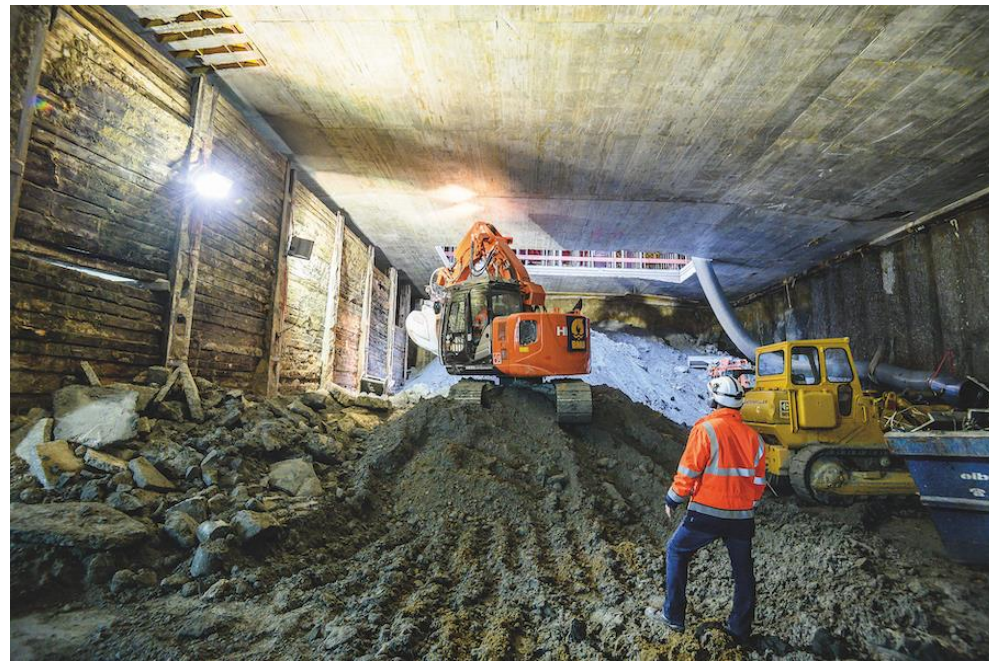




TCM 2430 – Construction Safety

Week 12 – Underground Construction + Caissons, & Cofferdams + Blasting and the Use of Explosives

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Underground Construction

Hazards in Underground Construction

Ground Instability

- **Collapse:** Excavations and tunnels can collapse if the surrounding soil or rock is not stable. This risk is heightened in areas with loose or fractured geological formations.
- **Subsidence:** Construction activities can lead to ground subsidence, causing settlement and potential damage to structures on the surface.



Hazards in Underground Construction

Gas and Dust Accumulation

- **Gas Buildup:** Underground spaces may contain naturally occurring gases or gases released during construction. Accumulation of gases like methane poses explosion risks.
- **Dust:** Drilling, blasting, and excavation can generate dust, which may cause respiratory issues and reduce visibility.



Hazards in Underground Construction

Water Ingress

- **Flooding:** Water can infiltrate underground spaces, leading to flooding. This poses risks to workers and can damage equipment and structures.



Hazards in Underground Construction

Confined Spaces

- **Air Quality:** Limited ventilation in underground spaces can result in poor air quality, leading to respiratory problems.
- **Restricted Movement:** Working in confined spaces poses risks of injury due to limited mobility and escape routes.



Hazards in Underground Construction

Mechanical and Electrical Hazards

- **Equipment Risks:** Operation of heavy machinery and equipment in confined spaces can lead to accidents.
- **Electrical Hazards:** Wiring and electrical systems can pose a risk of electrocution, especially in damp conditions.



Hazards in Underground Construction

Fire Hazards

- **Combustible Materials:** Construction materials, as well as the presence of flammable gases, can create fire hazards in underground environments.



Hazards in Underground Construction

Communication and Navigation Challenges

- **Limited Communication:** Underground spaces may hinder radio and electronic communication, making it challenging to coordinate activities and respond to emergencies.
- **Navigation Issues:** Lack of natural light and confined spaces can make it difficult for workers to navigate safely.



Hazards in Underground Construction

Health Risks

- **Exposure to Hazardous Materials:** Workers may be exposed to hazardous materials, such as asbestos or toxic chemicals, during excavation and tunneling activities.
- **Stress and Fatigue:** Working in confined spaces with challenging conditions can lead to stress and fatigue, impacting workers' overall health and safety.





