

**FAILURE MODES & STABILITY MODELLING FOR DESIGN OF  
SAND FILLED GEOSYNTHETIC STRUCTURES**

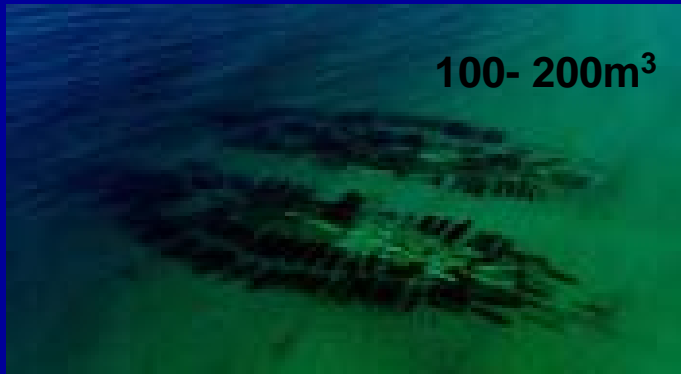


**Angus JACKSON,** International Coastal Management  
**Bobbie CORBETT,** International Coastal Management  
**Simon RESTALL,** Elco Solutions



# BACKGROUND

- Sand filled geosynthetic containers [SFGC] and tubes are being increasingly used as an alternative to rock and concrete to construct coastal structures.
- SFGC are often used for emergency protection or temporary works with limited design.
- Approval authorities often prefer SFGC structures as they can be easily removed and do not require haulage of rock or concrete to site.



TYPICAL CONTAINER SIZES USED IN AUSTRALIA  
non-woven geosynthetics



## DESIGN METHODS STILL IN EARLY STAGES

Rock and concrete armor unit design [and construction] methods are not suitable.

### WHY:

- Flexible
- Porous
- Possible underfilling / deflation



Testing of SFGC has been undertaken in wave flumes by a number of different researchers such as Oumerarci, Bleck, Cox, Andrews, .....

-results to date vary and not all geotextile parameters have been able to be fully investigated:

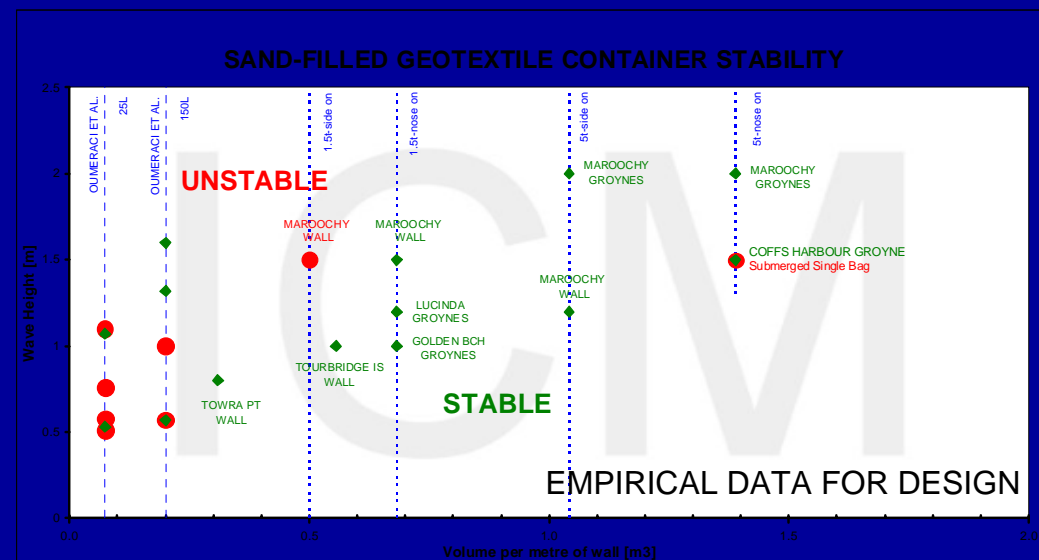
- Stiffness
- Friction
- Permeability

And container fill percentage

With this flume data, plus data from prototype structures and measurements:

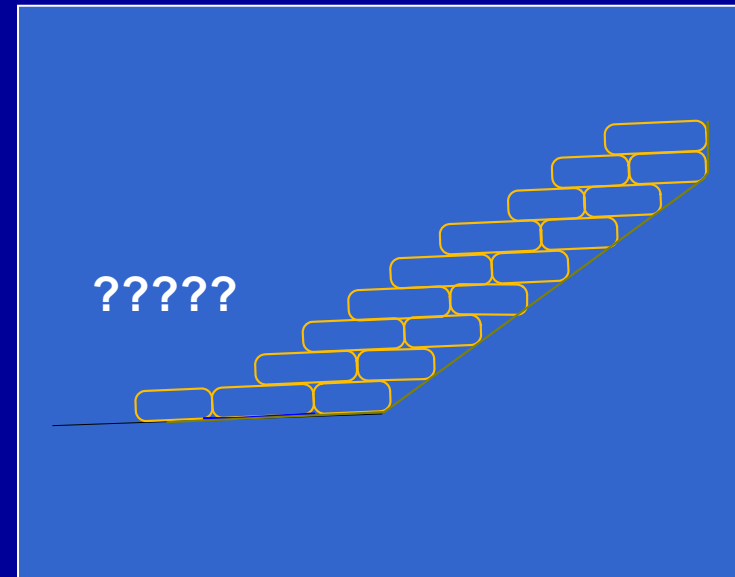
**TO DATE HAVE BEEN ABLE TO GROSSLY OVERDESIGN FOR STABILITY  
[ LARGER SFGC ARE USUALLY MORE COST EFFECTIVE ]**

