شركة المتطور للإستشارات الهندسية
Advanced Company For Engineering Consultancy

BRIDGES

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DEFINITIONS:

Bridge: Any structure having an opening not less than 6.1m(20 ft). Bridges are structures built to span physical obstacles like rivers, ravines, or roads, enabling the passage of people, vehicles, or goods from one side to the other. They come in various designs, including beam, arch, suspension, and cable-stayed bridges, each suited to specific needs and conditions. Bridges play a crucial role in transportation and connectivity.

Quality in concrete bridges is essential to ensure their structural integrity, durability, and safety. Here are some key aspects of quality in concrete bridge construction.

01 Material Selection

Choosing high-quality concrete and reinforcing materials is crucial. The concrete mix should meet specific strength and durability requirements, and reinforcing steel should be corrosion-resistant

1-1 Concrete Mix Design

The concrete mix design is one of the most crucial elements. It involves determining the proportion of different ingredients in the concrete, including cement, aggregates, water, and admixtures.

The mix design should consider the specific requirements of the bridge, such as strength, durability, and exposure to environmental factors.

1-2 Cement Type

The type of cement used, such as Portland cement, can impact the concrete's performance. Different types of cement offer varying levels of strength and durability.

1-3 Aggregates

Aggregates, including coarse and fine aggregates, are essential components of concrete. They should be sourced from high-quality materials and be free from impurities. - The gradation and properties of aggregates can affect the workability and strength of the concrete.

1-4 Reinforcing Materials

Reinforcing materials, typically steel bars or mesh, are used to enhance the tensile strength of concrete. It's crucial to use high-quality, corrosion-resistant reinforcing steel. - The placement and spacing of reinforcing materials should follow engineering specifications to ensure structural integrity.

1-5 Admixtures

Admixtures are chemical additives used to modify the properties of concrete. They can enhance workability, reduce water content, and improve resistance to environmental factors. - Proper selection and dosage of admixtures can optimize concrete performance.

1-6 Durability Enhancements

For bridges exposed to harsh environmental conditions, such as marine environments or areas with high chloride exposure, supplementary cementitious materials (SCMs) like fly ash or silica fume can be added to enhance durability.

1-7 Testing and Quality Assurance

Materials should undergo rigorous testing to ensure they meet specified standards and project requirements. This includes testing for compressive strength, durability, and consistency.

1-8 Sustainability and Environmental Considerations

Sustainable practices in material selection can include using recycled aggregates and incorporating environmentally friendly cements. These measures can reduce the environmental impact of bridge construction.

1-9 Local Conditions

Consideration of local conditions is vital. The choice of materials may vary depending on factors such as climate, geological conditions, and availability of resources.

1-10 Supplier Qualification

The suppliers of concrete and reinforcing materials should be qualified and reliable. It's essential to ensure a consistent supply of high-quality materials.

1-11 Quality Control During Mixing and Placement

Quality control should continue during the mixing and placement of concrete. This involves monitoring the mixing process, measuring the consistency of the mix, and ensuring proper curing techniques.

1-12 Documentation and Record Keeping

Comprehensive documentation of material selection, testing, and quality control measures should be maintained for reference and future maintenance.

Choosing the right materials and managing them properly during construction are essential for the quality and longevity of concrete bridges. A well-designed mix and quality control procedures will help ensure that the bridge meets its intended design life and withstands environmental and traffic-related stresses.

02 Proper Design

A well-engineered design is fundamental. It should consider factors such as the bridge's load-bearing capacity, environmental conditions, and seismic resilience.

DESIGN PHILOSOPHY

Bridges shall be designed for specified limit states to achieve the objectives of constructability, safety and serviceability, with due regard to issues of inspectability, economy, and aesthetics

Minimum Depths for Constant Depth Supcrstructurt

Superstructure		Minimum Depth (Including Deck) When variable depth members are used, values may be adjusted to account for changes in relative stiffness of positive and negative moment sections	
Material	Type	Simple Spans	Continuous Spans
Reinforced Concrete	Slabs with main reinforcement parallel to traffic	$\frac{1.2(S+10)}{30}$	$\frac{S+10}{30} \geq 0.54$ ft.
	T-Beams	$0.070L$	$0.065L$
	Box Beams	$0.060L$	$0.055L$
	Pedestrian Structure Beams	$0.035L$	$0.033L$
Prestressed Concrete	Slabs	$0.030L \geq 6.5$ in.	$0.027L \geq 6.5$ in.
	CIP Box Beams	$0.045L$	$0.040L$
	Precast I-Beams	$0.045L$	$0.040L$
	Pedestrian Structure Beams	$0.033L$	$0.030L$
	Adjacent Box Beams	$0.030L$	$0.025L$
Steel	Overall Depth of Composite I-Beam	$0.040L$	$0.032L$
	Depth of I-Beam Portion of Composite I-Beam	$0.033L$	$0.027L$
	Trusses	$0.100L$	$0.100L$