Hazards in Underground Construction **Geotechnical Challenges**

- **Rockfalls:** In rock tunneling, the risk of rockfalls and collapses is significant, especially in areas with unstable geological formations.

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CAISSON

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COFFERDAM



Caissons & Cofferdams Safety

What are caissons?

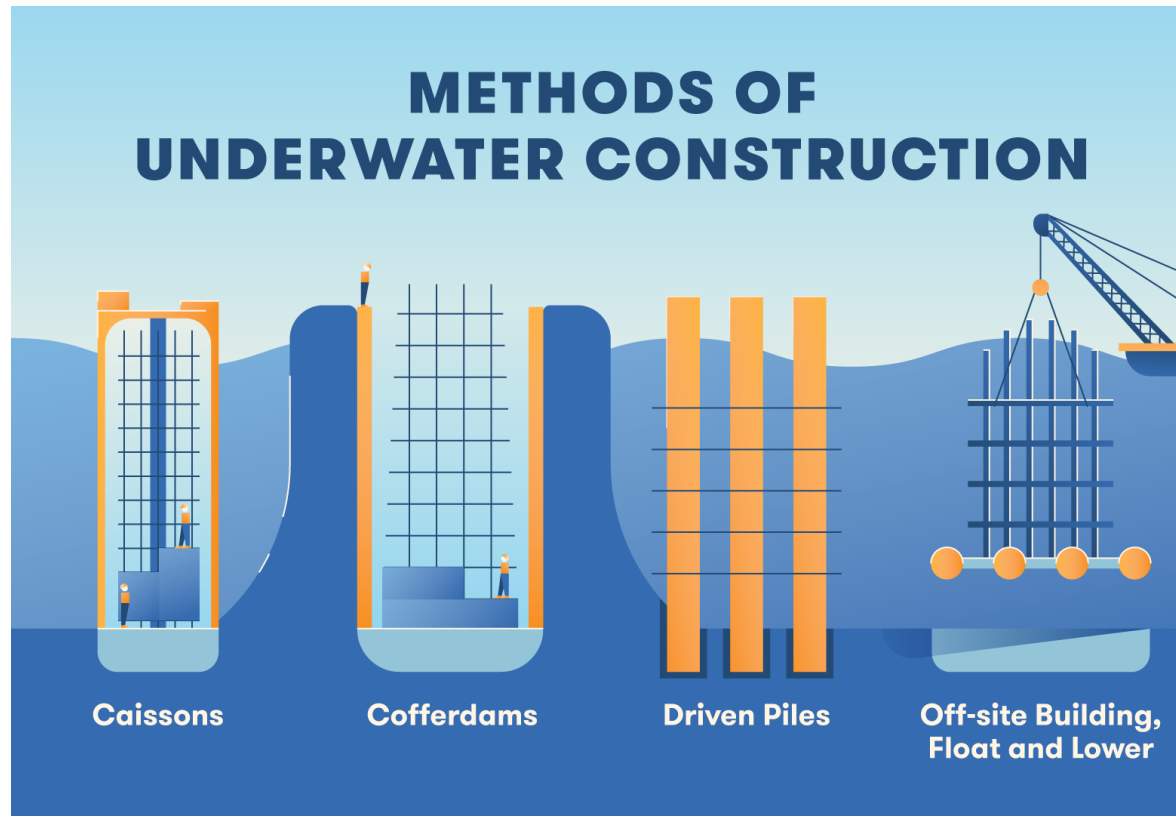
- Caisson construction involves the use of a caisson, a watertight structure, typically made of wood, steel, or concrete, that is used to create a dry working environment underwater.
- Caissons are commonly employed in civil engineering projects, particularly for the construction of bridge piers, harbor structures, and other underwater foundations.



Video

How It Works - Sunk Caisson Construction for Lift Stations

- https://www.youtube.com/watch?v=MaYjxifnZj8&t=4s&ab_channel=MetropolitanCouncil



What are cofferdams?

- A cofferdam is a temporary structure designed to exclude water from a specific area, typically to facilitate construction or repair work below the water level.
- It creates a dry work environment, allowing construction activities to take place in areas that would otherwise be submerged.
- Cofferdams are commonly used in various civil engineering and construction projects, such as bridge construction, dam construction, and pipeline installation.
- There are different types of cofferdams, and their selection depends on the specific requirements of the project.



Video

What are Cofferdams and How are They Used?