**=> NO FAILURES** *of permanent works*



# OBJECTIVE - DESIGN FOR LARGER WALLS

- SUCH AS GOLD COAST SEAWALLS



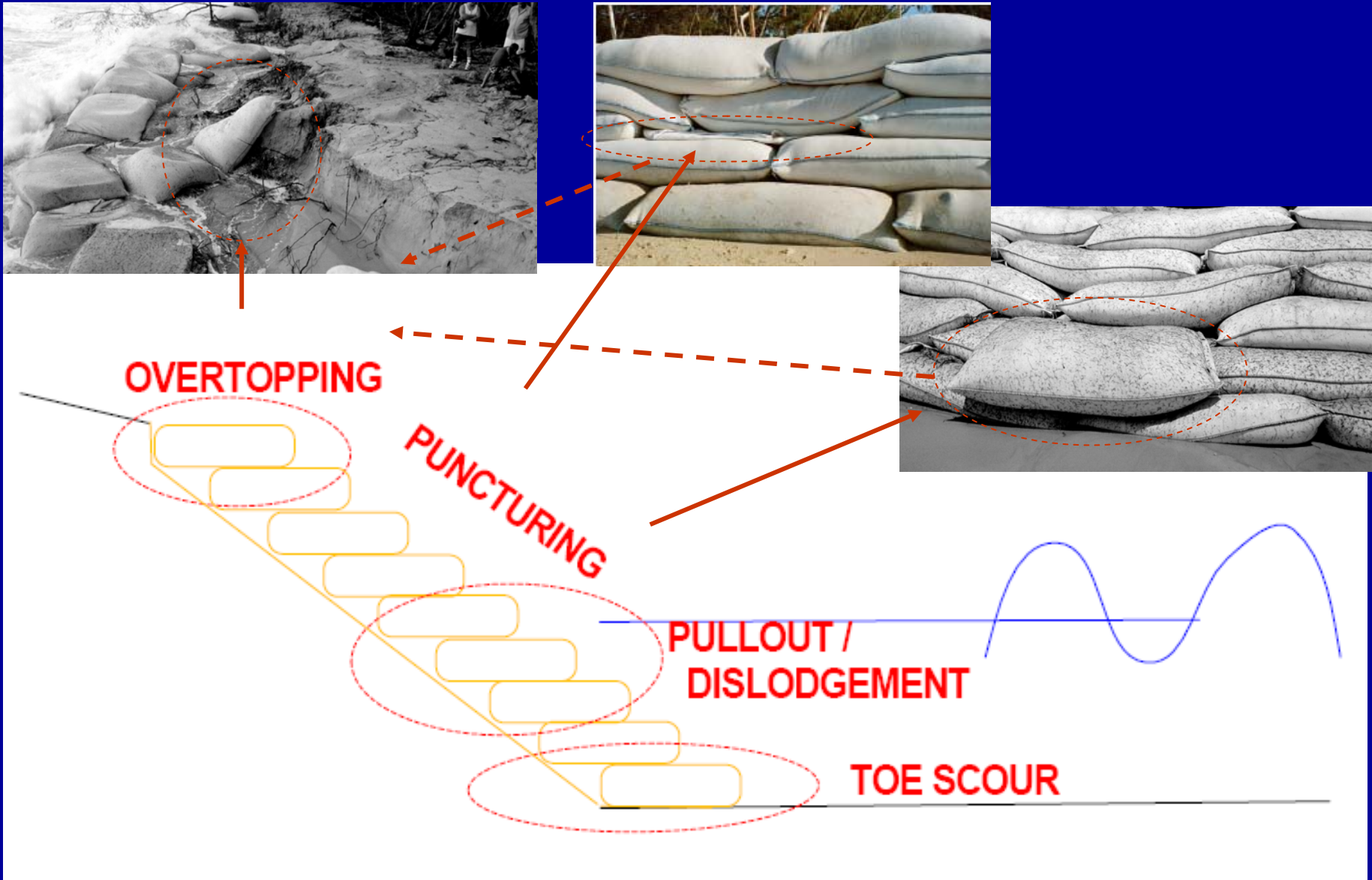
3-5T armor rock — — — — ▶ 2 LAYERS X 2.5m<sup>3</sup> SFGC ??

