SAFETY BY DESIGN

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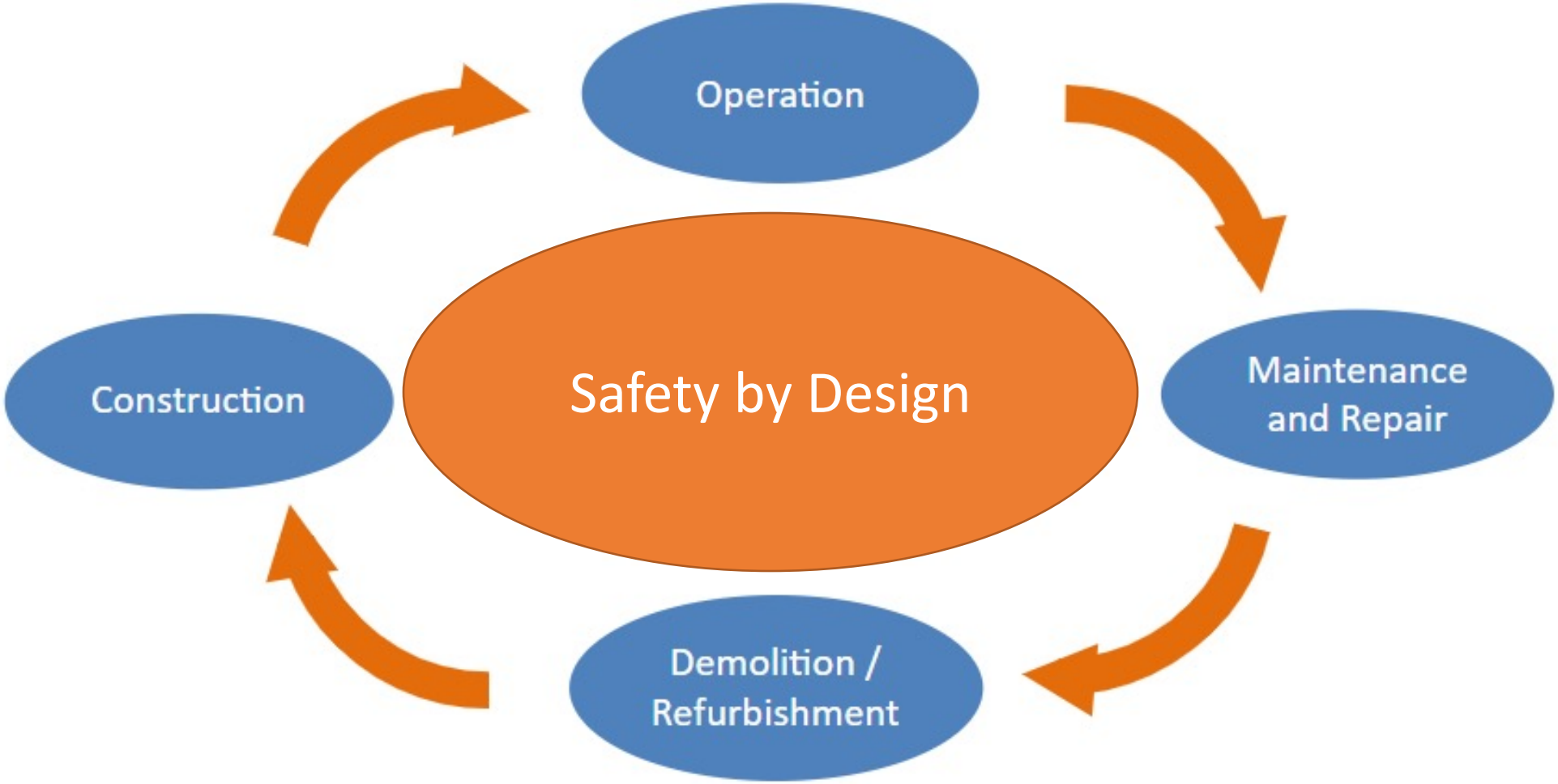
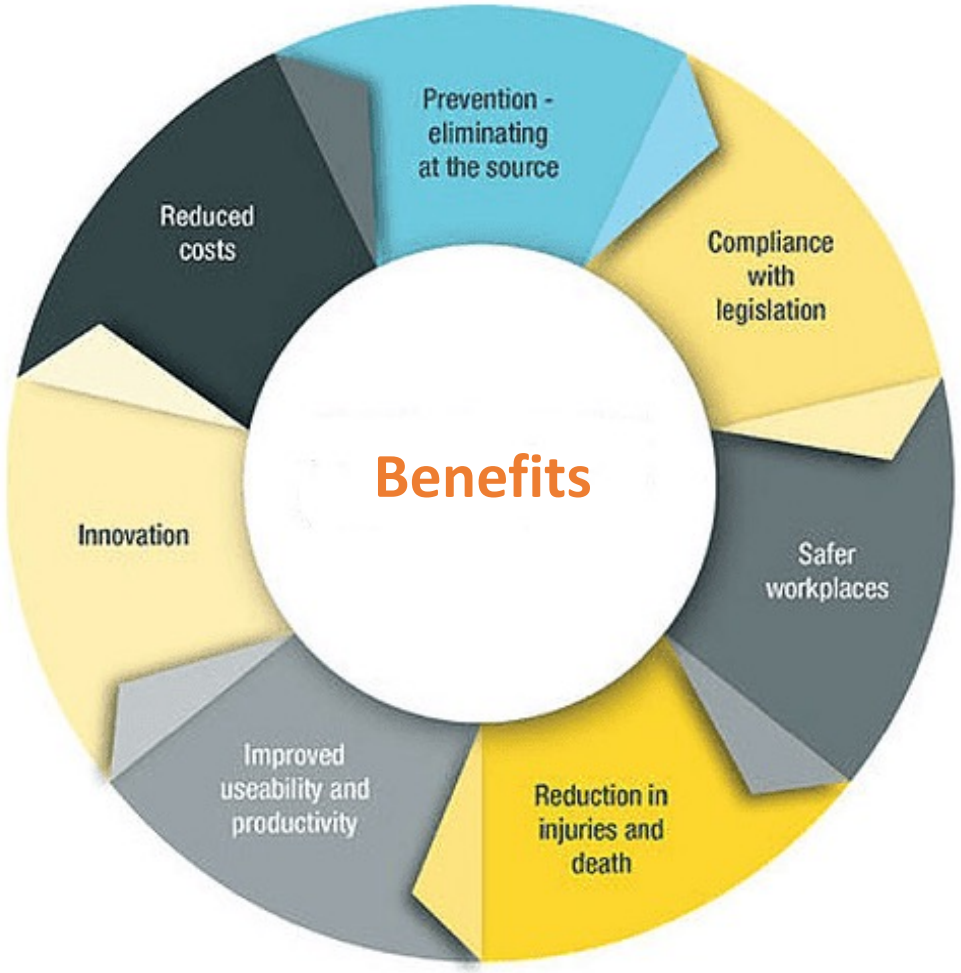
What is Safety by Design?