- https://www.youtube.com/watch?v=sXRHerkmOU0&ab_channel=ConcerningReality



How are caissons and cofferdams different?

Permanent vs. Temporary:

- Caissons: Caissons are often permanent structures that become part of the foundation.
- Cofferdams: Cofferdams are temporary structures used during construction and are typically removed once the project is complete.

Working Environment:

- Caissons: Workers in pneumatic caissons may work in pressurized conditions during the sinking process.
- Cofferdams: Workers in cofferdams do not work in pressurized conditions.

Application:

- Caissons: Primarily used for creating foundations underwater.
- Cofferdams: Used for creating dry spaces in water for various construction activities.

Hazards in caisson & cofferdam construction

High Pressure and Decompression Sickness

- **Pressurized Environment:** Workers inside pneumatic (open) caissons operate in a pressurized environment. Rapid decompression can lead to decompression sickness or "the bends," a condition caused by the formation of nitrogen bubbles in the bloodstream.
- **Safety Precautions:** Strict safety protocols, including gradual decompression and monitoring of workers' health, are essential to prevent decompression-related health issues.

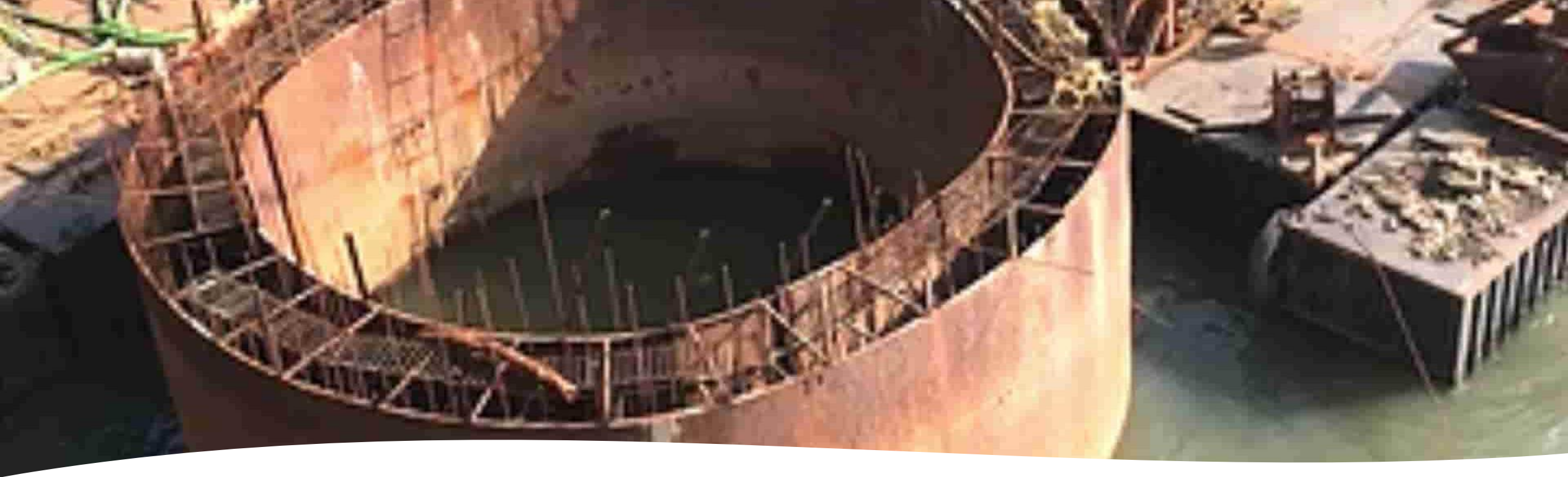


Hazards in caisson & cofferdam construction

Air Quality and Contaminants

- **Limited Ventilation:** The confined space of a caisson can result in limited air circulation and potential air quality issues.
- **Contaminants:** The excavation process may release contaminants, such as gases and dust, which can pose respiratory hazards to workers.





Hazards in caisson & cofferdam construction

Confined Space Risks

- **Limited Mobility:** Working in the confined space of a caisson can restrict the movement of workers, increasing the risk of injuries.
- **Emergency Evacuation:** Limited access and egress routes can hinder quick evacuation in case of emergencies.

Hazards in caisson & cofferdam construction

Falling Materials and Objects

- **Construction Debris:** Excavated materials and debris can pose a risk of falling onto workers inside the caisson.
- **Tools and Equipment:** Tools and equipment used in the construction process may also pose a hazard if not properly secured.



