routes that do not allow for one-way systems and/or vehicular traffic segregated from site personnel.
- ▼ Site layout that does not allow adequate room for delivery and/or storage of materials, including site-specific components.
- ▼ Heavy construction components which cannot be handled using mechanical lifting devices (because of access restrictions/floor loading and so on).
- ▼ On-site welding, in particular for new structures.
- ▼ Use of large piling rigs and cranes near live railways and overhead electric power lines or where proximity to obstructions prevents guarding of rigs.

GREEN

Products, processes and procedures to be positively encouraged.

- ▼ Adequate access for construction vehicles to minimise reversing requirements (one-way systems and turning radii)
- ▼ Provision of adequate access and headroom for maintenance in plant room and adequate provision for replacing heavy components.
- ▼ Thoughtful location of mechanical and electrical equipment, light fittings, security devices and so on to facilitate access, and placed away from crowded areas
- ▼ Specification of concrete products with pre-cast fixings to avoid drilling
- ▼ Specification of half board sizes for plasterboard sheets to make handling easier
- ▼ Early installation of permanent means of access, and prefabricated staircases with hand rails
- ▼ Provision of edge protection at permanent works where there is a foreseeable risk of falls after handover
- ▼ Practical and safe methods of window cleaning (such as from the inside)
- ▼ Appointment of a temporary works co-ordinator
- ▼ Off-site timber treatment if PPA- and CCA-based preservatives are used (boron or copper salts can be used for cut ends on site)
- ▼ Off-site fabrication and prefabricated elements to minimise on site hazards
- ▼ Encourage the use of engineering controls to minimise the use of personal protective equipment

Reviewing Control Measures

Principals of Prevention



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



Evaluating the risks that cannot be avoided



Combating the risks at source



Adapting to technical progress: consider new techniques or technologies



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



Giving collective protective measures priority over individual protective measures



Making provisions so that the work can be organised to reduce exposure to hazards



Giving appropriate instructions to employees



Design Information

OBTAIN

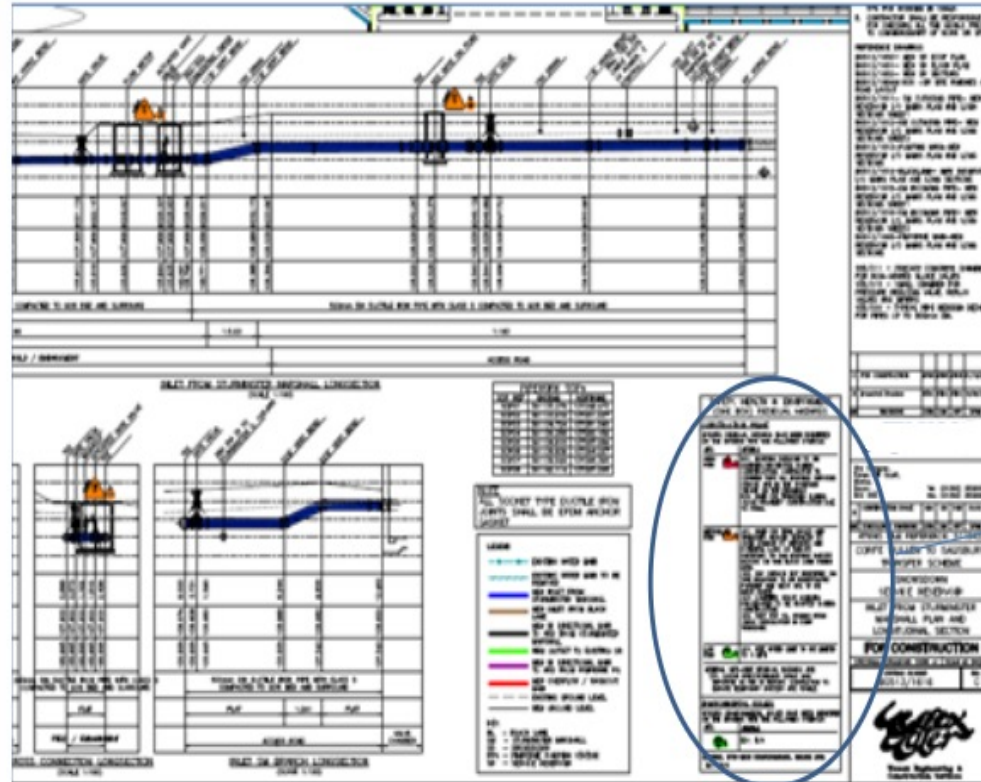
- Pre-construction information.
- A client brief, including how the finished project will be used.
- Information on the site and ground conditions.
- The methods for communicating during the design.
- Information held by others (such as other designers).
- Sustainability objectives, for example: BREEAM, LEED, IGBC etc.




