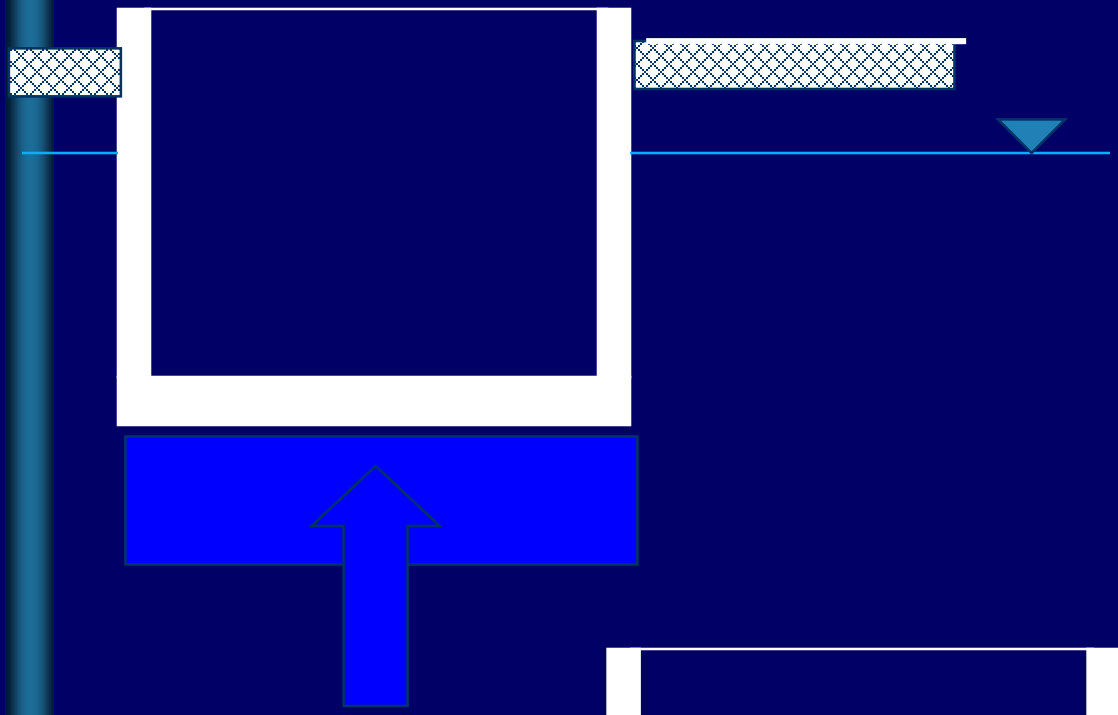
FLOTATION

- As empty tank constructed in water bearing soil will tend to move upwards, in the ground or float. This tendency must be counteracted by ensuring that the weight of the empty tank is greater than the uplift.
- The factor of safety varies between 1.05-1.25.
- The weight of the tank may be increased by thickening the floor or by providing a heel on the perimeter of the floor. ※