Hazards in caisson & cofferdam construction

Structural Failures

- **Collapse:** There is a risk of the caisson collapsing or failing during the construction process, especially if it encounters unstable soil conditions or excessive external pressures.
- **Instability:** The structural stability of the caisson and its ability to withstand external forces must be carefully monitored.

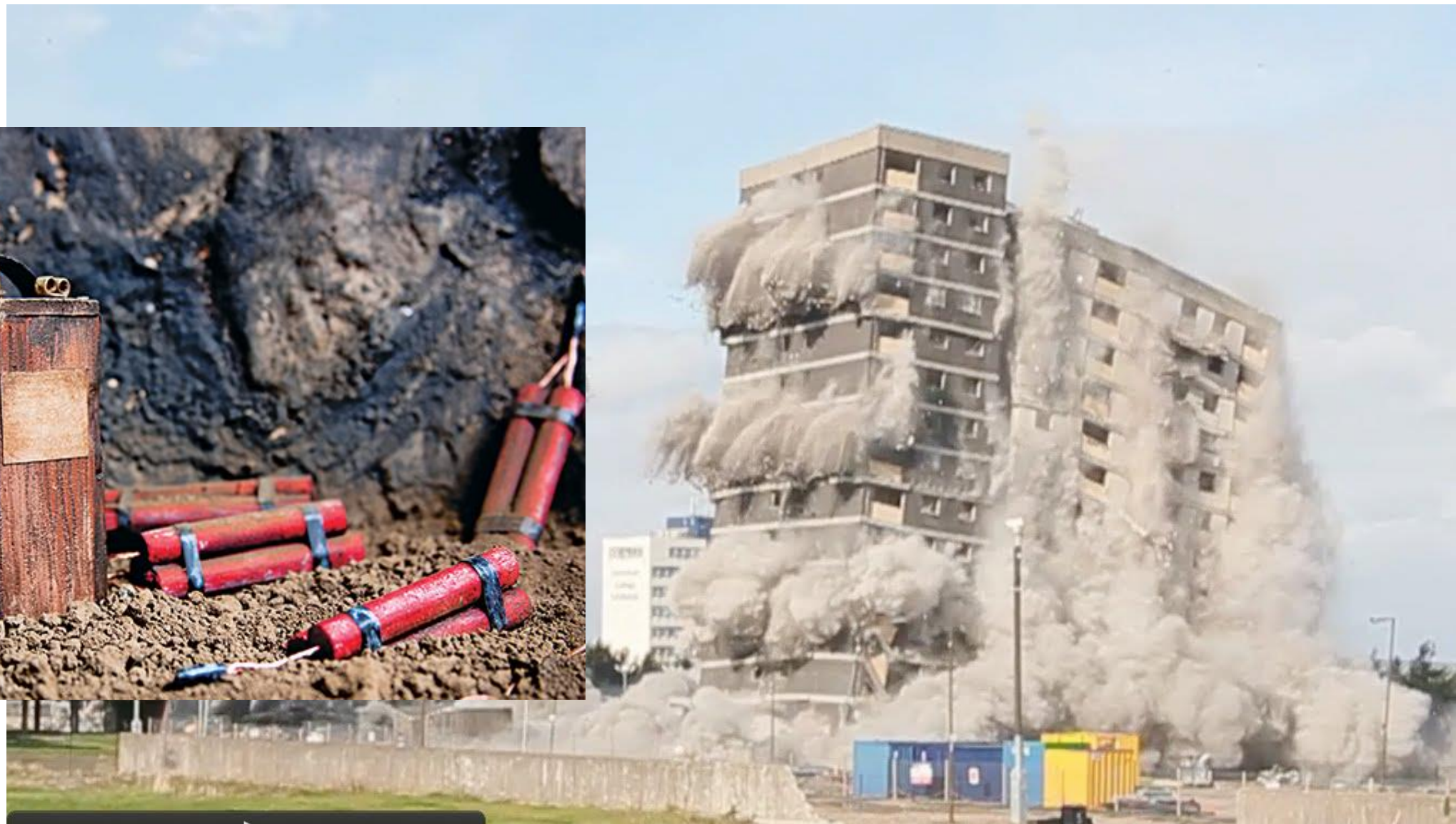


Hazards in caisson & cofferdam construction

Water Ingress

- **Flooding:** The caisson must remain watertight to prevent flooding. Any failure in the watertight seal can lead to flooding inside the caisson, posing a drowning risk for workers.