NEED MORE THAN DESIGN FORMULAE

NEED TO UNDERSTAND FAILURE MODES AND AVOID BY GOOD DESIGN

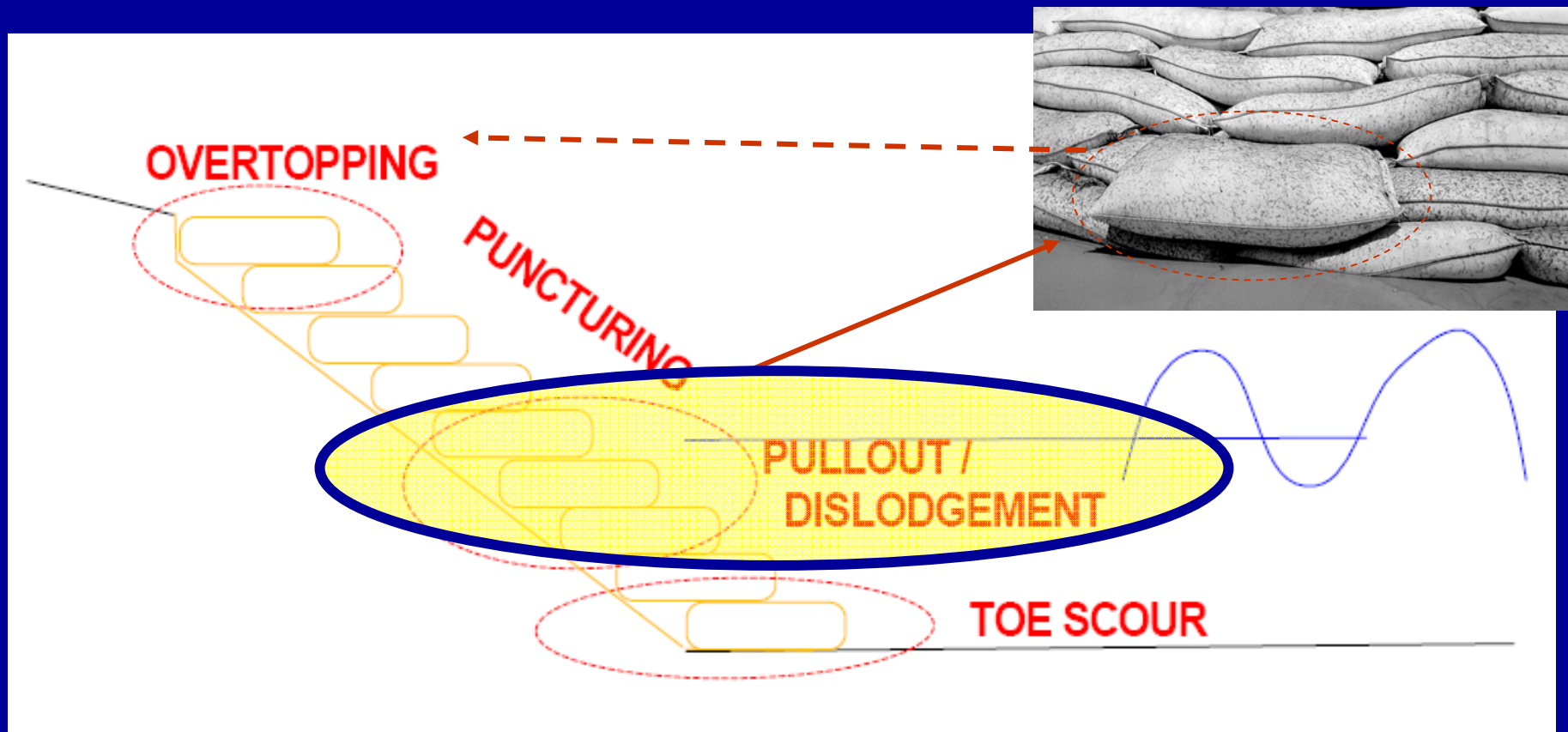
# FAILURE MODES

-Overtopping and Pullout failures in “real world” similar to observed in flume by Oumeraci et al