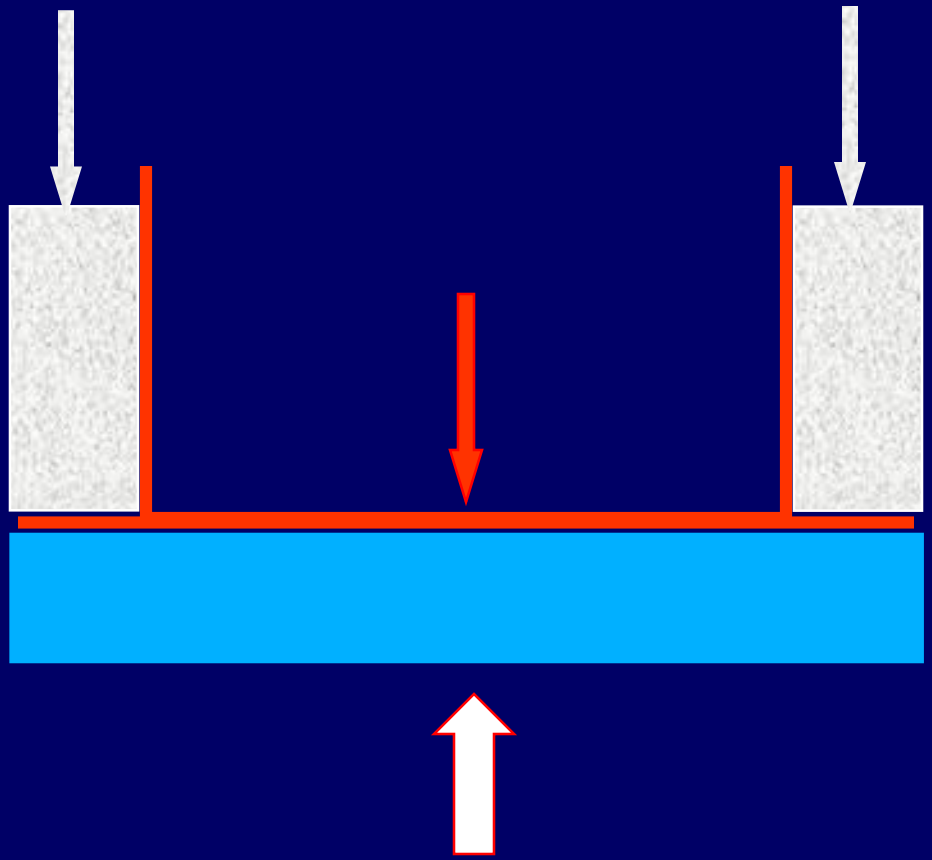
FLOTATION



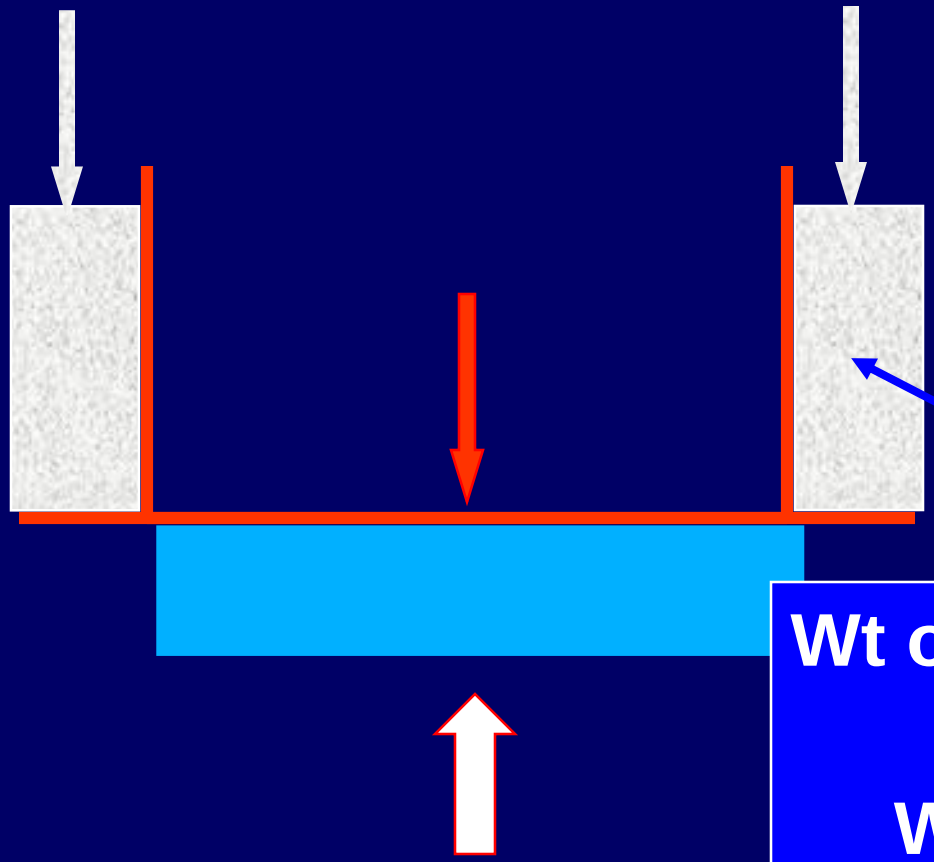
Floor
Thickened

Heel
Added

Flotation



Flotation



Wt of Saturated Soil

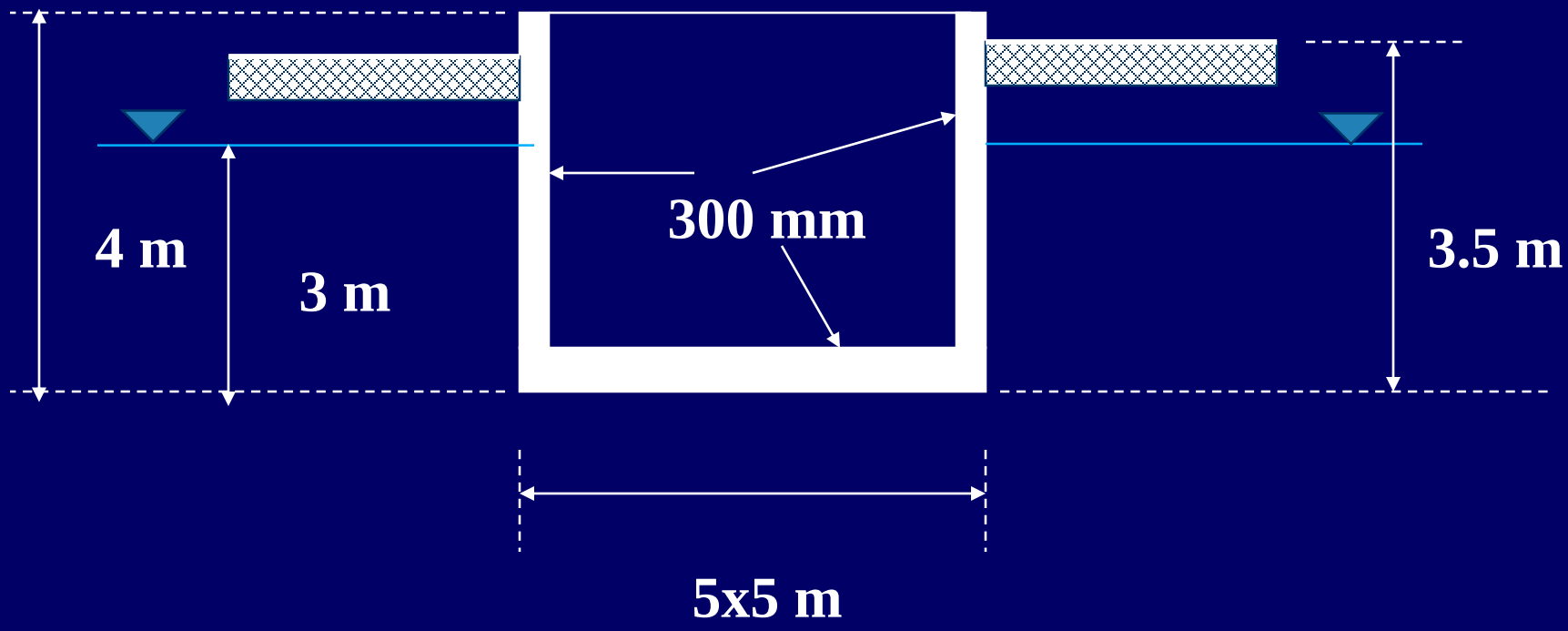
-

Wt of Water

Soil above heel is saturated

Flotation

Example



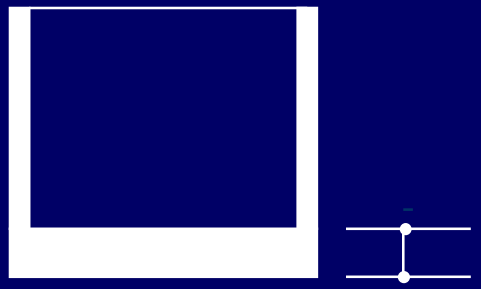
FOS vs Floatation 1.20

Calculations

Weight of Empty Tank		
Floor	24 x 0.3 x 5.0 x 5.0	= 180 kN
Walls	24 x 4 x (0.3 x 4.7 x 3.7)	= 500 kN
Total Weight		= 680 kN
Uplift due to ground water		
	=10 x 5.0 x 5.0 x 3.0	= 750 kN
Required Dead Weight = 1.20x750		= 900 kN

Solution 1

Thickened Floor



0.3 + t m

Increase Thickness of Floor (add t meters)

24 x 4 x (0.3 x 4.7 x 3.7) + 24 x [5 x 5 x (0.3+t)]

1.2 x 10 x (3+t) x (5x5)

Equating the two gives t = 0. m or mm

Solution 2

Provide B m Heel Around The Tank

Weight of Soil = 18 kN/m^3

Weight of concrete

$\underline{24 \times 4 \times 0.3 \times 3.7 \times 4.7}$ + 24 x (5+2B) x (5+2B) x 0.3

Weight of Soil on Heel = 18 x(4 x (5+B) x B x 3.2)

Uplift=1.2 x 10 x 3.5 x (5+2B)x (5+2B)

Equate the two to obtain B

JOINTS

- Construction Joints
- Contraction Joints
- Expansion Joints (should be avoided as far as possible)

Movement Joints

JOINTS

- It is rarely possible to build an RC structure in one piece.
- It is therefore necessary to design and locate joints which allow the contractor to construct the elements of the structure in convenient sections.
- In normal structures , the position of construction joints is specified in general terms by the designer.
- And the contractor decides on the number of joints and their precise location subject to final approval by the designer. ※