PROVIDE

- You need to provide the right level of information to the right people at the right time.
- Information should be project specific and of suitable and sufficient detail to those who need it.
- You should agree with the principal designer how information will be exchanged.
- Residual risks, if any.

How do I do that?

Designer's hazard record

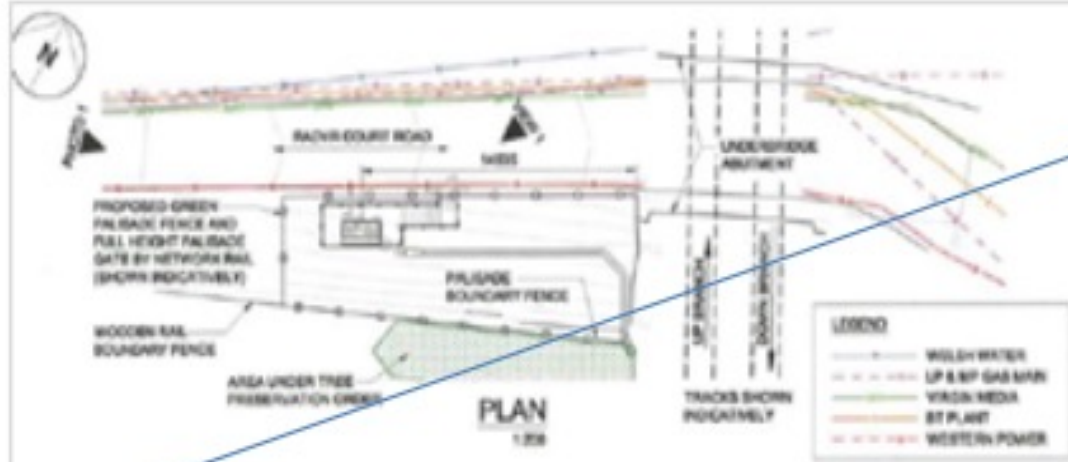


SAFETY, HEALTH & ENVIRONMENT (SHE BOX) RESIDUAL HAZARDS	
CONSTRUCTION PHASE	
SPECIFIC RESIDUAL HAZARDS HAVE BEEN IDENTIFIED ON THE DRAWING WITH THE FOLLOWING SYMBOLS:	
KEY	DETAILS
<p>HIGH RISK </p>	<p>RO1. EXISTING SERVICES TO BE DIVERTED/PROTECTED DURING CONSTRUCTION. CONTRACTOR TO CONFIRM THAT ALL EXISTING SERVICES (TRACE) ARE IN THE POSITIONS SHOWN ON THE DRAWINGS RO2. HAND DIG TRENCHES DURING CLOSE PROXIMITY CONSTRUCTION DUE TO PIPES.</p>
<p>MEDIUM RISK </p>	<p>AO1. HAND DIG TRIAL HOLES AND TRENCHES AROUND SERVICES TO AVOID DAMAGE TO SERVICES AND POTENTIAL LOSS OF THRUST RESTRAINT VIA THE EXISTING THRUST BLOCKS ON THE BLACK LANE RISING MAIN. AO2. ANY SERVICE NOT IDENTIFIED ON THE DRAWINGS TO BE INVESTIGATED FURTHER AND WECS ARE TO BE MADE AWARE. AO3. CONFINED SPACE WORKING PROCEDURES TO BE ADOPTED DURING CONSTRUCTION. AO4. TEST FOR CO₂ ARISING FROM CHALK DISSOLUTION IN DEEP TRENCHES.</p>
<p>LOW RISK </p>	<p>GO1. SITE SPEED LIMIT TO BE LIMITED TO 5 MPH</p>