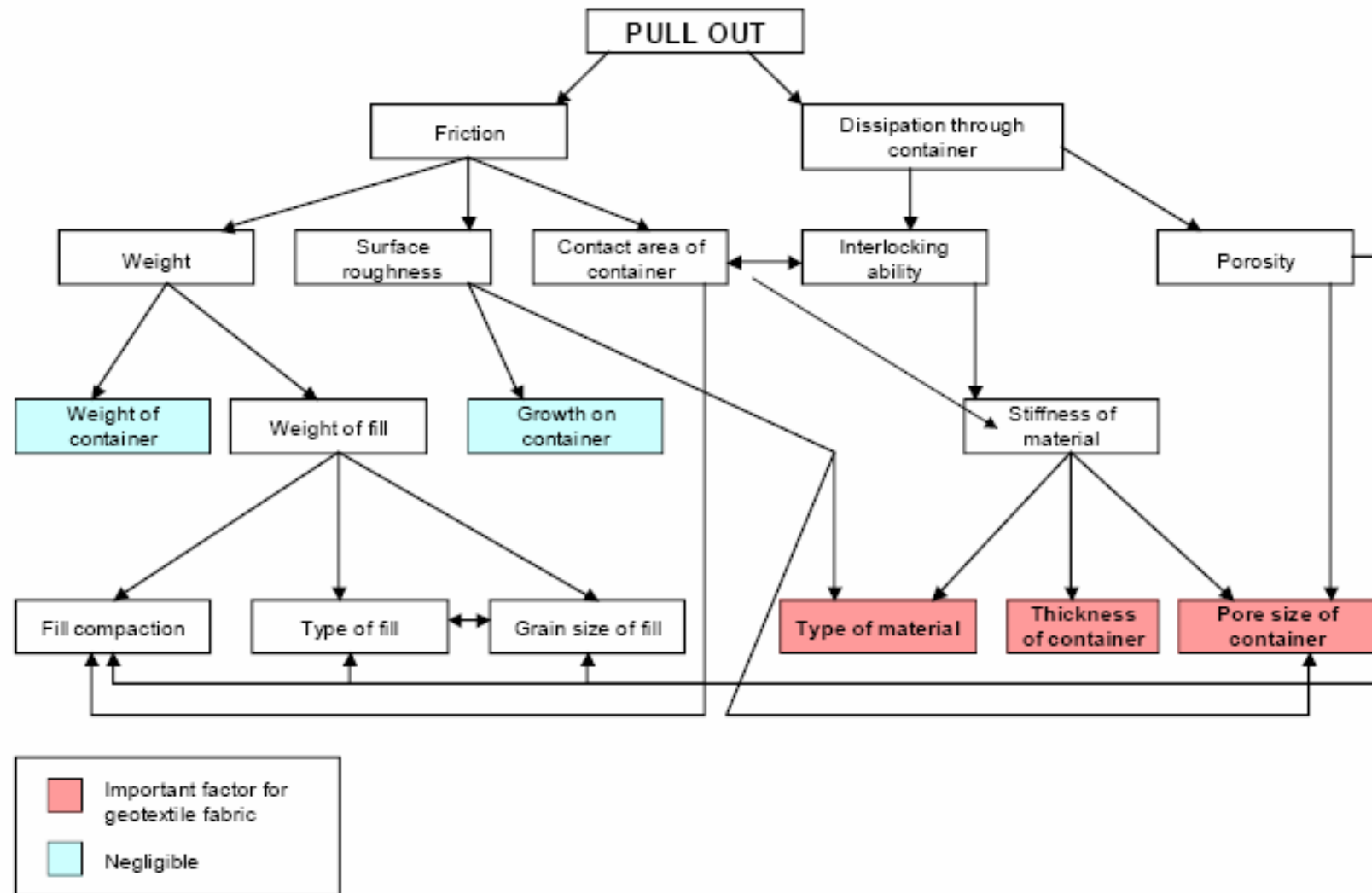
# FAILURE MODES

- To date have concentrated on better understanding pullout failure mode.

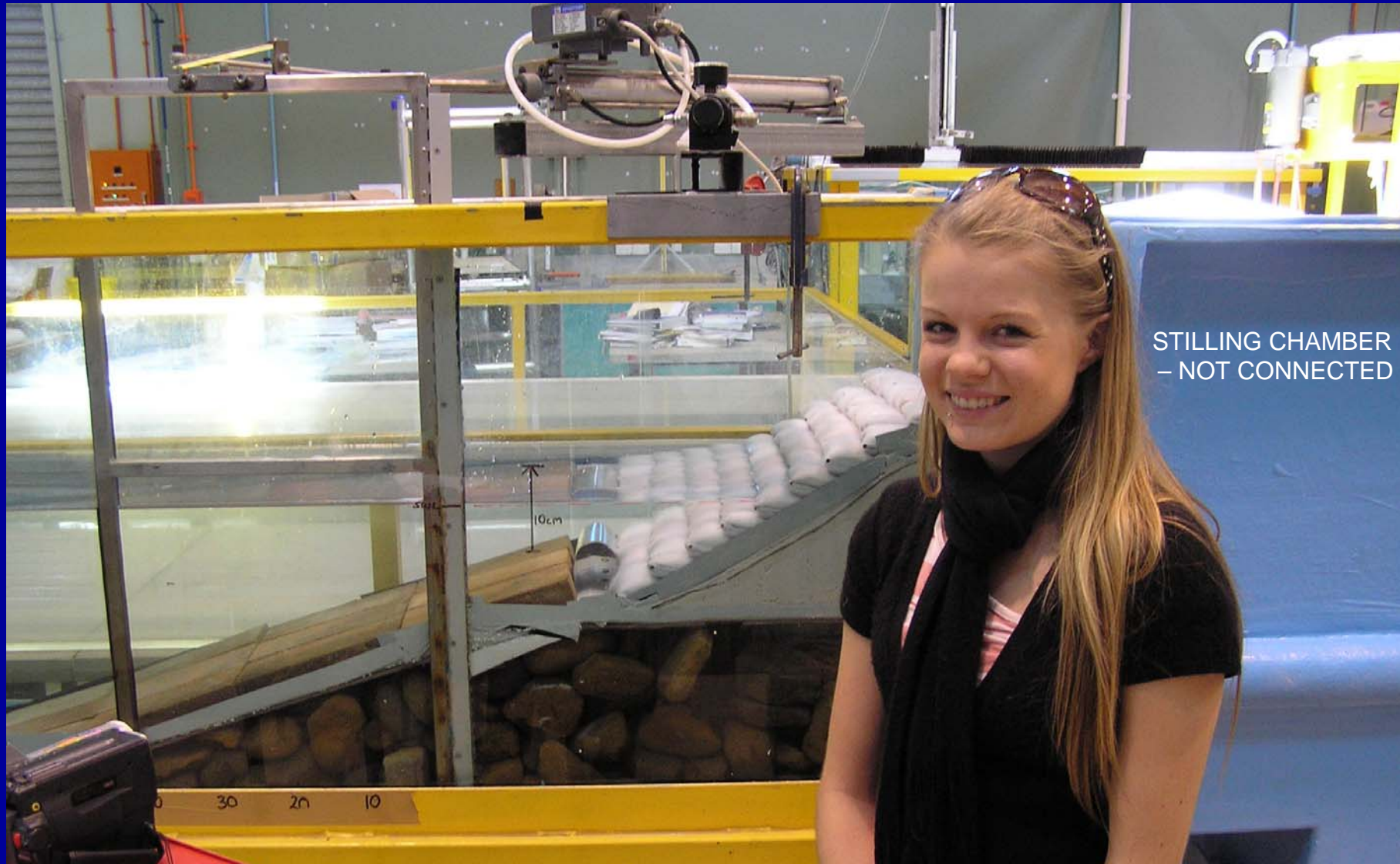


# COMPLEX INTERACTIONS

LOOKED LIKE NEEDED MORE THAN 10 MINS THOUGHT!