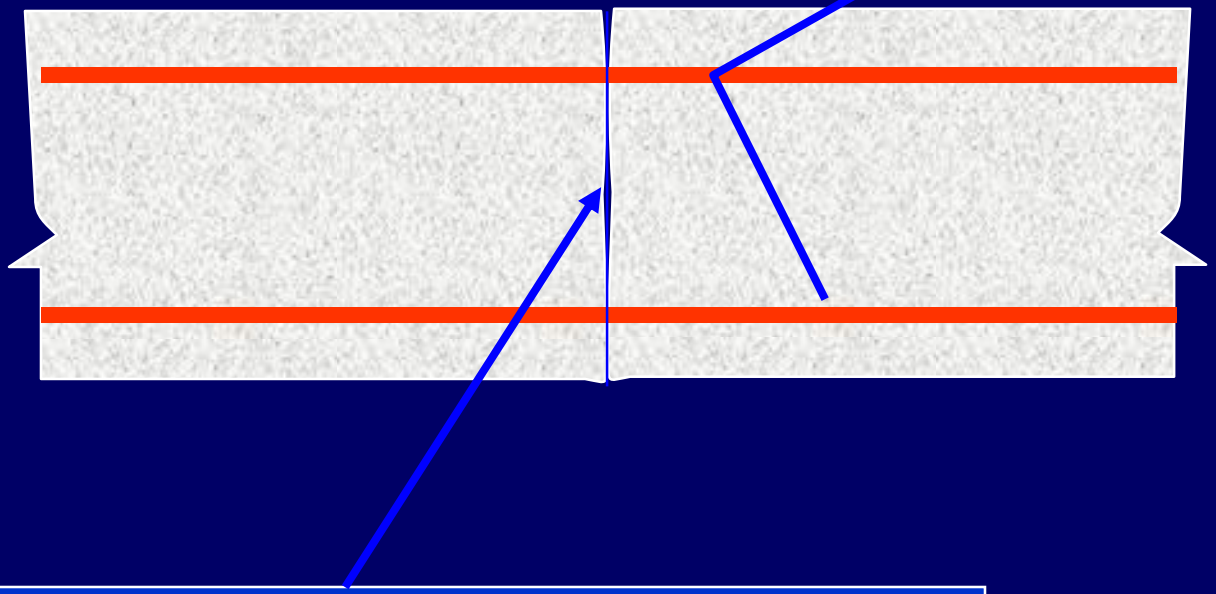
JOINTS

- In liquid retaining structures this approach is not satisfactory.
- The design of the structure against early thermal movements and shrinkage is closely allied to the frequency and spacing of all types of joints.
- And it is mandatory for the designer to specify on the drawings exactly where construction joints (or other joints) will be located.
- Construction joints are specified where convenient breaks in placing concrete are required.※

CONSTRUCTION JOINTS

- Concrete is placed separately on either side of a construction joint, but the reinforcement is continuous through the joint.
- At a horizontal construction joint, the free surface of the concrete must be finished to a compacted level surface.
- At a junction between a base slab and wall, it is convenient to provide a short kicker which enables formwork for the walls to be placed accurately and easily.
- A vertical joint is made with formwork.※

CONSTRUCTION JOINTS



CONSTRUCTION JOINTS

- Construction joints are not intended to accommodate movement across the joint but, due to the discontinuity of the concrete, some slight shrinkage may occur.
- This is reduced by proper preparation of the face of the first placed section of concrete to enhance adhesion between the two concrete faces.
- Joint preparation consists in removing the surface laitance from the concrete without disturbing the particles of aggregate. ※

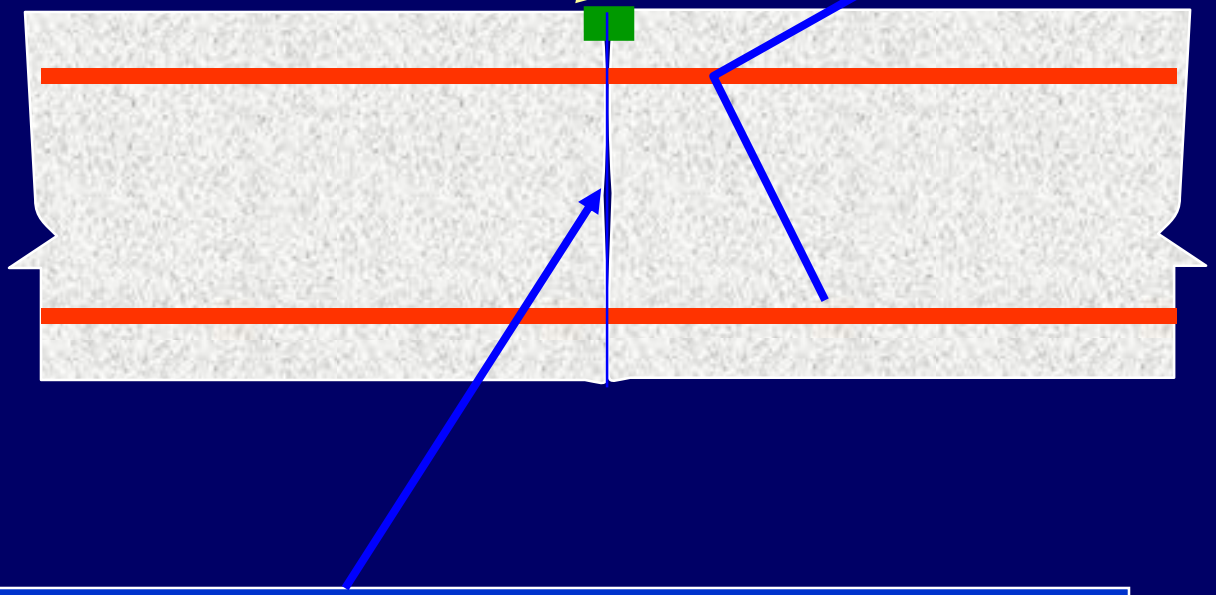
CONSTRUCTION JOINTS

- It is preferable to carry out the treatment when the concrete is at least 5 days old, either by sandblasting or scabbling with a small air tool.
- The use of retarders painted on the formwork is not recommended, because of the possibility of contamination of the reinforcement passing through the end formwork.
- The face of construction joint must be flat.
- If a construction joint has been properly designed, prepared and constructed, it will retain liquid without a water-stop .※

CONSTRUCTION JOINTS

Joint sealing compound

Steel continuity



Concrete joint surface prepared for subsequent continuity

Extra protection may be provided by sealing the surface.