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.

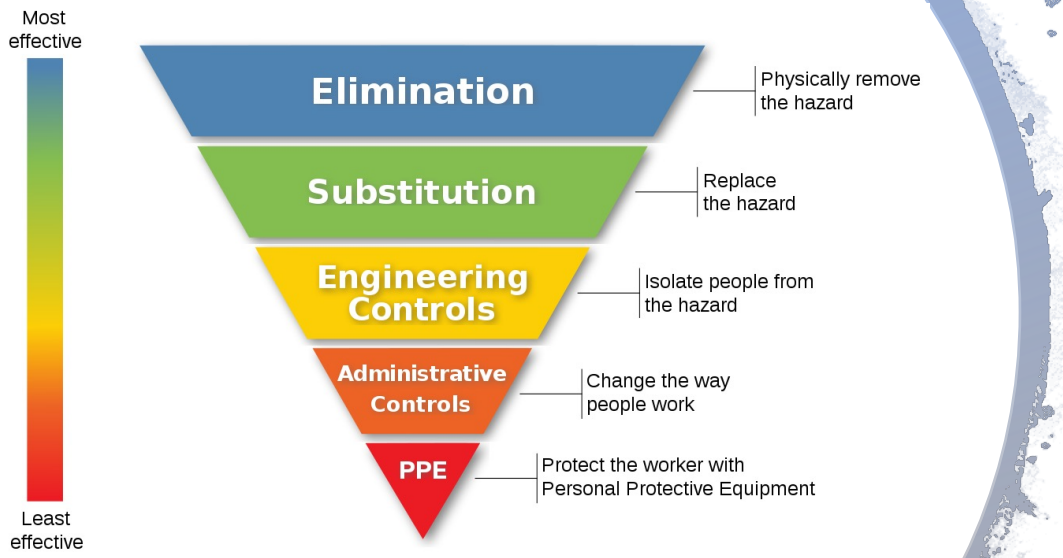
Risk Management

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

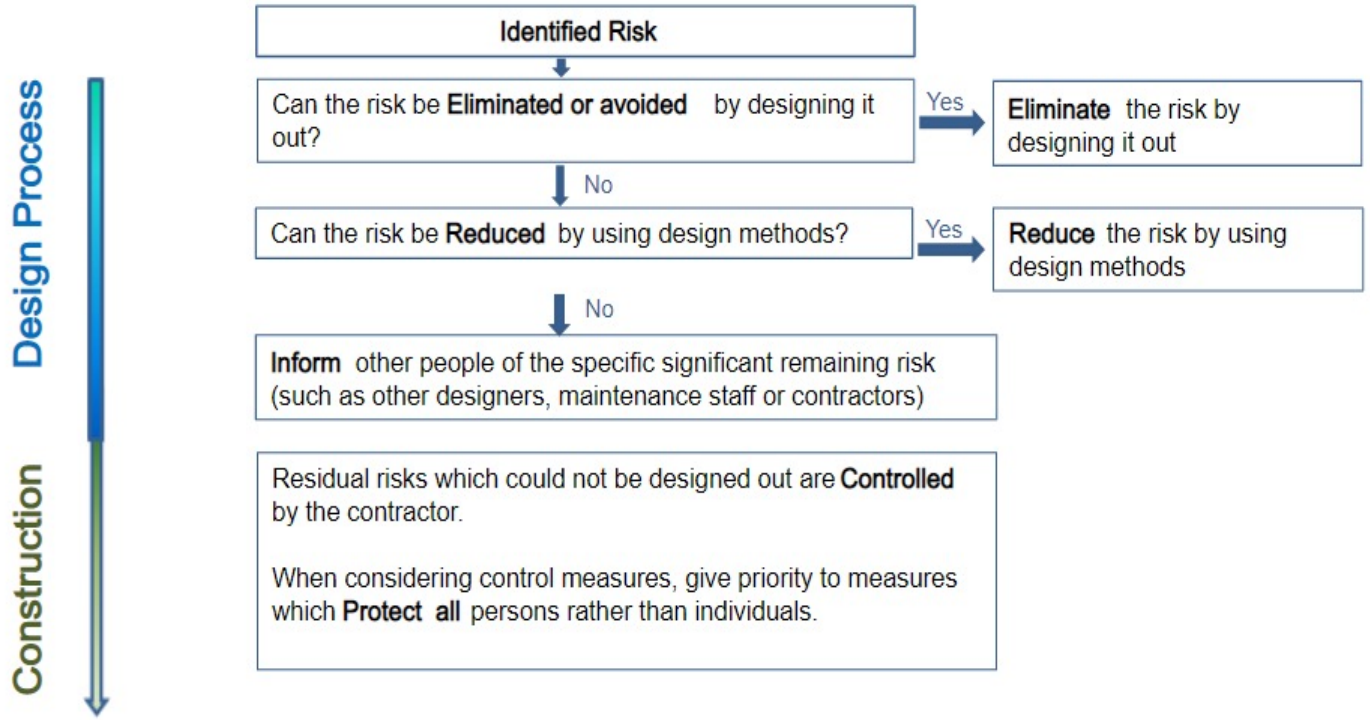
Hierarchy of Control Measures



OR

ERICPD

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



Reviewing Control Measures

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

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