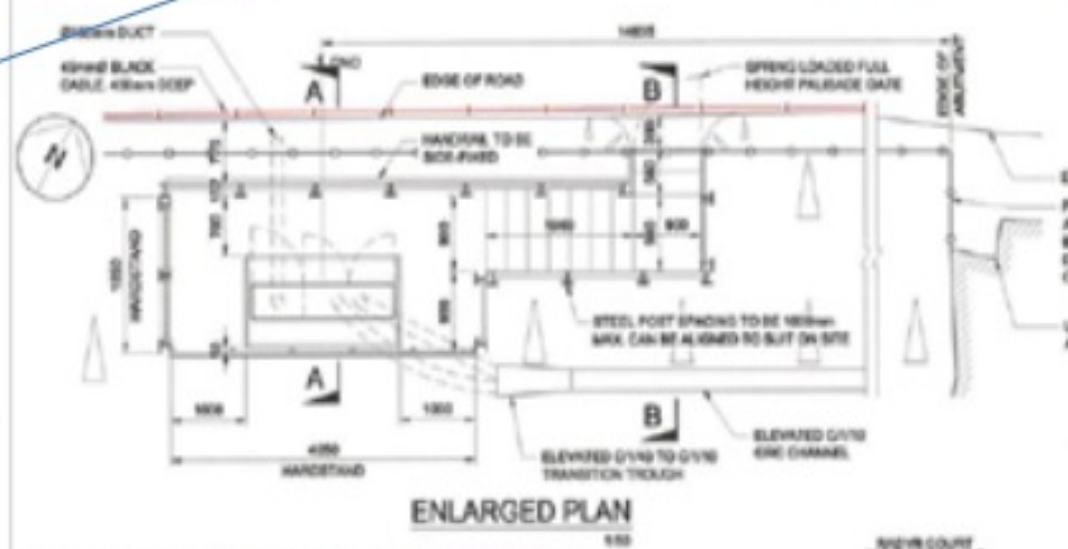
What do I tell them?

Residual risk & Hazard warning

Work Sequence

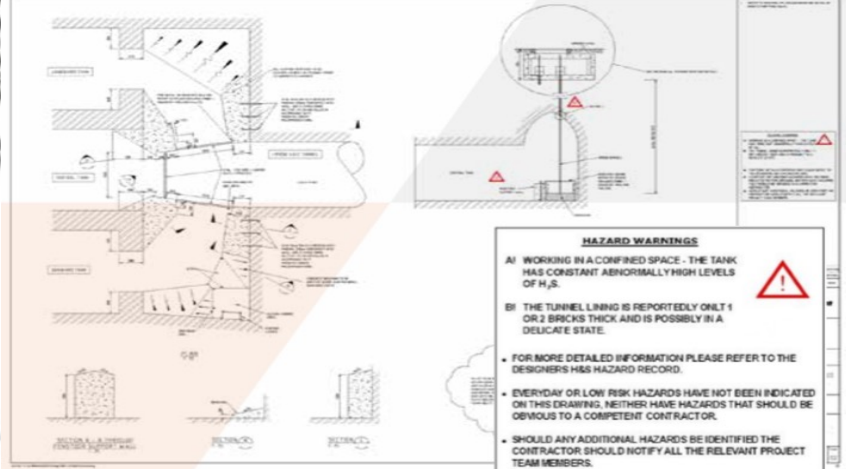
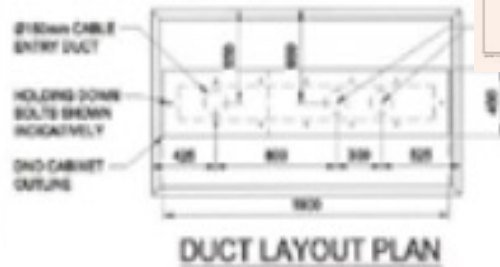