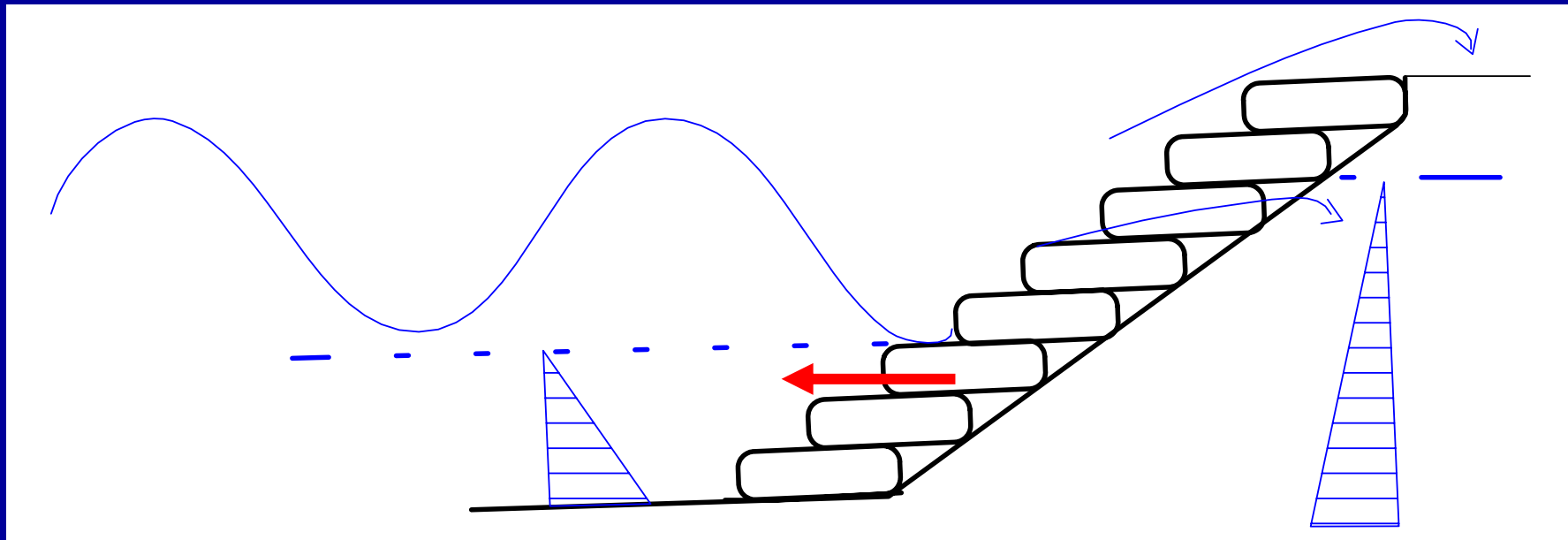
## GRIFFITH UNIVERSITY UNDERGRAD PLUS FLUME USED TO INVESTIGATE FAILURE MODES



STILLING CHAMBER  
- NOT CONNECTED