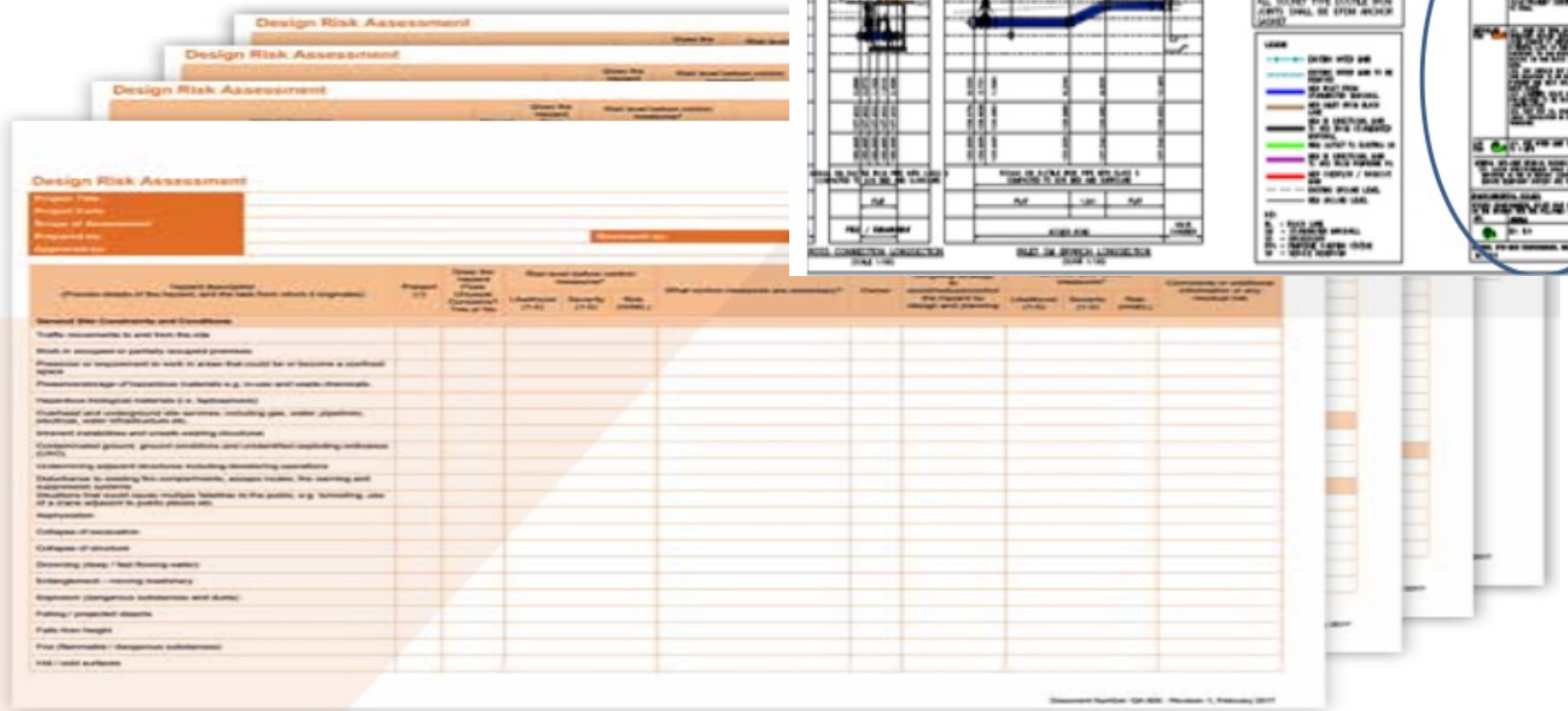
- Pre-construction information.
- A client brief, including how the finished project will be used.
- Information on the site and ground conditions.
- The methods for communicating during the design.
- Information held by others (such as other designers).
- Sustainability objectives, for example: BREEAM,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