HAZARD TABLE		
HAZARD	DESCRIPTION	MITIGATION
WASTE DISPOSAL	EXISTING WASTE DISPOSAL SITE IDENTIFIED BY HAZARD DIRECTORY, POSSIBLE GAS PRESENCE.	THE DNO IS NOT LOCATED WITHIN THE VICINITY OF THE EXISTING WASTE DISPOSAL SITE AND IS NOT ENGAGED TO AFFECT CONSTRUCTION.
VEGETATION	VEGETATION WORKS REQUIRED.	THE CONTRACTOR IS TO ENSURE APPROPRIATE SAFE SYSTEM OF WORK IS SET UP AND ALL PERSONNEL ARE IN POSSESSION OF APPROPRIATE COMPETENCIES FOR ANY FORM OF PLANT OR CHEMICALS THEY ARE TO USE.
TREE PRESERVATION ORDER	AREA UNDER TREE PRESERVATION ORDER ADJACENT TO NETWORK RAIL BOUNDARY (SEE PLAN VIEW)	THE CONTRACTOR IS TO IDENTIFY TREES UNDER TPO PROTECTION PRIOR TO CONSTRUCTION. NO TREES WITHIN ADJACENT BOUNDARY FENCE ARE TO BE REMOVED.
STRUCTURE ADJACENT TO CARRIAGEWAY	HAZARD OF VEHICULAR STRIKE FROM ADJACENT CARRIAGEWAY, WORKING NEXT TO LIVE CARRIAGEWAY, HAZARD OF CONTACT WITH VEHICLE.	PERMITS NOT REQUIRED. SEE DESIGN RISK ASSESSMENT FOR FURTHER INFORMATION, TRAFFIC MANAGEMENT REQUIRED.
SLOPE STABILITY	INSTABILITY OF THE SLOPE PRIOR TO INSTALLATION OF THE RETAINING WALL.	THE CONTRACTOR IS TO VERIFY THE STABILITY OF THE SLOPE PRIOR TO CONSTRUCTION AND MONITOR THROUGHOUT IF REQUIRED.



BURIED SERVICES		
TELECOM CABLES	BURIED TELECOM CABLES IN THE VICINITY	BURIED SERVICES SEARCH UNDERTAKEN BY NETWORK RAIL ON 03/11/12. 80mm BLACK CABLE LOCATED AT SOUTH EDGE OF ROAD 400mm BELOW SURFACE. SEE PLAN AND SECTION.
WESTERN POWER	BURIED ELECTRIC CABLES IN RAOVIA COURT ROAD.	
GAS MAIN	LP & MFG MAINS IN RAOVIA COURT ROAD.	OTHER SERVICES MAY BE PRESENT IN THE VICINITY AND THE CONTRACTOR IS TO UNDERTAKE BURIED SERVICES SEARCH PRIOR TO CONSTRUCTION IN ACCORDANCE WITH +MRL 100/1000, MRL 1000 AND 1500 +STRUCT.
WILSH WATER	EXISTING MAIN IN RAOVIA COURT ROAD.	
ST PLANT	ST PLANT IN RAOVIA COURT ROAD.	
VIBRA MEDIA	BURIED CABLES IN RAOVIA COURT ROAD.	WHERE BURIED SERVICES ARE ENCOUNTERED AT THE PROPOSED EXCAVATION POSITIONS, THE EXCAVATION CONTRACTOR SHALL STOP WORK AND NOTIFY ALL RELEVANT AUTHORITIES.

- ENVISAGED CONSTRUCTION SEQUENCE**
1. IDENTIFY AND PROTECT BURIED SERVICES.
 2. INVERTED ROOSTS TO BE ALIGNED, INSTALLED AND FILLED WITH CONCRETE.
 3. INSTALL DUCTS.
 4. INSTALL TRIMMER PLANS.
 5. INSTALL AND COMPACT FILL TO UNDERSIDE OF DNO FOUNDATION.
 6. INSTALL DNO FOUNDATION.
 7. INSTALL AND COMPACT TYPE 1 TO TOP OF HANGSTAND LEVEL.
 8. IDENTIFY REINFORCEMENT LOCATIONS AND POSITION PILING HOLES ACCORDINGLY TO AVOID CLASH WITH REINFORCEMENT.
 9. DRILL AND CHEMICALLY BOND AND-CAS.
 10. INSTALL DNO CABE.
 11. INSTALL STEPS, GUARDRAIL AND ELEVATED CHANNEL.



HAZARD WARNINGS

A) WORKING IN A CONFINED SPACE - THE TANK HAS CONSTANT ABNORMALLY HIGH LEVELS OF H₂S.

B) THE TUNNEL LINING IS REPORTEDLY ONLY 1 OR 2 BRICKS THICK AND IS POSSIBLY IN A DELICATE STATE.

FOR MORE DETAILED INFORMATION PLEASE REFER TO THE DESIGNER'S H&S HAZARD RECORD.

EVERYDAY OR LOW RISK HAZARDS HAVE NOT BEEN INDICATED ON THIS DRAWING. NEITHER HAVE HAZARDS THAT SHOULD BE OBVIOUS TO A COMPETENT CONTRACTOR.