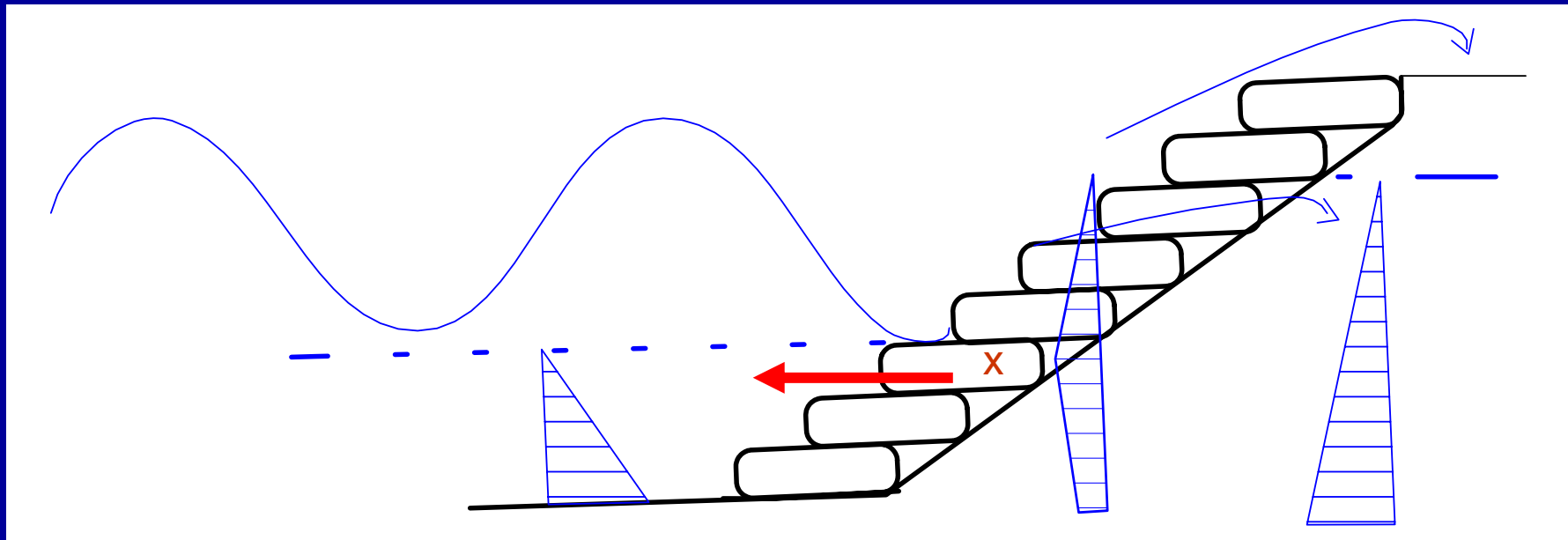
# PULL OUT FAILURE MODE

**HYPOTHESIS - pressure differentials at draw down**

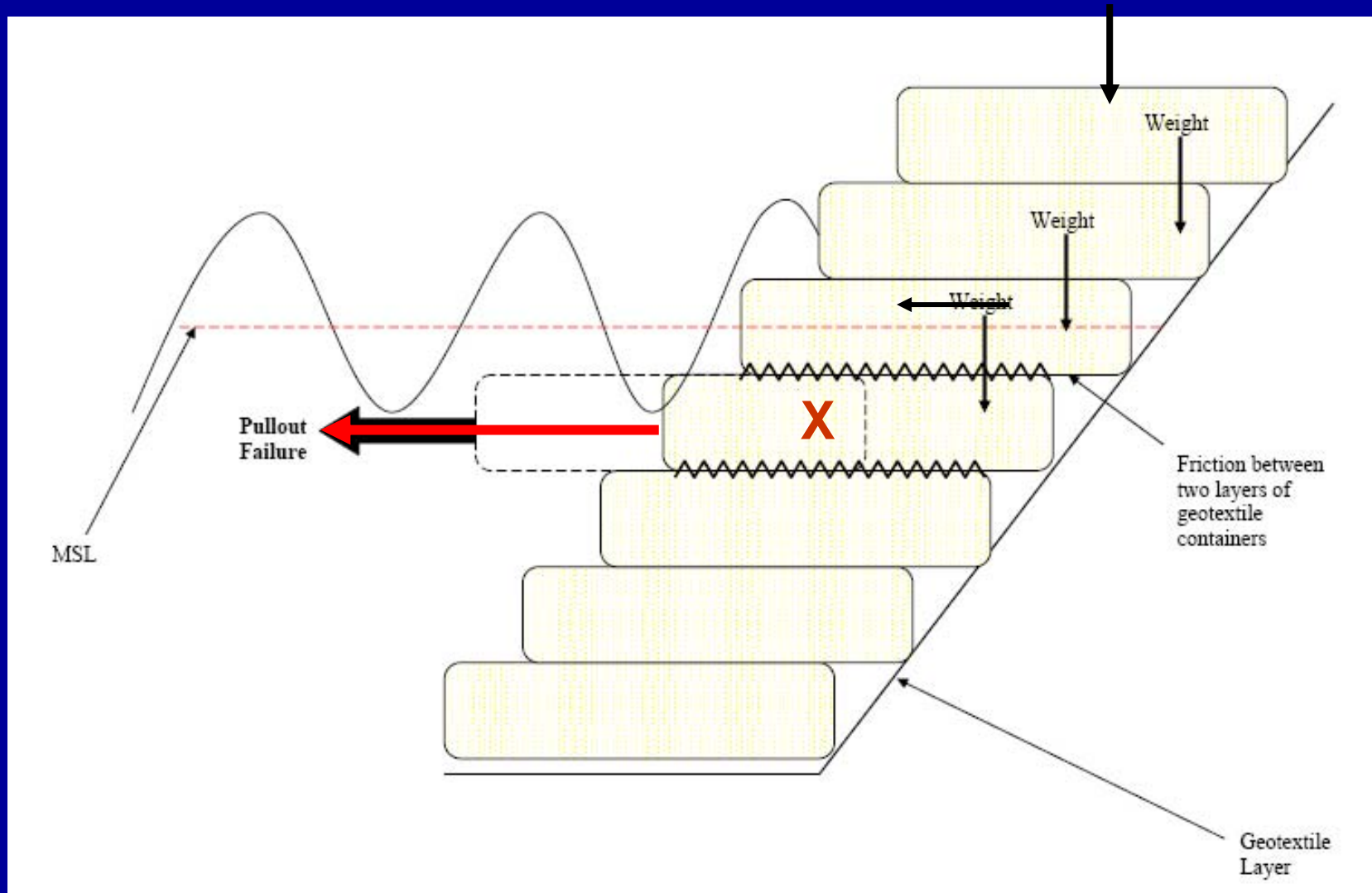