Load and Load Designation

PERMANENT LOADS

CR =FORCE EFFECTS DUE TO CREEP

DD =DOWN DRAG FORCE

DC =DEAD LOAD OF STRUCTURAL COMPONENTS AND

DW =DEAD LOAD OF WEARING SURFACES AND UTILITIES

EH =HORIZONTAL EARTH PRESSURE LOAD

EL =MISCELLANEOUS LOCKED-IN FORCE EFFECTS

ES =EARTH SURCHARGE LOAD

EV =VERTICAL PRESSURE FROM DEAD LOAD OF EARTH FIJI

PS =SECONDARY FORCES FROM POSTTENSIONING

SH =FORCE EFFECTS DUE TO SHRINKAGE

Transient Loads

BL =BLAST LOADING
BR =VEHICULAR BRAKING FORCE
CE =VEHICULAR CENTRIFUGAL FORCE
CT =VEHICULAR COLLISION FORCE
CV =VESSEL COLLISION FORCE
EQ =EARTHQUAKE LOAD
FR =FRICTION LOAD
IC =ICE LOAD
=VEHICULAR DYNAMIC LOAD ALLOWANCE
=VEHICULAR LIVE LOAD
LS =LIVE LOAD SURCHARGE
PL =PEDESTRIAN LIVE LOAD
SE =FORCE EFFECT DUE TO SETTLEMENT
TG =FORCE EFFECT DUE TO TEMPERATURE GRADIENT
TU =FORCE EFFECT DUE TO UNIFORM TEMPERATURE
WA =WATER LOAD AND STREAM PRESSURE
WL =WIND ON LIVE LOAD
WS =WIND LOAD ON STRUCTURE

03 Construction Standards

Adherence to construction standards and codes is vital. This includes following guidelines set by organizations like the American Association of State Highway and Transportation Officials (AASHTO) or (ACI).

04 Quality Control and Inspection

Rigorous quality control during construction is necessary. Regular inspections, testing of materials, and monitoring construction processes can help identify and address any issues early.

Quality control (QC) is a critical process in construction, including concrete bridge construction, that focuses on monitoring and ensuring that the project meets specified quality standards and requirements. Here are more details about quality control in the context of concrete bridges:

1. Inspection and Testing
2. Documented Procedures
3. Construction Monitoring

4. Defect Identification and Correction
5. Adherence to Standards and Codes
6. Quality Control Plans
7. Testing and Inspection Frequency
8. Documentation and Records
9. Communication
10. Audits and Reviews
11. Third-Party Inspection
12. Continuous Improvement

In summary, quality control in concrete bridge construction involves a systematic approach to monitoring, inspecting, and testing to ensure that all aspects of the project, from materials to workmanship, meet specified quality standards and project requirements. It is an essential part of ensuring the safety, durability, and functionality of the bridge.

05 Skilled Workforce

Skilled and experienced construction workers and engineers are essential for maintaining quality. They should be well-trained in concrete construction techniques.

06 Proper Curing

Adequate curing of concrete is crucial for its strength and durability. It involves keeping the concrete moist and at the right temperature during the initial curing period.

07 Maintenance and Monitoring

After construction, regular maintenance and structural monitoring are essential to address wear and tear, prevent corrosion, and ensure the long-term safety of the bridge.

08 Environmental Considerations

Bridges should be designed and constructed with environmental factors in mind, such as minimizing the impact on nearby ecosystems and using sustainable construction practices.

09 Safety

Safety measures during construction and for ongoing maintenance are vital to protect both workers and the public.

10 Risk Assessment

A comprehensive risk assessment should be conducted to identify potential vulnerabilities and ensure the bridge's resilience against natural disasters and extreme events.

Overall, quality in concrete bridge construction involves a combination of design, materials, workmanship, and ongoing maintenance to ensure the bridge's long-term safety and functionality.

The role of the consultant in the quality: of bridges work is crucial to ensure the quality and safety standards. Here are some functions of the consultant in this context:

1. Bridge Design

The consultant participates in designing the bridge in line with engineering specifications and standards. The design should ensure the use of high-quality materials and meet strength and durability requirements.

2. Material Review

The consultant reviews and selects the materials used in the bridge construction based on quality specifications and compliance with standard standards.

3. Construction Supervision

The consultant oversees the construction operations to ensure they are carried out according to the approved design and quality standards. They monitor the execution of work and necessary tests.

4. Quality Assurance

The consultant helps in establishing quality assurance plans and ensures their proper implementation to verify quality and safety.

5. Maintenance Monitoring

After construction, the consultant can assist in developing regular maintenance plans to preserve the long-term quality and safety of the bridge.

6. Problem Solving

In case quality issues or concerns arise, the consultant analyzes them and provides the necessary engineering solutions.

In general, the consultant's role in the quality of concrete bridges work is to ensure that all activities are in compliance with standards and specifications and to ensure the highest levels of quality and safety in the project."

HOW ARE BRIDGES USED?

- Walkways
- Highways/Roads
- Railways
- Pipelines
- Connecting Lands
- Crossing Rivers
- Stadiums
- Roofs

What Makes a Bridge Stay Up?