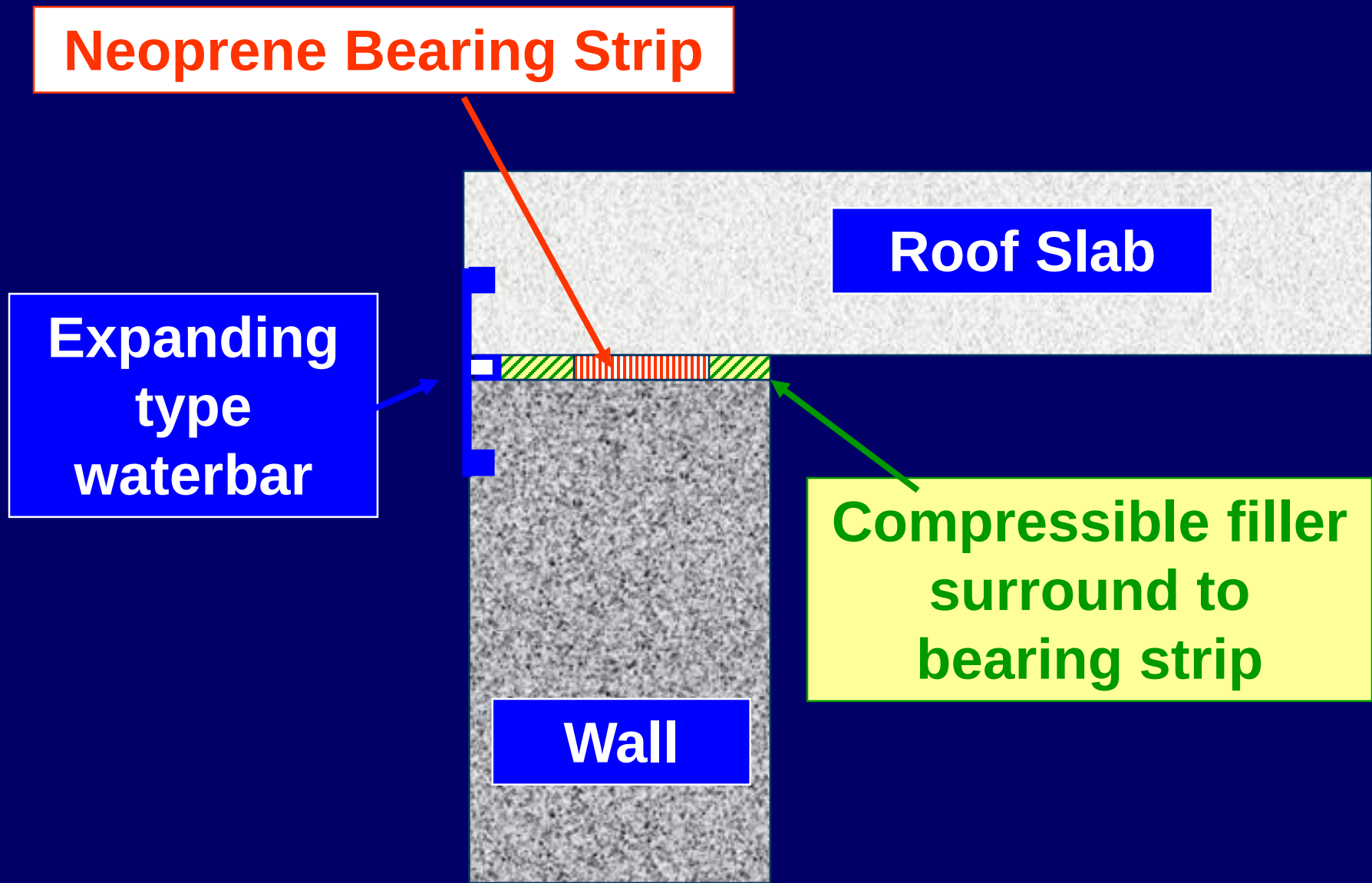
MOVEMENT JOINTS

- Movement joints are designed to provide a break in the continuity of a slab, so that relative movement may occur across the joint in the longitudinal direction.
- The joints may provide for the two faces to move apart (contraction joints) or, if an initial gap is created, the joint faces are able to move together (expansion joints).※

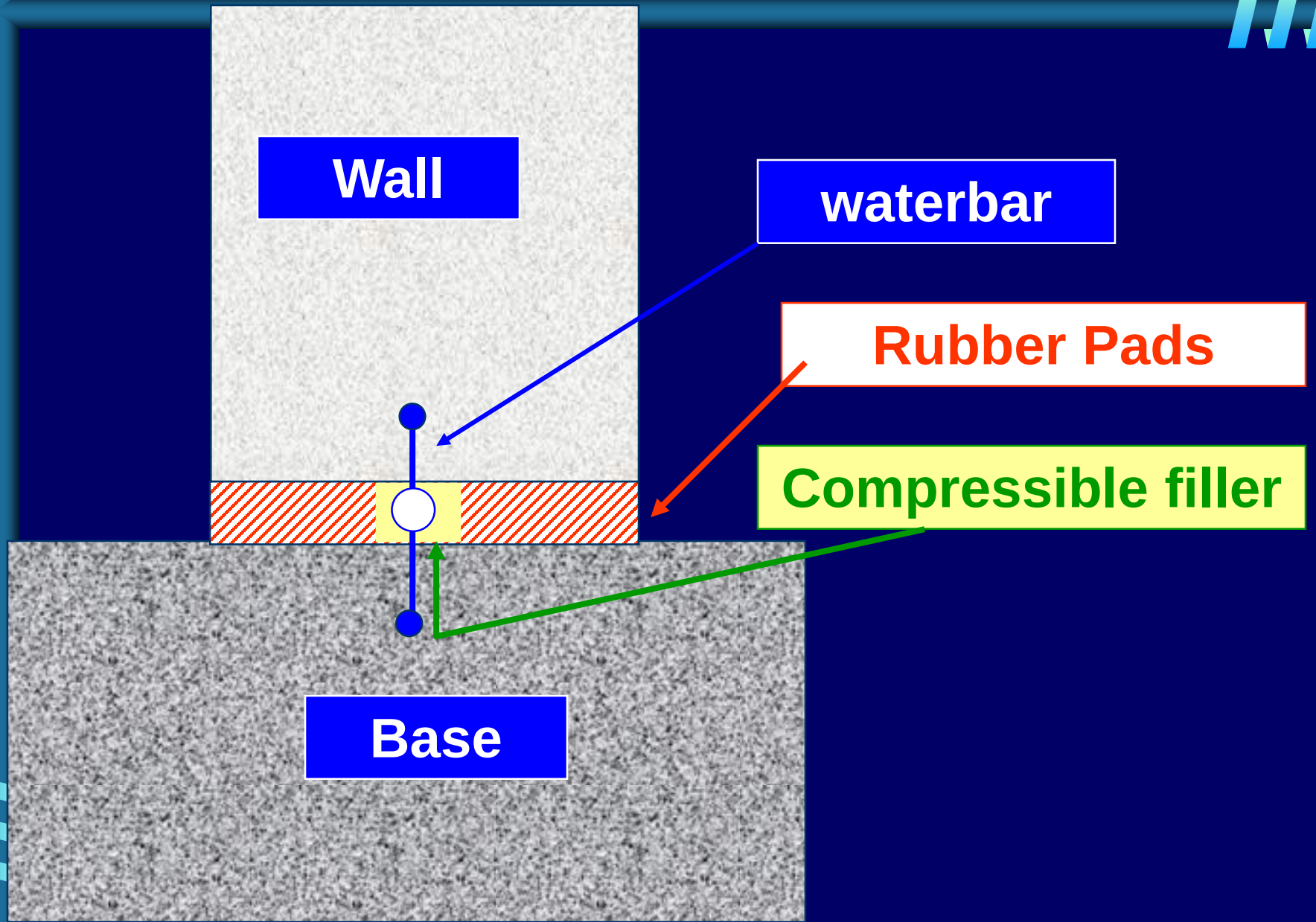
CONTRACTION JOINTS

- Contraction joints are divided into
  - Complete Contraction Joints
  - Partial Contraction Joints
- Other types of movement joints are needed at the junction of a wall and roof slab. (as follows)※