# PULL OUT FAILURE MODE

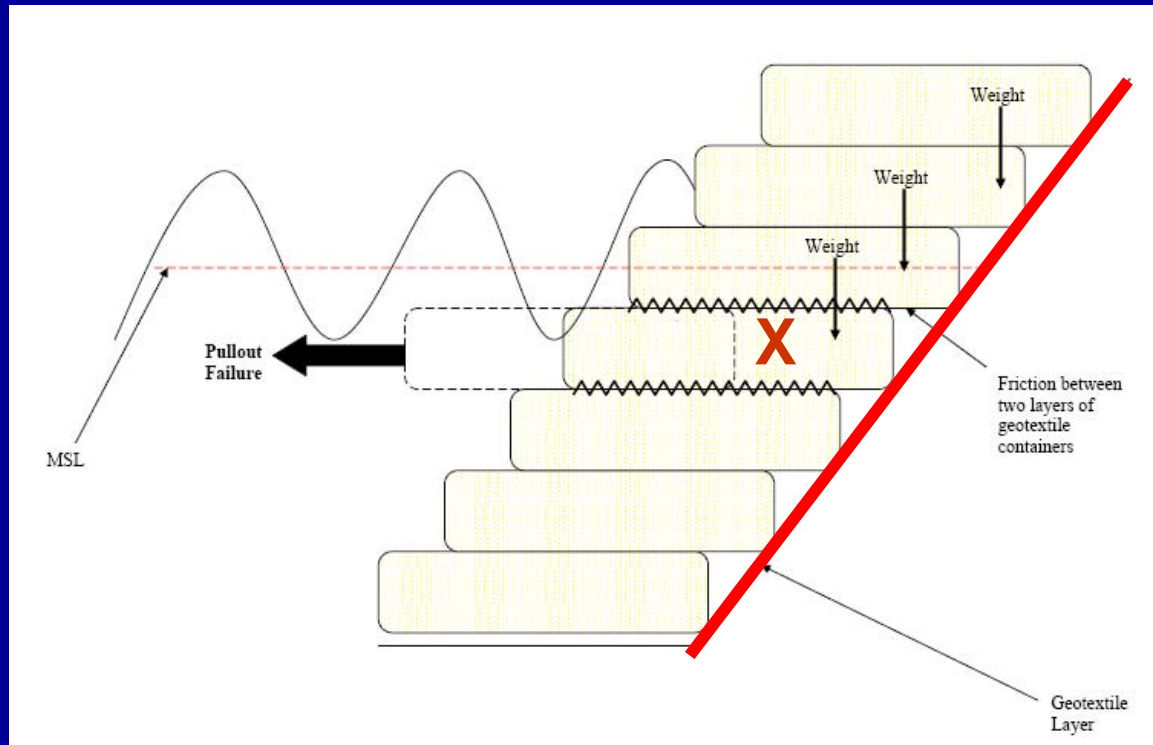
## HYPOTHESIS



# FORCES ON CRITICAL CONTAINER(S)



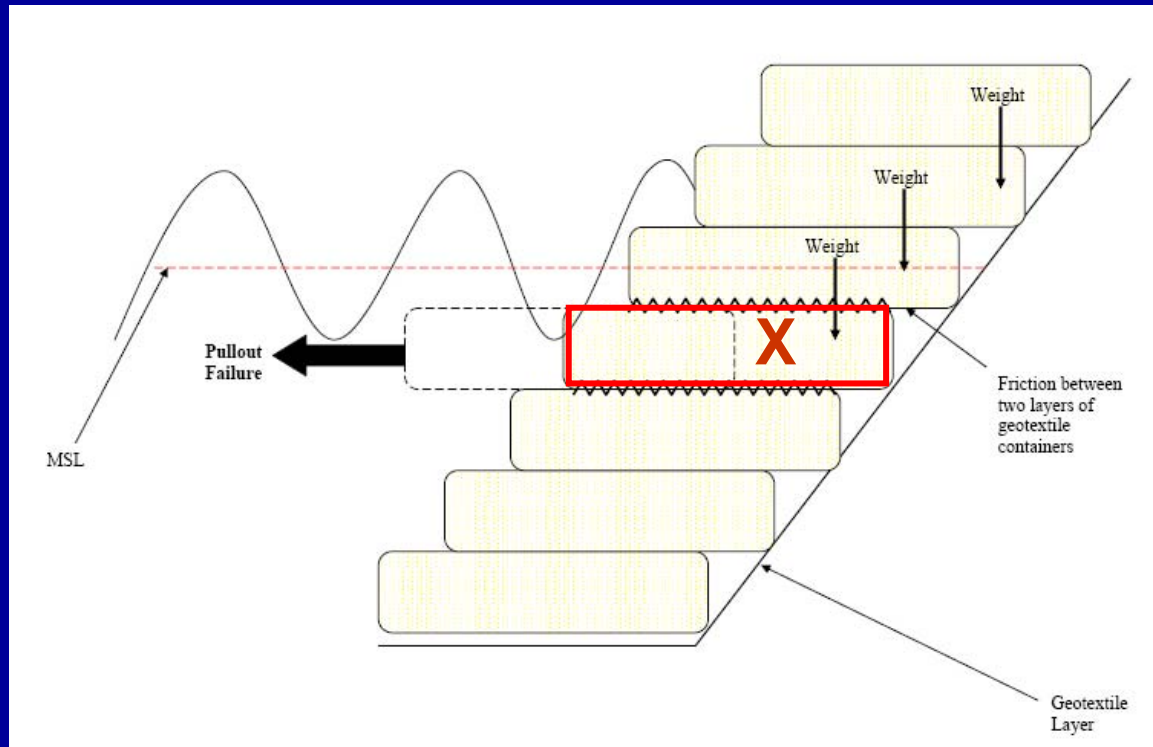
## FORCES ON CRITICAL CONTAINER(S)