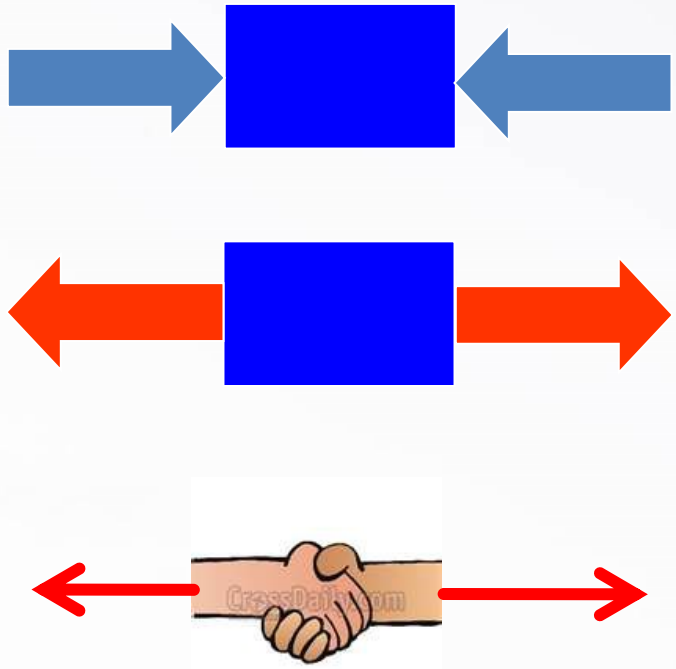
Forces – 2 Types

1st - Compression

-Pushing or Squeezing Force

2nd - Tension

-Pulling or Stretching Force



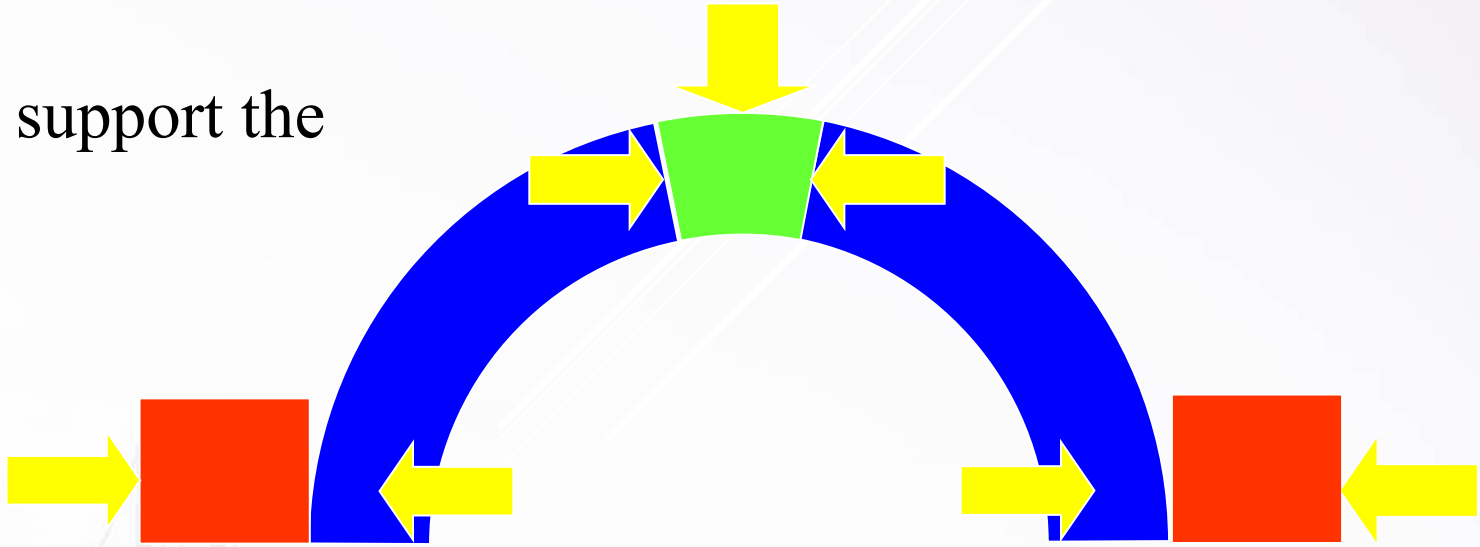
Types Of Bridges

- Arch Truss
- Cantilever
- Cable-Stayed
- Suspension
- Beam
- Moveable

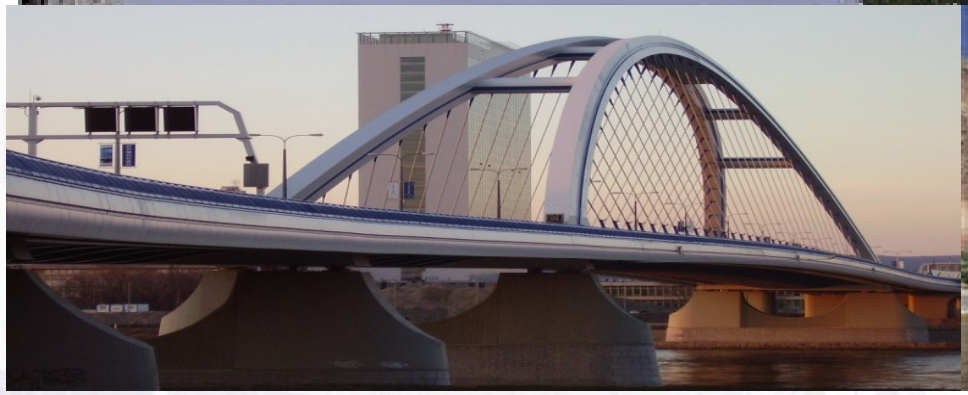
ARCH BRIDGES

Keystone – the wedge-shaped stone of an arch that locks its parts together