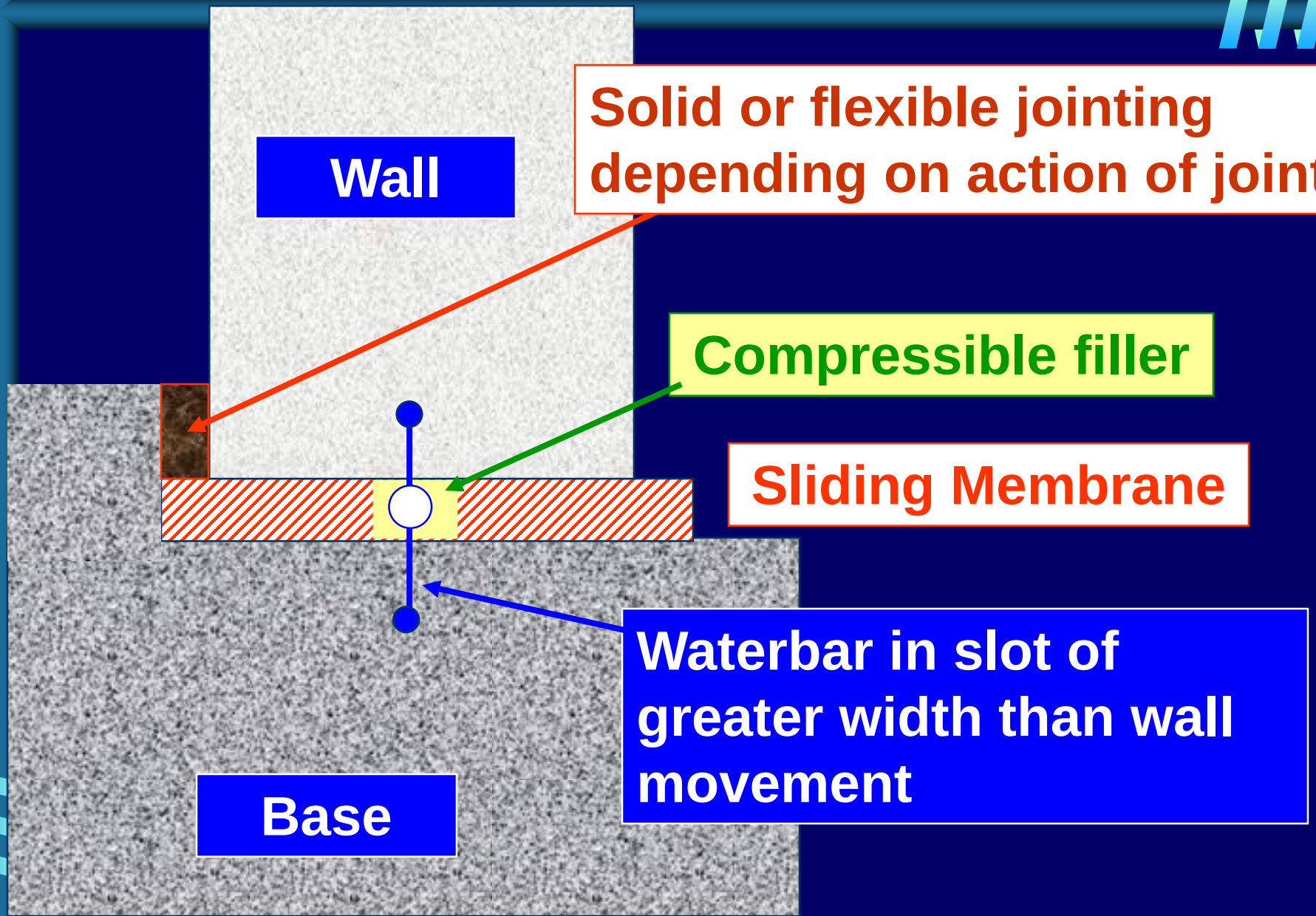
Movement Joint between Wall and Roof slab



Movement Joint between Wall and base slab (Prestressed Tank)

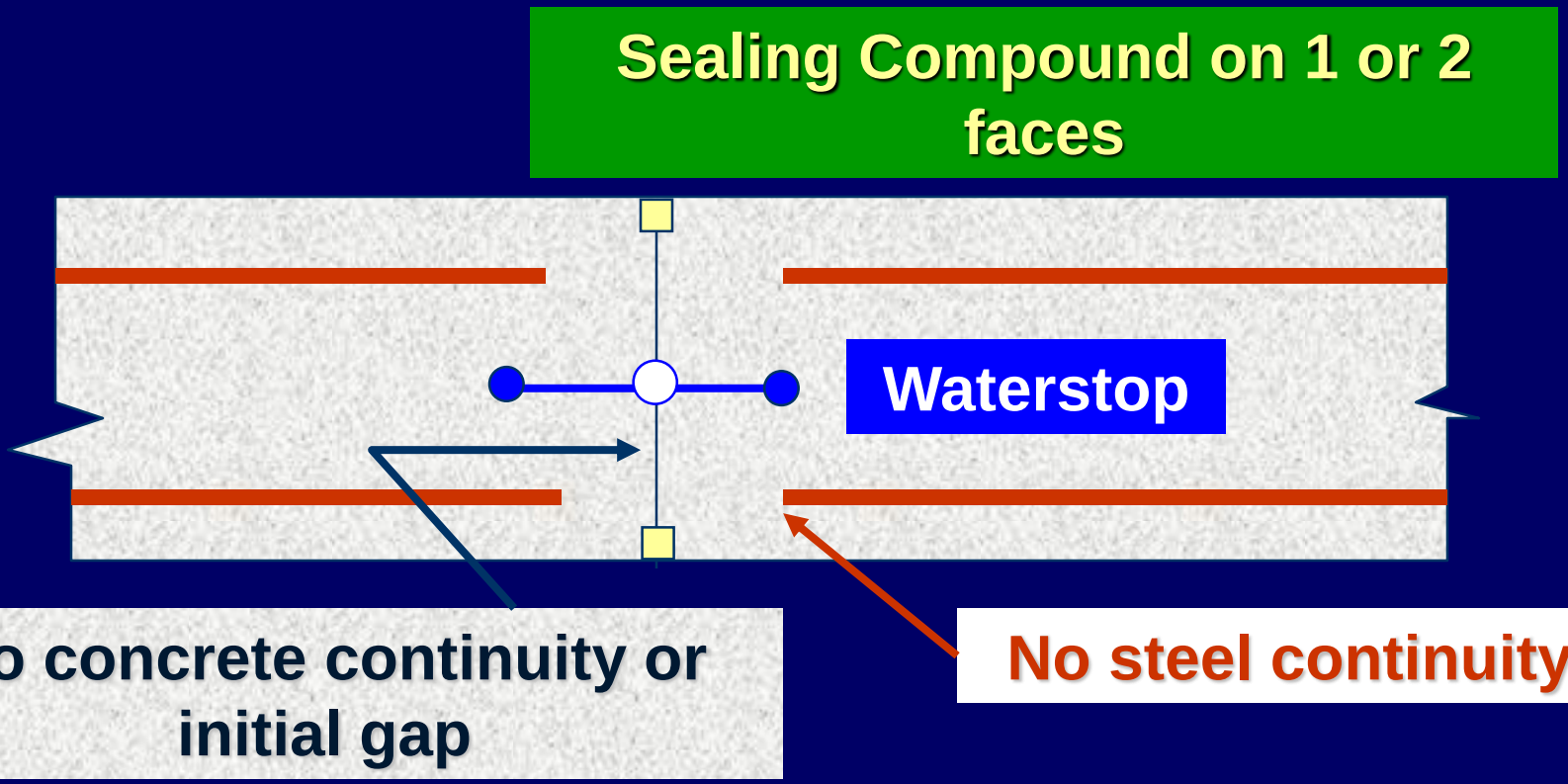


Movement Joint between Wall and base slab (Prestressed Tank)