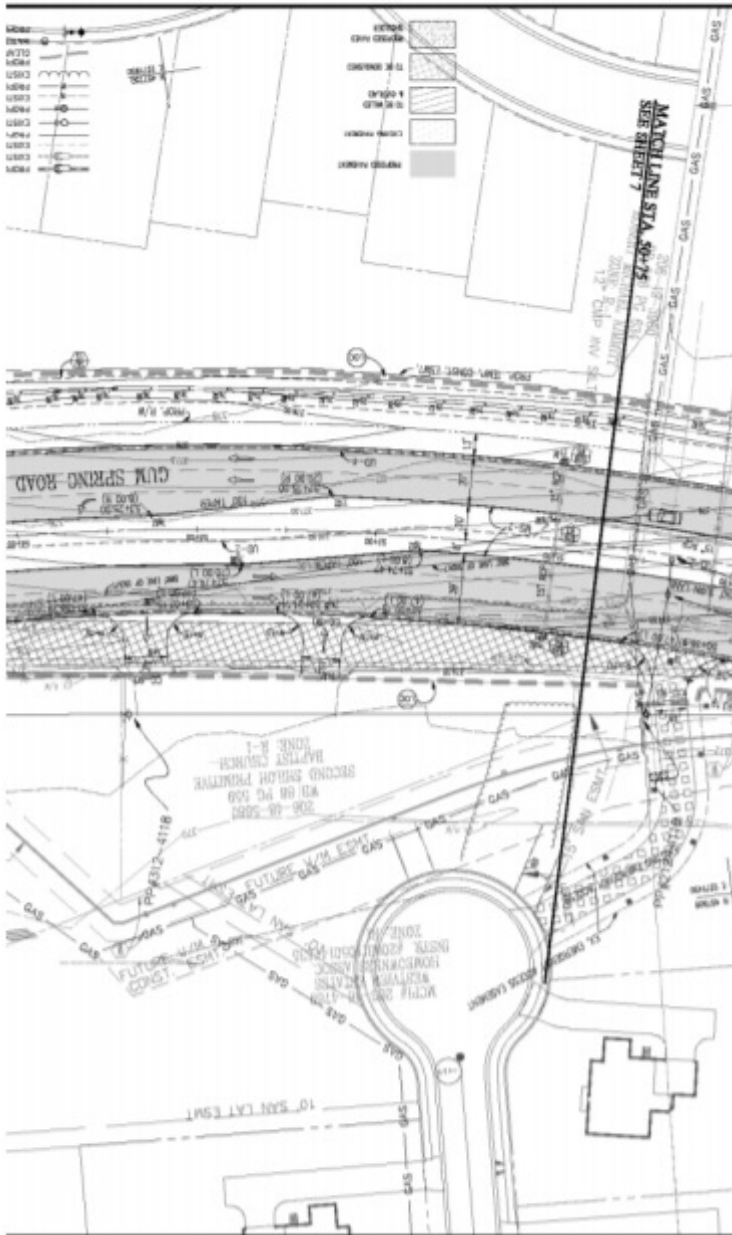
SHOULD ANY ADDITIONAL HAZARDS BE IDENTIFIED THE CONTRACTOR SHOULD NOTIFY ALL THE RELEVANT PROJECT TEAM MEMBERS.

GRC CHANNEL

Approved for Const

Name: [Signature]

Case Study(CS) 1 - Construction



Design spec:

- Dig groundwater monitoring wells at various locations.
- Wells located directly under overhead power lines.

Accident:

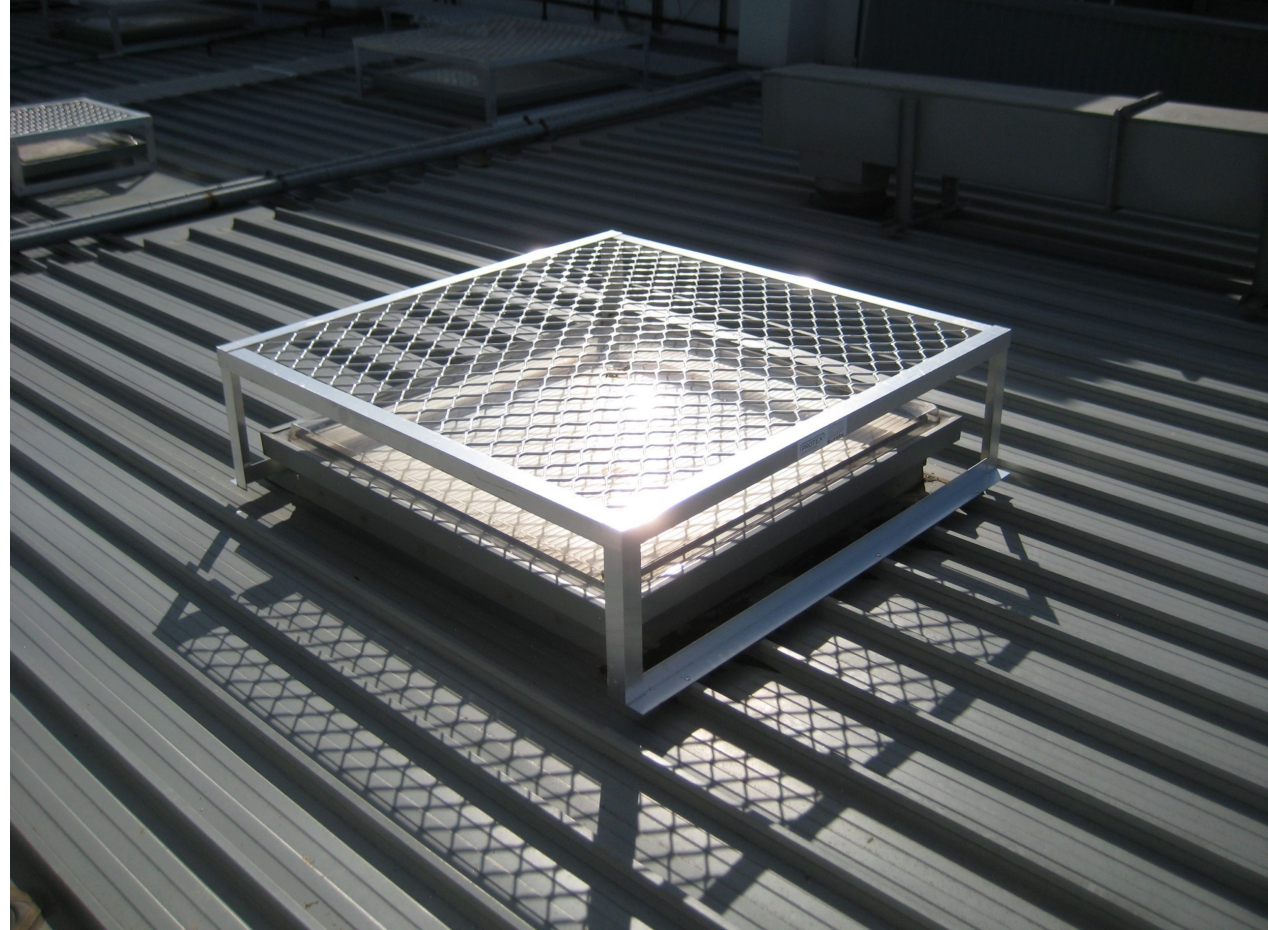
- Worker electrocuted when his drill rig got too close to overhead power lines.

Designer could have:

- specified wells be dug away from power lines; and/or
- better informed the contractor of hazard posed by wells' proximity to powerlines through the plans, specifications, and bid documents.

CS 2 – Operational (Cleaning and Maintenance)





CS 3- Fragile roof

CS 4 – Demolition



CS 5 – Health Hazards

- **Chemical** e.g. Welding fumes, Asbestos, high VOC paint etc.
- **Physical** e.g. Noise , vibration , radiation etc.
- **Biological** e.g. animal, insects, plants , sewage water etc.
- **Ergonomic** e.g. Manual handing, lifting and pushing, using wrong tools, poor grip or posture etc.



Example of Good Practice

Eliminate hazards at design stage

Review design at concept stage

Have your design peer reviewed

Develop good working relationships

Ensure you understand the scope of work

Undertake an early site visit – if required

Hold regular design meetings

Verify design changes – including VO's

Communicate with those you need to communicate with

Ask for photographs of the location to visualise the wider challenges of the design

Complete risk assessments this is a continual process

Obtain any preconstruction information to assist with design

Provide the right information to the right people

Transfer the right information at the right time

Use building information modelling (BIM)

Add risk information to the drawing

Make sure you are using the latest design standards

Remember not everyone is a designer

Verify any design change

Be innovative

One size doesn't fit all

ANY QUESTIONS?

Thank you!

Subhash Bhatt, CMIOSH, FIIRSM RSP

LinkedIn: [linkedin.com/in/bhattsubhash](https://www.linkedin.com/in/bhattsubhash)

Other social media : @subibhatt