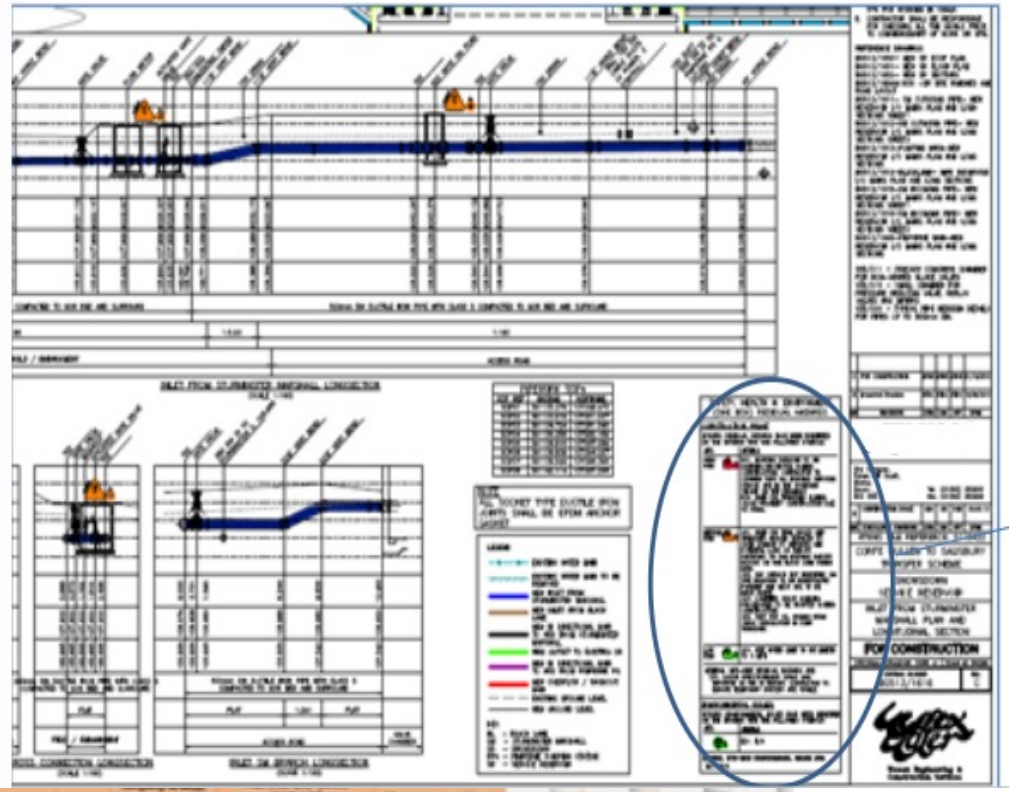
PROVIDE

- 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