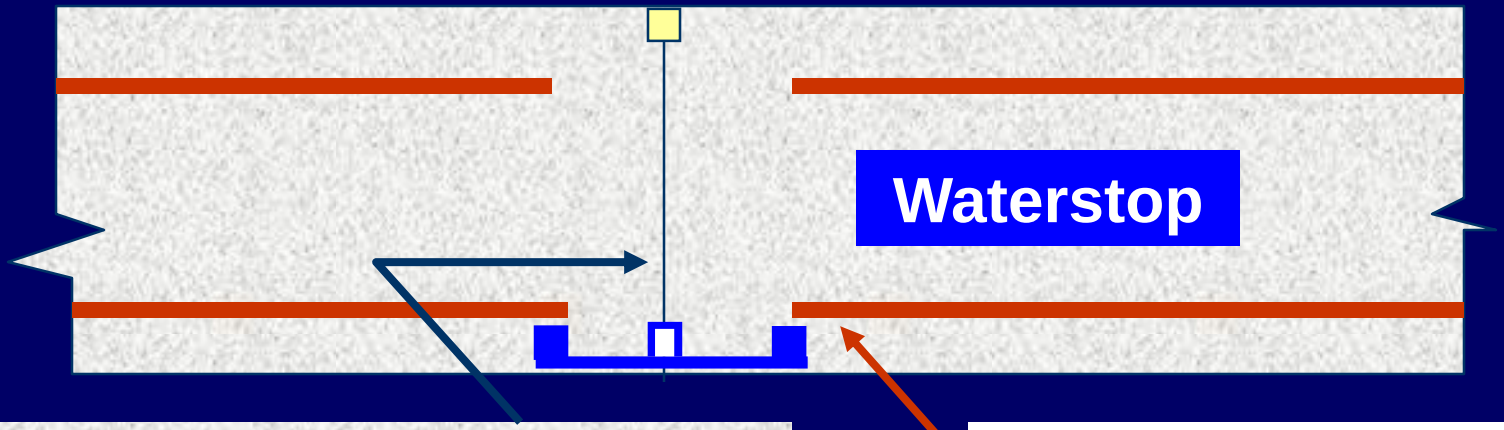
WALL CONTRACTION JOINTS (FULL)

Complete contraction joints have discontinuity of both Steel and Concrete.



FLOOR CONTRACTION JOINTS (FULL)

Sealing Compound on top face

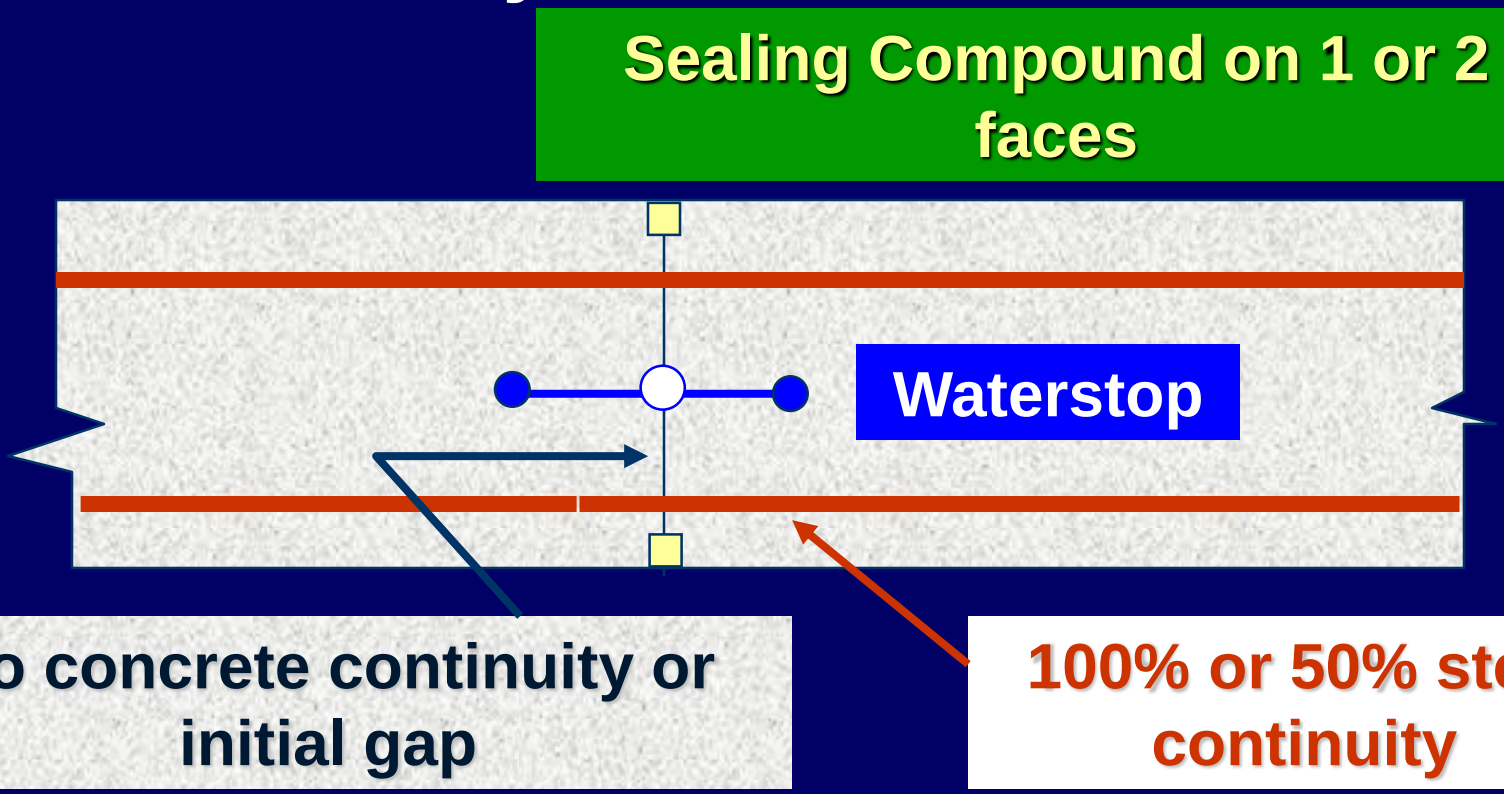


No concrete continuity or initial gap

No steel continuity

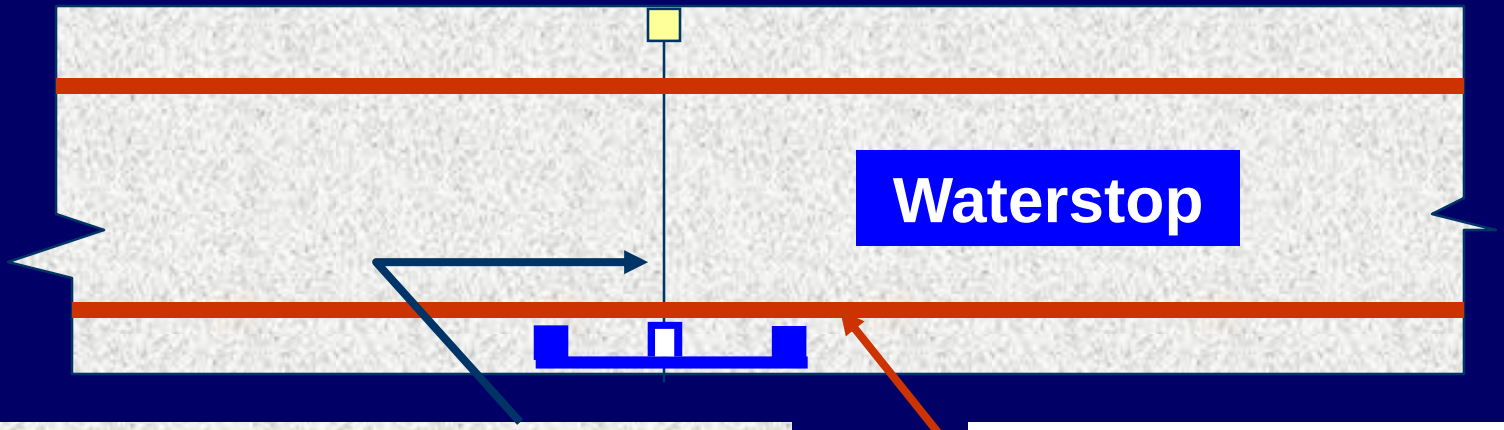
WALL CONTRACTION JOINTS (Partial)