Abutments – the structures that support the ends of the bridge



ARCH BRIDGES



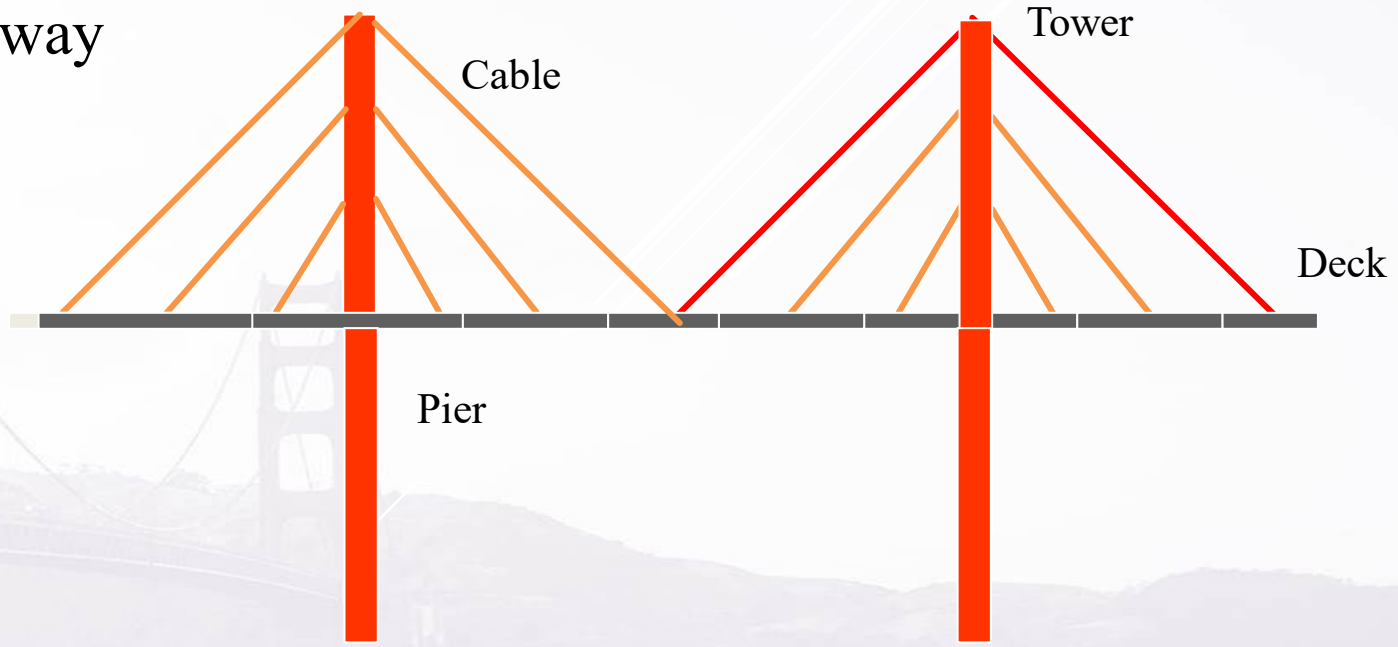
CABLE-STAYED BRIDGES

Piers – Supports the Towers

Towers – Support the Cables

decking is suspended Cables – Thick Steel Ropes from which the

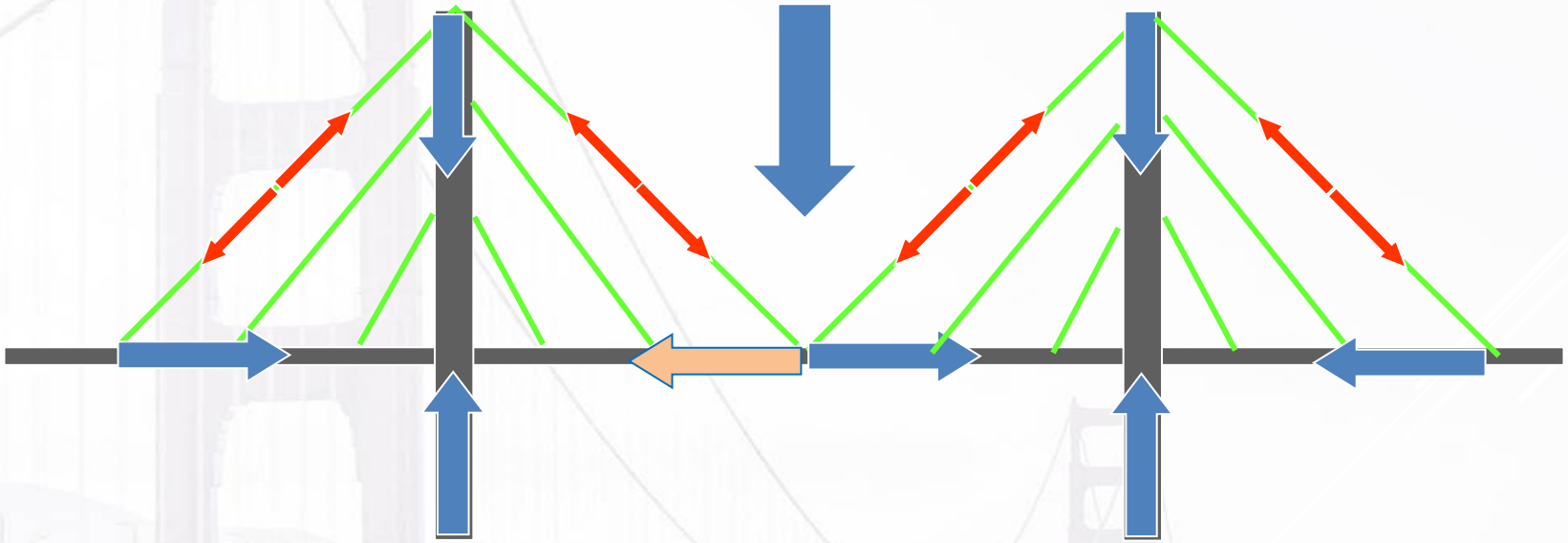
Decking – Supports the Roadway

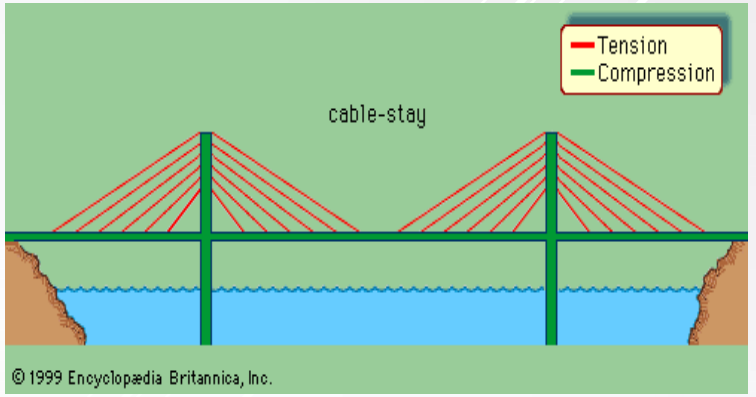


CABLE-STAYED BRIDGES

HOW DOES IT WORK?