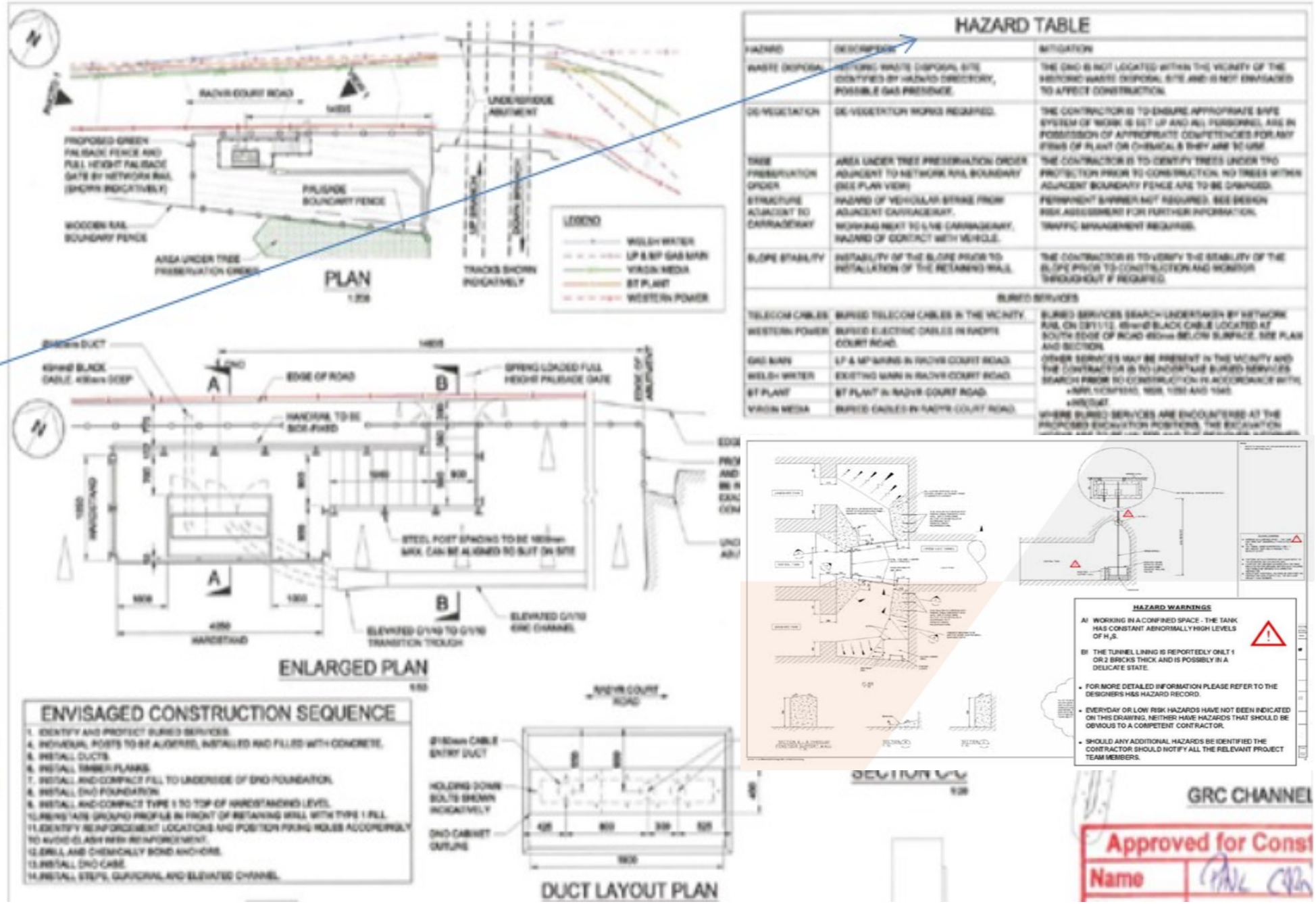
SPECIFIC RESIDUAL HAZARDS HAVE BEEN IDENTIFIED ON THE DRAWING WITH THE FOLLOWING SYMBOLS:

KEY	DETAILS
HIGH RISK	R01. EXISTING SERVICES TO BE DIVERTED/PROTECTED DURING CONSTRUCTION. CONTRACTOR TO CONFIRM THAT ALL EXISTING SERVICES (TRACE) ARE IN THE POSITIONS SHOWN ON THE DRAWINGS R02. HAND DIG TRENCHES DURING CLOSE PROXIMITY CONSTRUCTION DUE TO PIPES.
MEDIUM RISK	A01. 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. A02. ANY SERVICE NOT IDENTIFIED ON THE DRAWINGS TO BE INVESTIGATED FURTHER AND WECS ARE TO BE MADE AWARE. A03. CONFINED SPACE WORKING PROCEDURES TO BE ADOPTED DURING CONSTRUCTION. A04. TEST FOR CO_2 ARISING FROM CHALK DISSOLUTION IN DEEP TRENCHES.
LOW RISK	G01. SITE SPEED LIMIT TO BE LIMITED TO 5 MPH

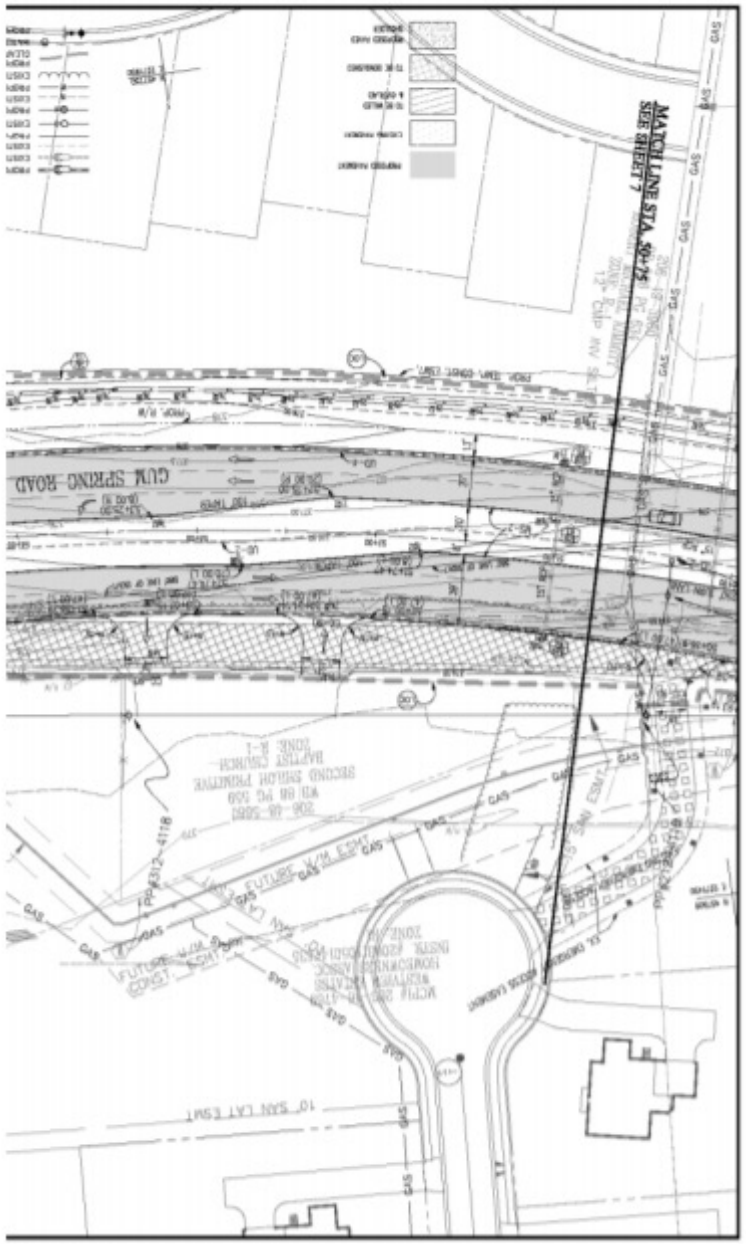
What do I tell them?