Partial contraction joints have discontinuity of Concrete and 100% or 50% continuity of steel



FLOOR CONTRACTION JOINTS (Partial)

Sealing Compound on top face



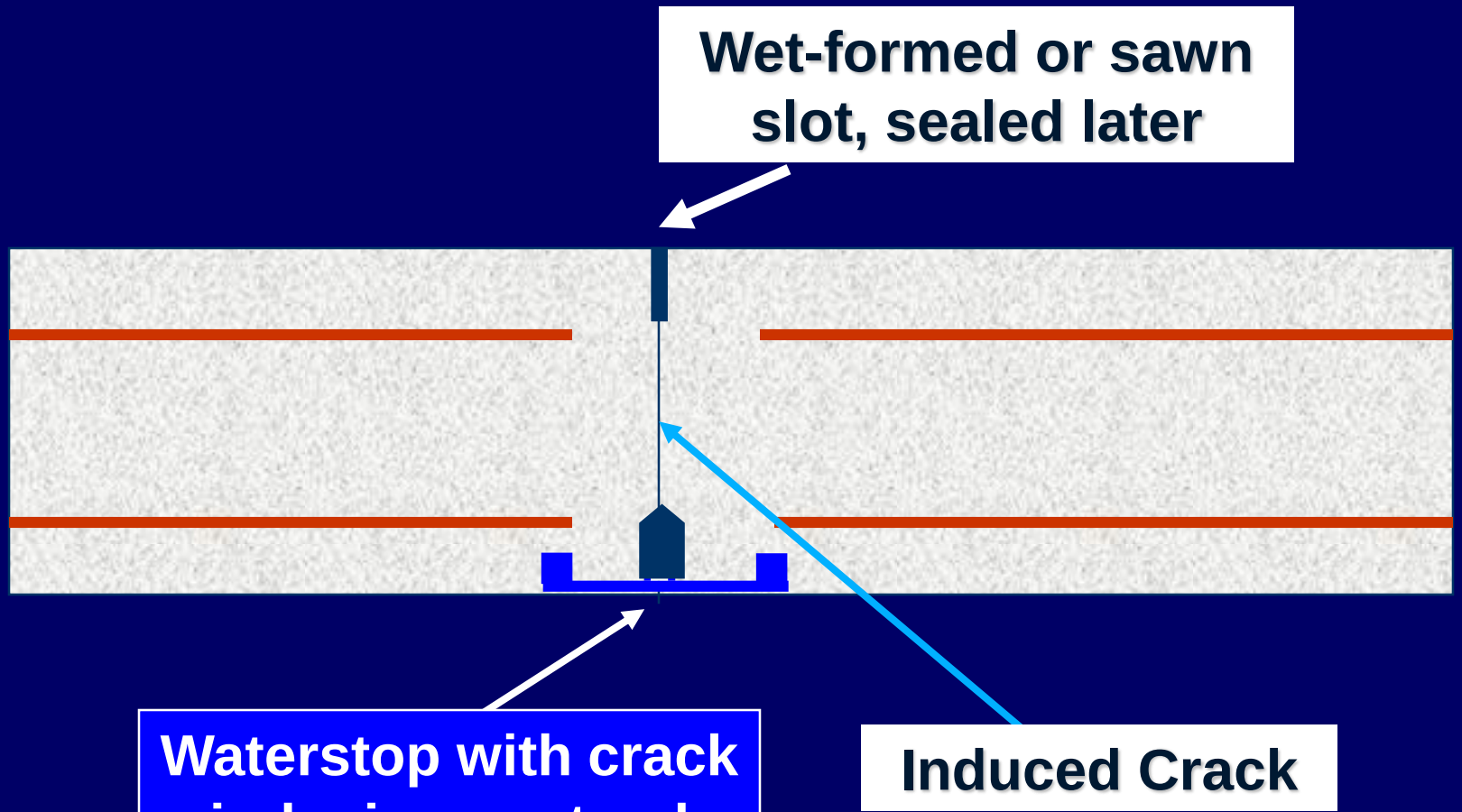
No concrete continuity or initial gap

100% or 50% steel continuity

CONTRACTION JOINTS

- Contraction joints may be constructed as such, or may be induced by providing a plane of weakness which causes a crack to form on a preferred line.
- In this case concrete is is placed continuously across the section, and the action of a device which is inserted across the section, to reduce the depth of concrete locally, causes a crack to form.※

SELF INDUCED CONTRACTION JOINT



CONTRACTION JOINTS

- The formation of the crack releases the stresses in the adjacent concrete, and the joint then acts as a normal contraction joint
- Great care is necessary to position the crack inducers on the same line, as otherwise the crack may form away from the intended position.※

EXPANSION JOINTS

- Expansion joints are formed with a compressible layer of material between the faces of joint.
- The material must be chosen to be durable in wet conditions.
- Be non-toxic for potable water construction, and have the necessary properties to be able to compress by the required amount and to subsequently recover its original thickness.※

EXPANSION JOINTS

- An expansion joint always needs sealing to prevent leakage of liquid.
- In a wall, a water bar is necessary containing a bulb near to the center which will allow movement to take place without tearing.
- The joint also requires surface sealing to prevent the ingress of solid particles.※

EXPANSION JOINTS

- By definition, it is not possible to transmit longitudinal structural forces across an expansion joint, but the designer may wish to provide for shear forces to be carried across the joint, or to prevent the slabs on each side of the joint moving independently in a lateral direction.※

EXPANSION JOINTS

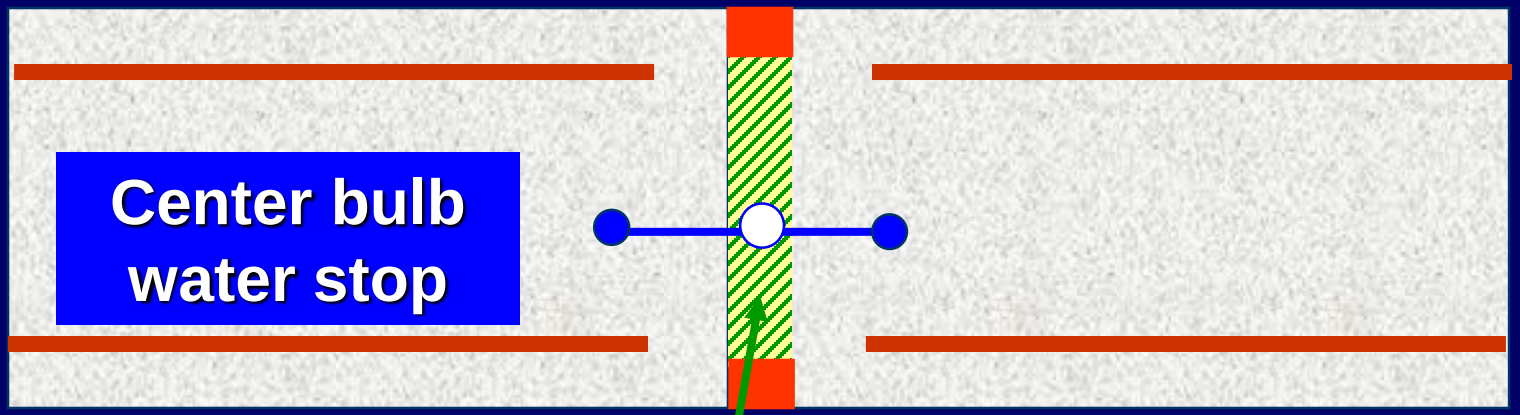
- The slabs on either side of the joint may be prevented from relative lateral movement by providing dowel bars with provision for longitudinal movement.
- The dowel bars must be located accurately in a line.※