Blasting and the Use of Explosives

Hazards of Blasting and the Use of Explosives in construction

Flying Debris

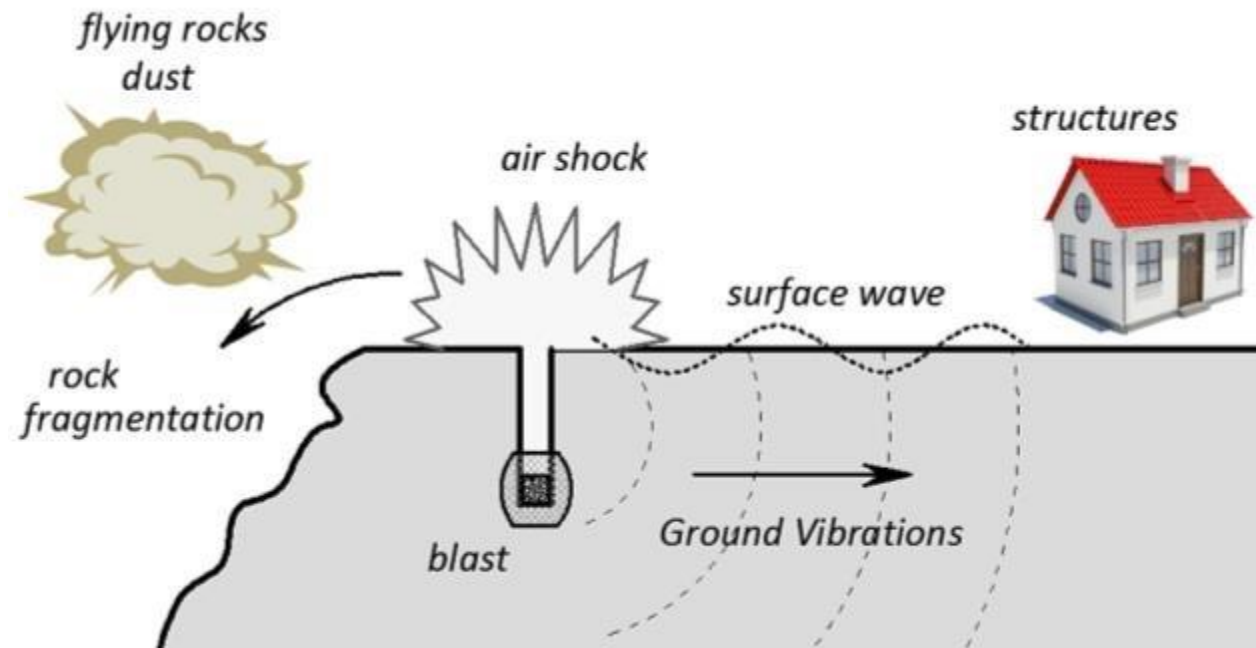
- **Projectile Hazard:** The detonation of explosives can propel rock fragments, soil, and other debris at high velocities, posing a risk to workers and nearby structures.