Residual risk & Hazard warning

Work Sequence



Case Study(CS) 1 - Construction



Design spec:

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

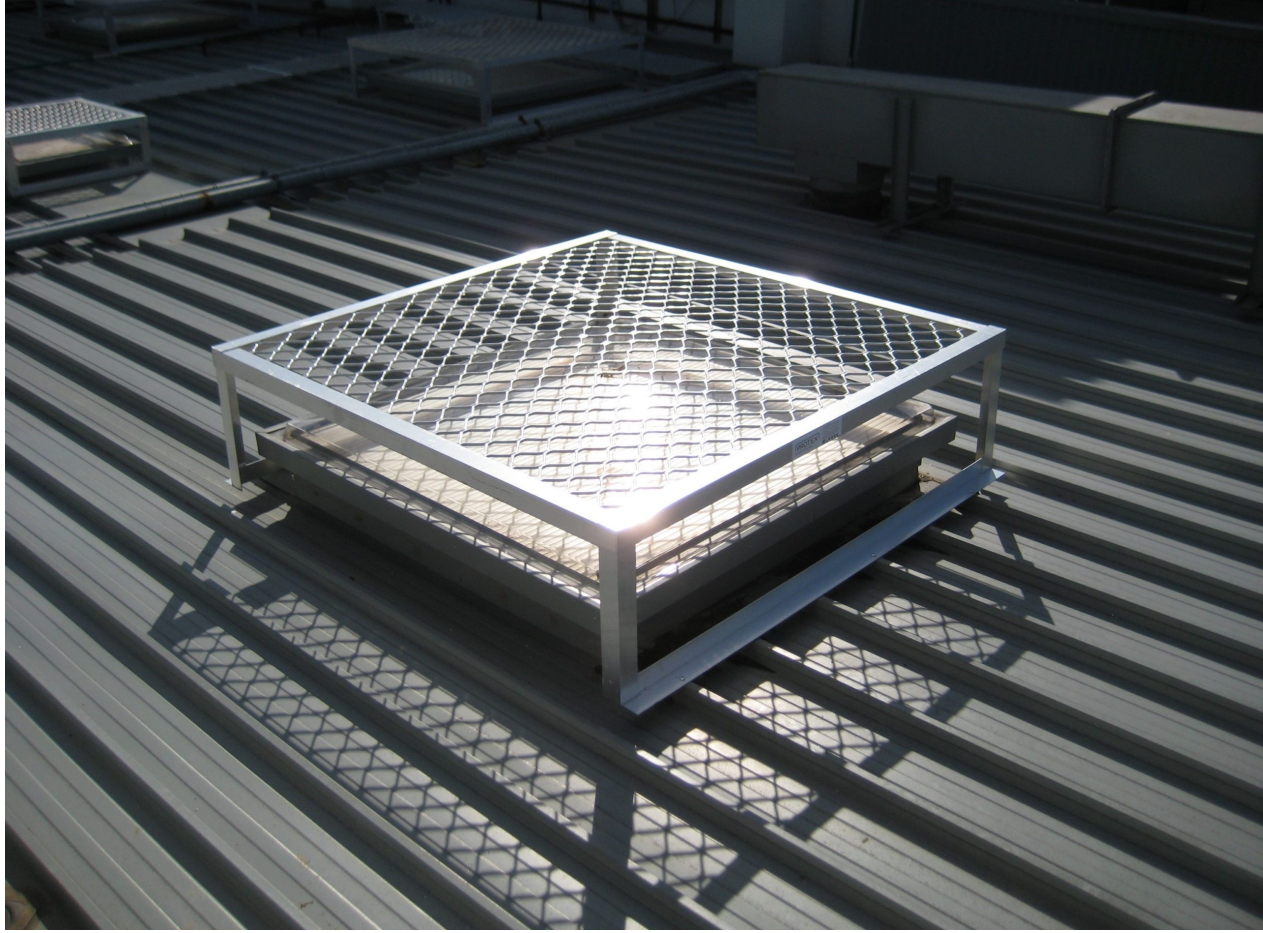
Accident:

- 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

ANY QUESTIONS?

Thank you!

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