EXPANSION JOINTS

- The dowel bars be provided with an end cap to allow movement, and be coated on one side of the joint with a de-bonding compound to allow longitudinal movement to take place.※

WALL EXPANSION JOINTS

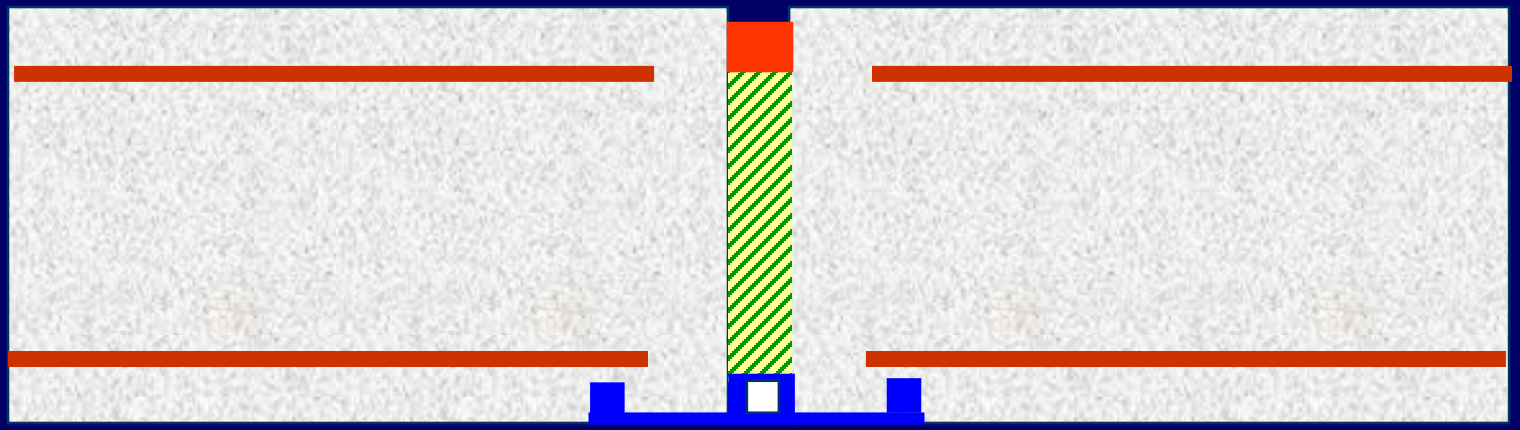
Sealing Compound on one or both faces



Non absorbent joint filler in an initial gap for expansion

FLOOR EXPANSION JOINTS

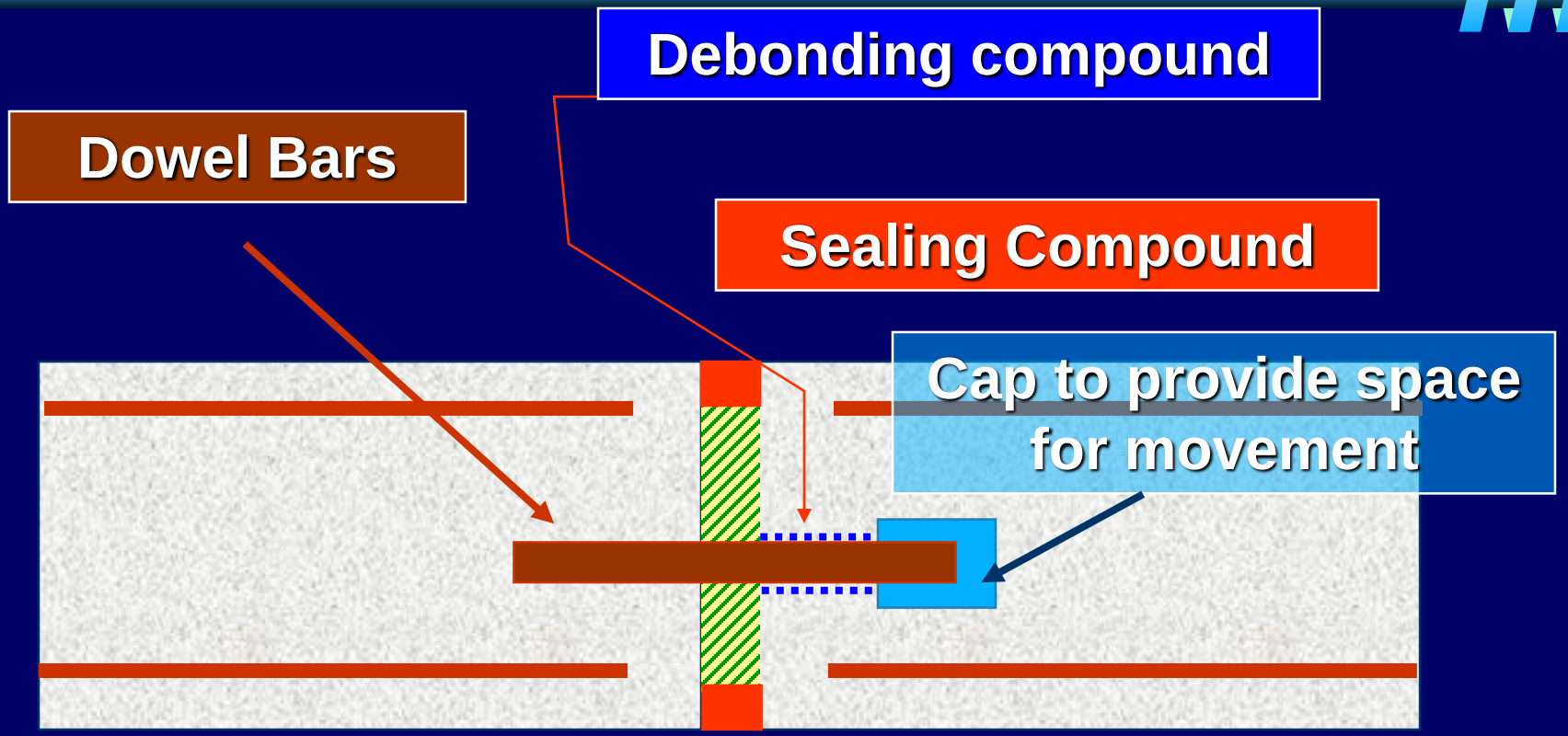
Sealing Compound



Expansion type water stop

Non absorbent joint filler in an initial gap for expansion

EXPANSION JOINTS with DOWEL BARS



Non absorbent joint filler in an initial gap for expansion

END OF PART I