Hazards of Blasting and the Use of Explosives in Construction

Ground Vibration

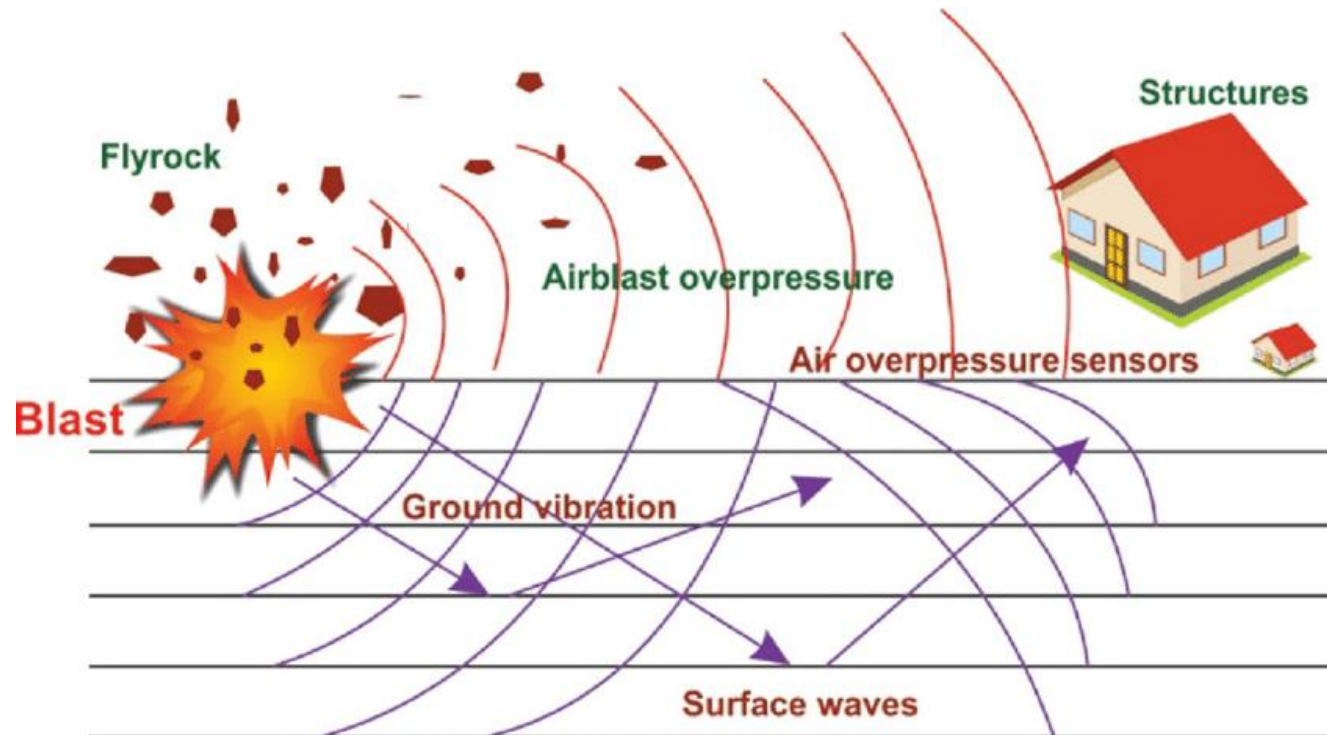
- **Structural Damage:** The shockwaves generated by blasting can cause ground vibrations that may lead to structural damage in nearby buildings, bridges, and infrastructure.



Hazards of Blasting and the Use of Explosives in Construction

Air Blast

- **Pressure Waves:** The release of energy during a blast produces pressure waves that can cause damage to structures, especially windows and fragile components, within the vicinity of the blast site.



Hazards of Blasting and the Use of Explosives in Construction

Toxic Fumes and Dust

- **Gas Emissions:** Blasting can release toxic gases and fumes, depending on the types of explosives used and the materials being blasted.
- **Dust Generation:** The process can generate dust, which may contain harmful particles, contributing to respiratory issues for workers and nearby residents.



Hazards of Blasting and the Use of Explosives in Construction

Initiation Failures

- **Misfires:** The initiation system of explosives may fail, resulting in misfires. Misfires pose a risk of delayed detonation, leading to unpredictable and potentially hazardous situations



Hazards of Blasting and the Use of Explosives in Construction

Overcharging

- **Excessive Explosives:** Using too much explosive material for a given blast can lead to larger-than-intended explosions, causing more significant safety risks and potential damage.



Hazards of Blasting and the Use of Explosives in construction

Flyrock

- **Uncontrolled Fragments:** Flyrock refers to fragments that are propelled away from the blast site. It can travel long distances, posing a serious hazard to people, structures, and equipment.



Hazards of Blasting and the Use of Explosives in construction

Poor Blasting Design

- **Inadequate Planning:** Improper design of the blast pattern, including hole placement, stemming, and timing, can result in uneven fragmentation, excessive ground vibration, and other safety hazards.



Hazards of Blasting and the Use of Explosives in construction

Electrical Hazards

- **Detonation Systems:** Electrical initiation systems used in blasting introduce the risk of electrical hazards, especially in the presence of water or other conductive materials.



Hazards of Blasting and the Use of Explosives in construction

Inadequate Warning Systems

- **Insufficient Notifications:** Inadequate warning systems and communication with nearby residents and workers can lead to unexpected exposure to blasts.



Hazards of Blasting and the Use of Explosives in construction

Unsafe Storage and Handling

- **Explosive Storage:** Improper storage of explosives can lead to accidental detonation or theft, posing serious safety risks.
- **Handling Procedures:** Incorrect handling procedures during transportation and loading of explosives increase the risk of accidents.



Video

What are the precautions to be taken in the process of blasting? Blasting Safety | Blasting Process

- https://www.youtube.com/watch?v=3ROhBhnNDbQ&ab_channel=HSEMANAGEMENTSYSTEM