TENSION & COMPRESSION

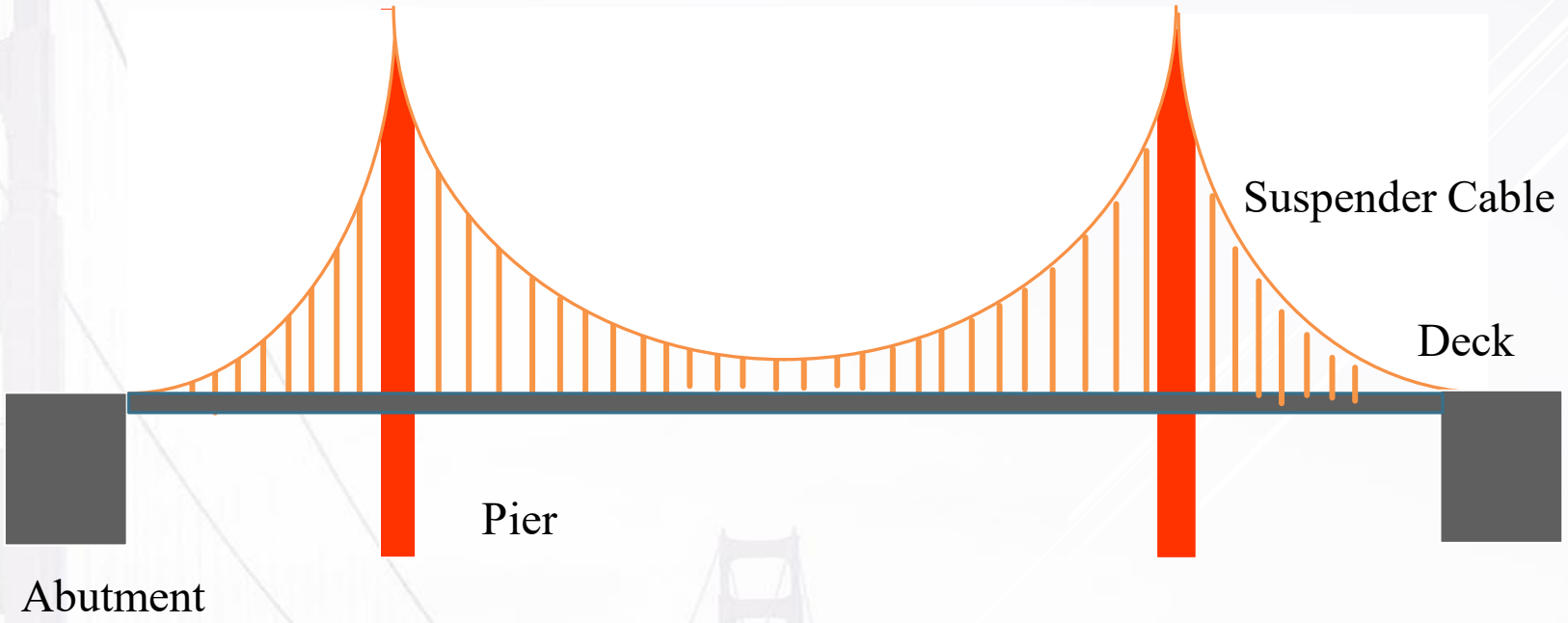




CABLE-STAYED BRIDGES

CABLE-STAYED BRIDGES

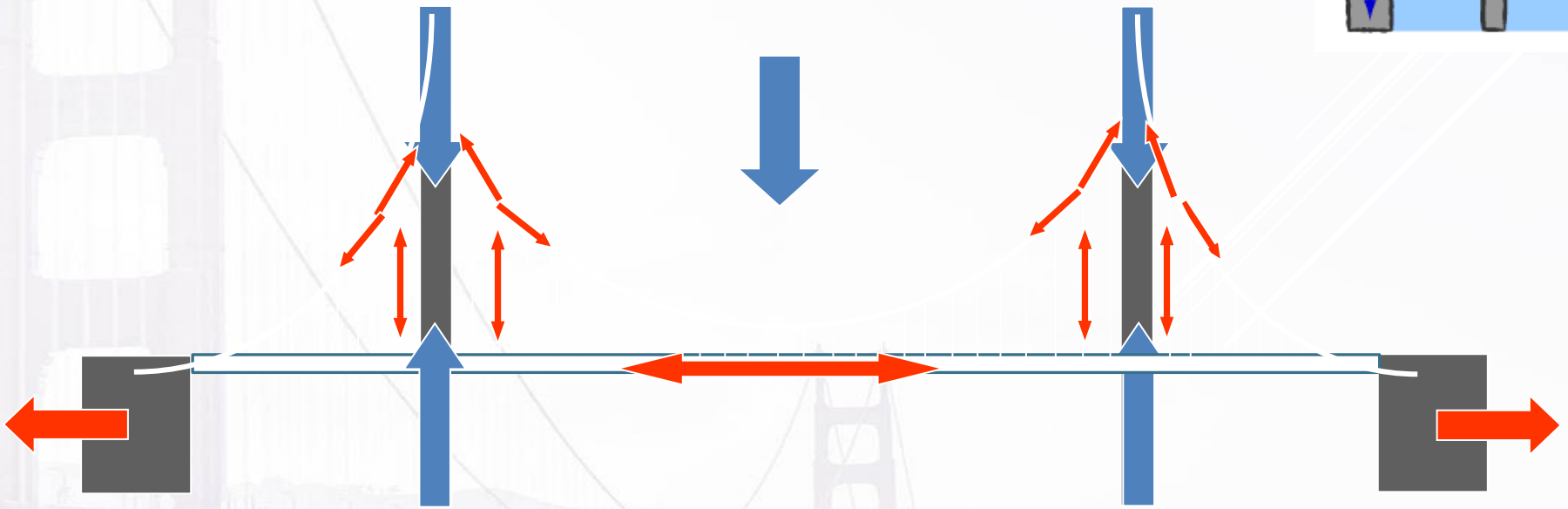
SUSPENSION BRIDGES



SUSPENSION BRIDGES

How does it Work?

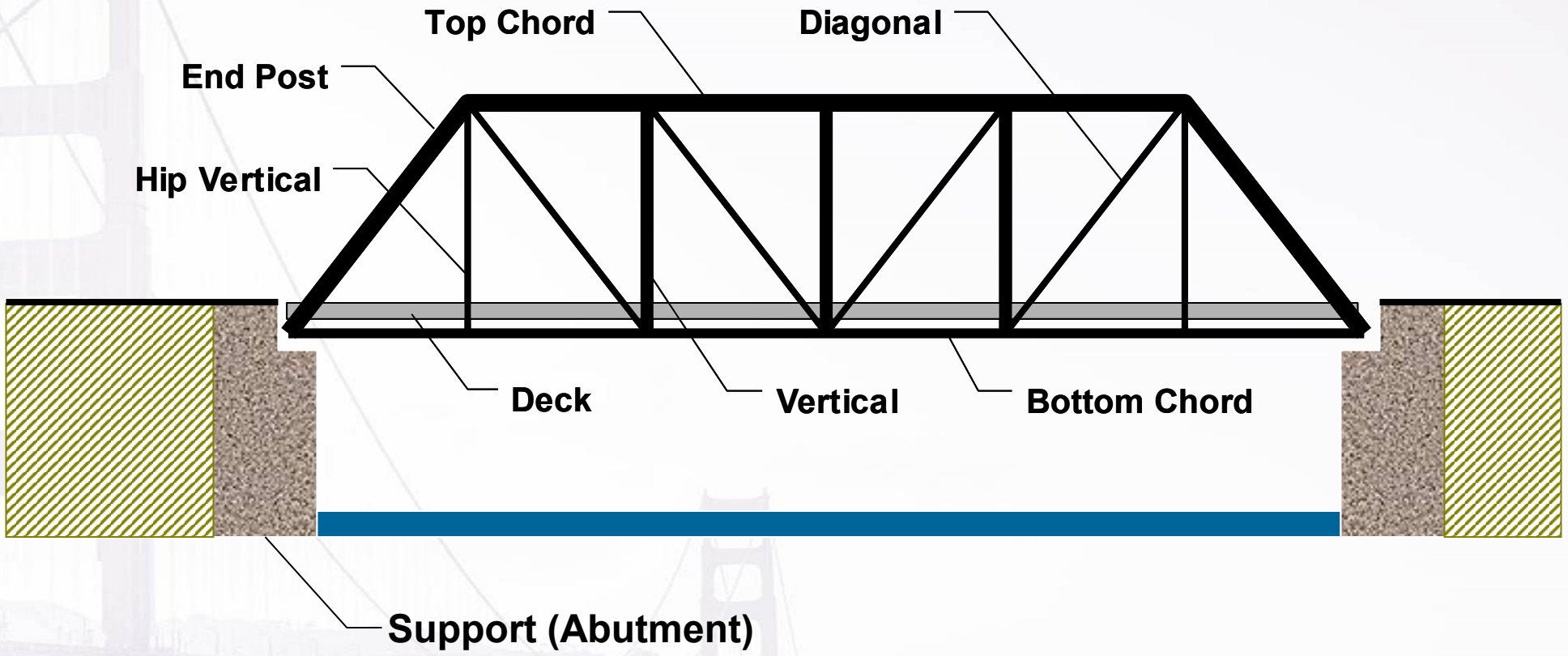
Tension & Compression



SUSPENSION BRIDGES

SUSPENSION BRIDGES

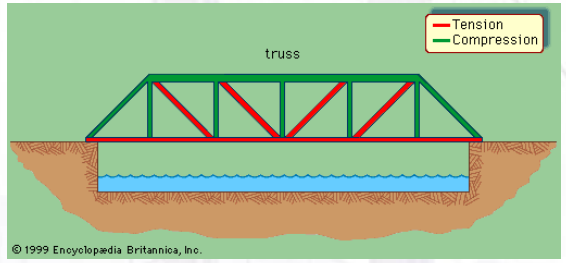
TRUSS BRIDGE

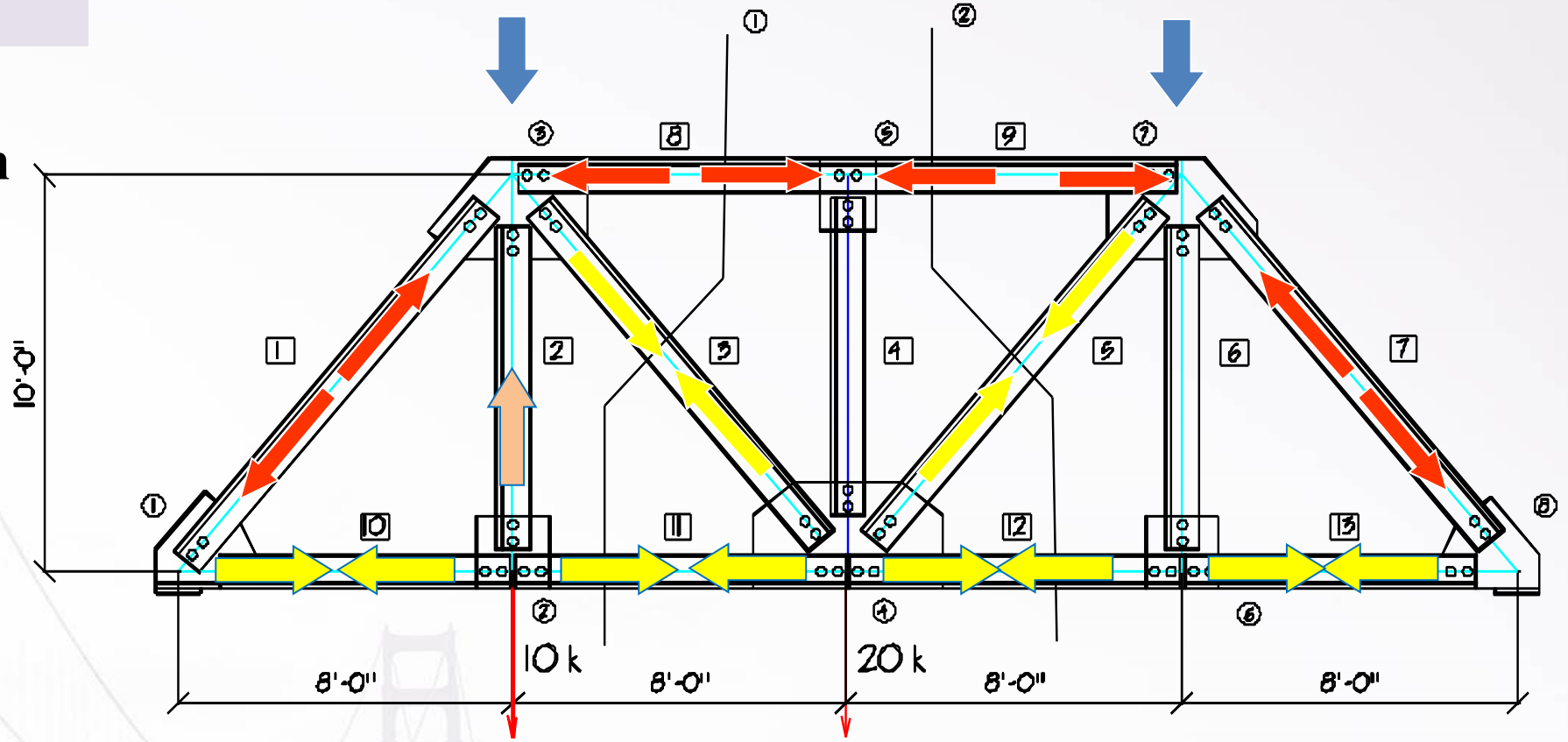


TRUSS BRIDGE

How does it Work?

Tension & Compression



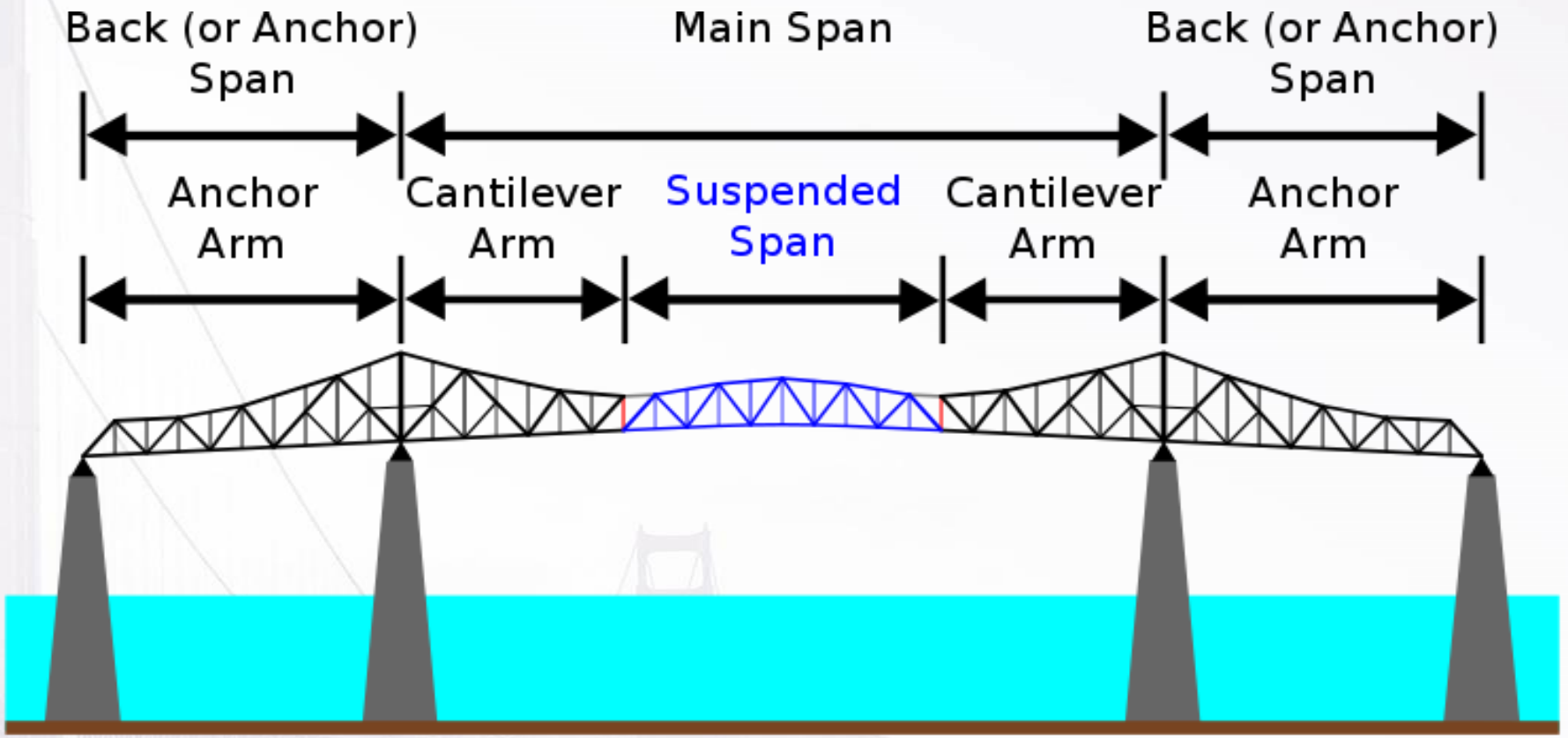


PRATT TRUSS

TRUSS BRIDGE

TRUSS BRIDGE

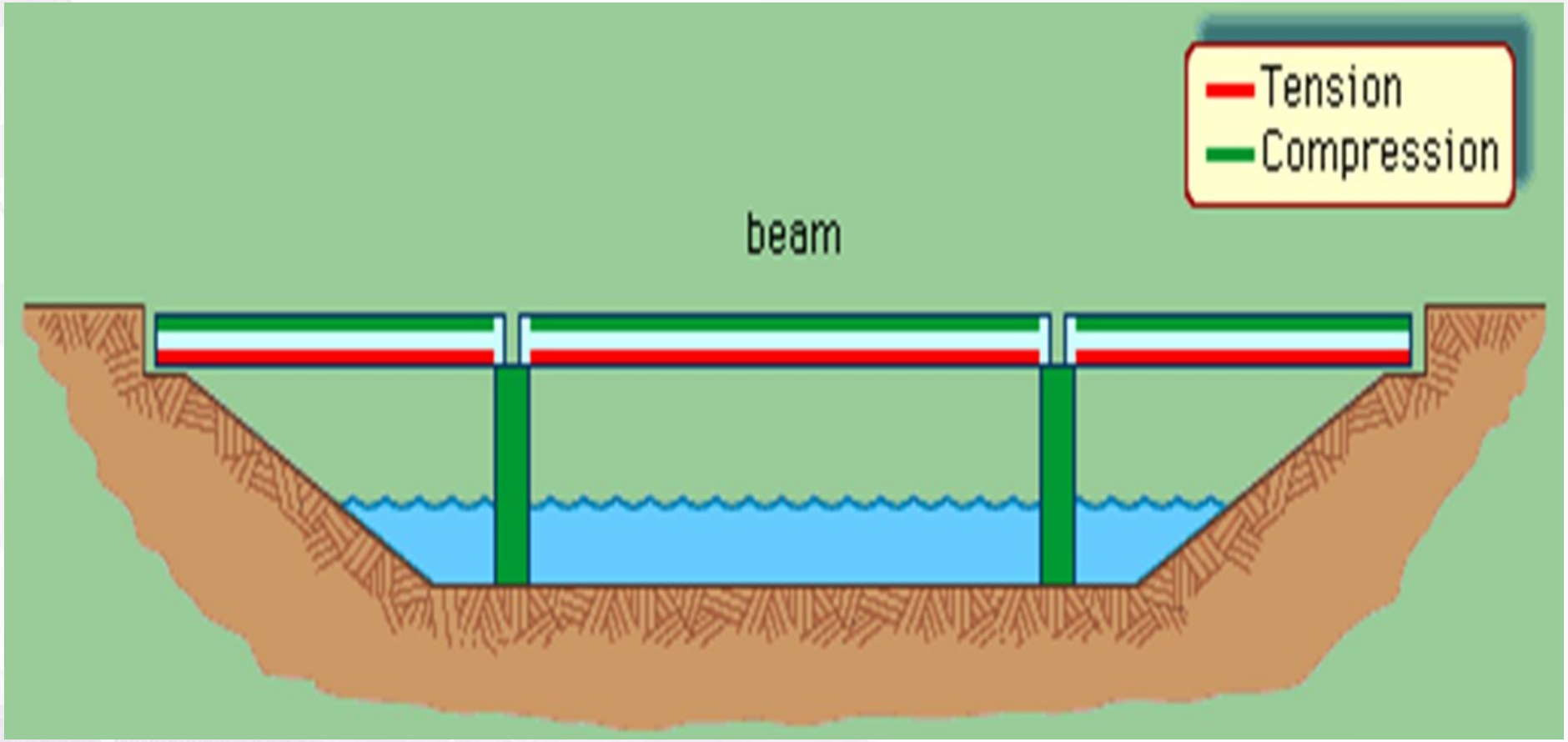
CANTILEVER BRIDGE



CANTILEVER BRIDGE

CANTILEVER BRIDGE

BEAM BRIDGE



BEAM BRIDGE


وزارة النقل
TRANSPORT MINISTRY
AdEC
مشروع استكمال طريق الدائري الثالث بالمدينة المنورة بطول (10) كم

BEAM BRIDGE

MOVEABLE BRIDGES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