**STABILITY WILL BE AFFECTED BY THE FOLLOWING WALL VARIABLES:**

- Permeability of geosynthetic at back of wall and backfill material

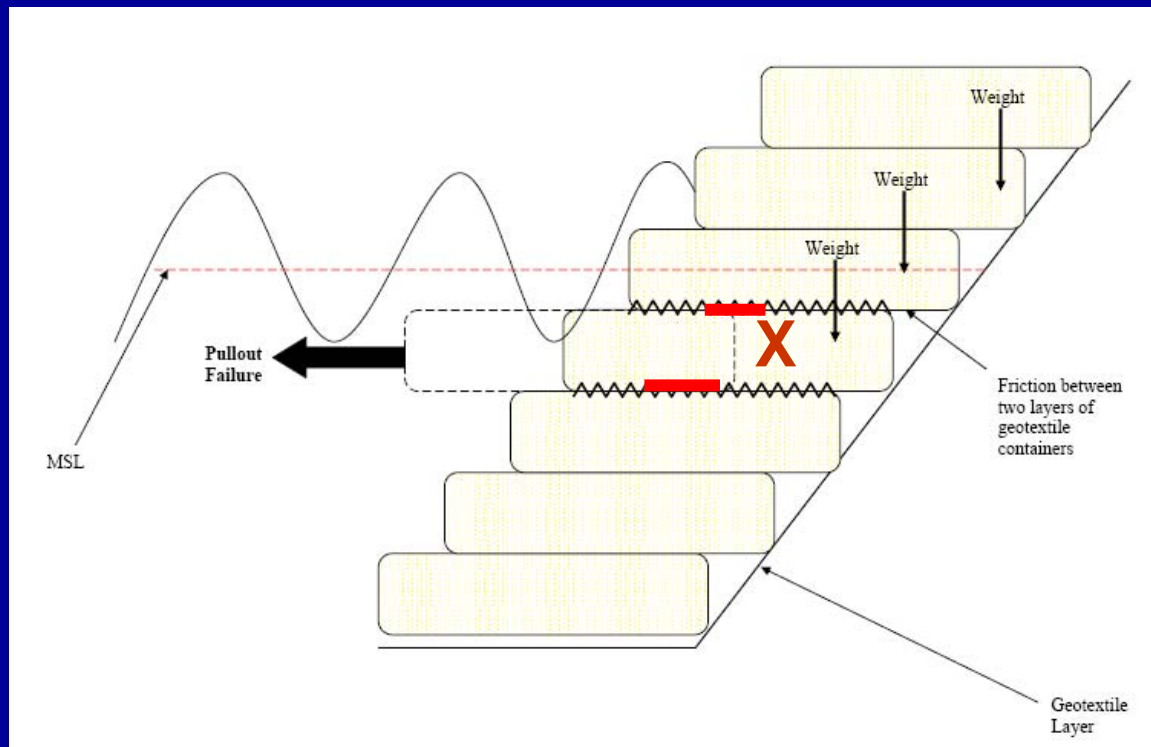
## FORCES ON CRITICAL CONTAINER(S)



### STABILITY WILL BE AFFECTED BY THE FOLLOWING WALL VARIABLES:

- Permeability of geosynthetic at back of wall and backfill material
- **Type of geosynthetic for containers**
  - friction coefficient
  - permeability

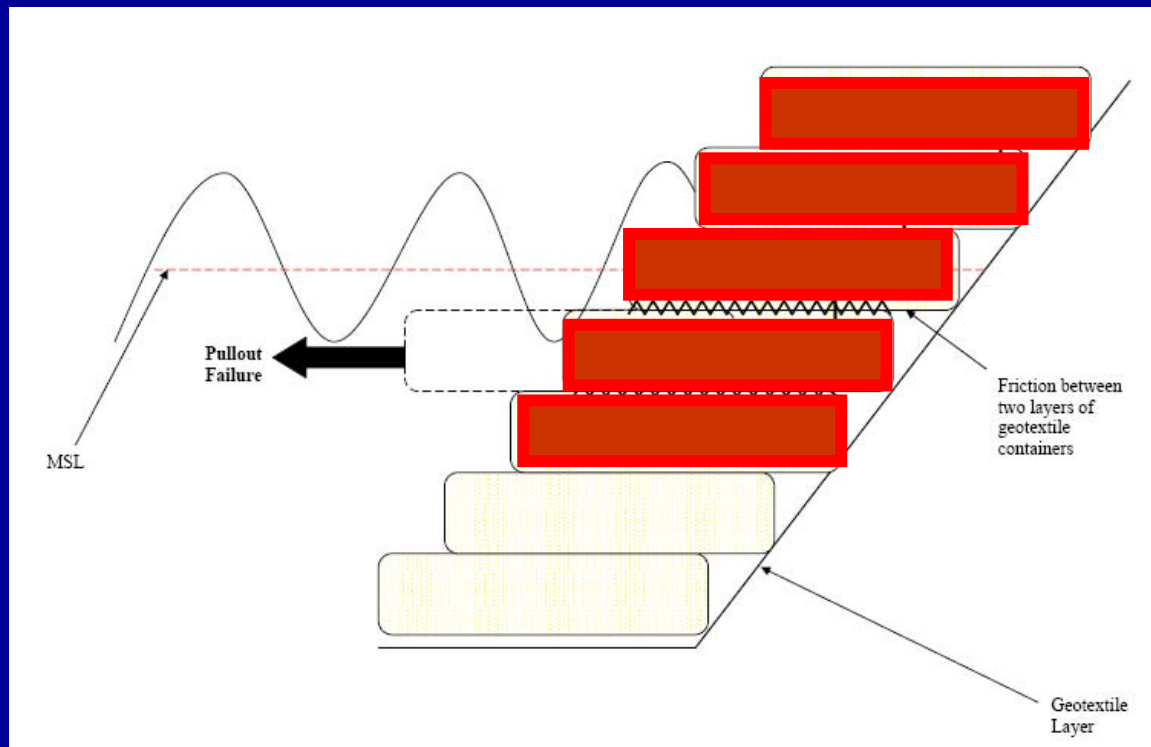
## FORCES ON CRITICAL CONTAINER(S)



### STABILITY WILL BE AFFECTED BY THE FOLLOWING WALL VARIABLES:

- Permeability of geosynthetic at back of wall and backfill material
- Type of geosynthetic for containers
  - friction coefficient → Velcro? → durability???
  - permeability

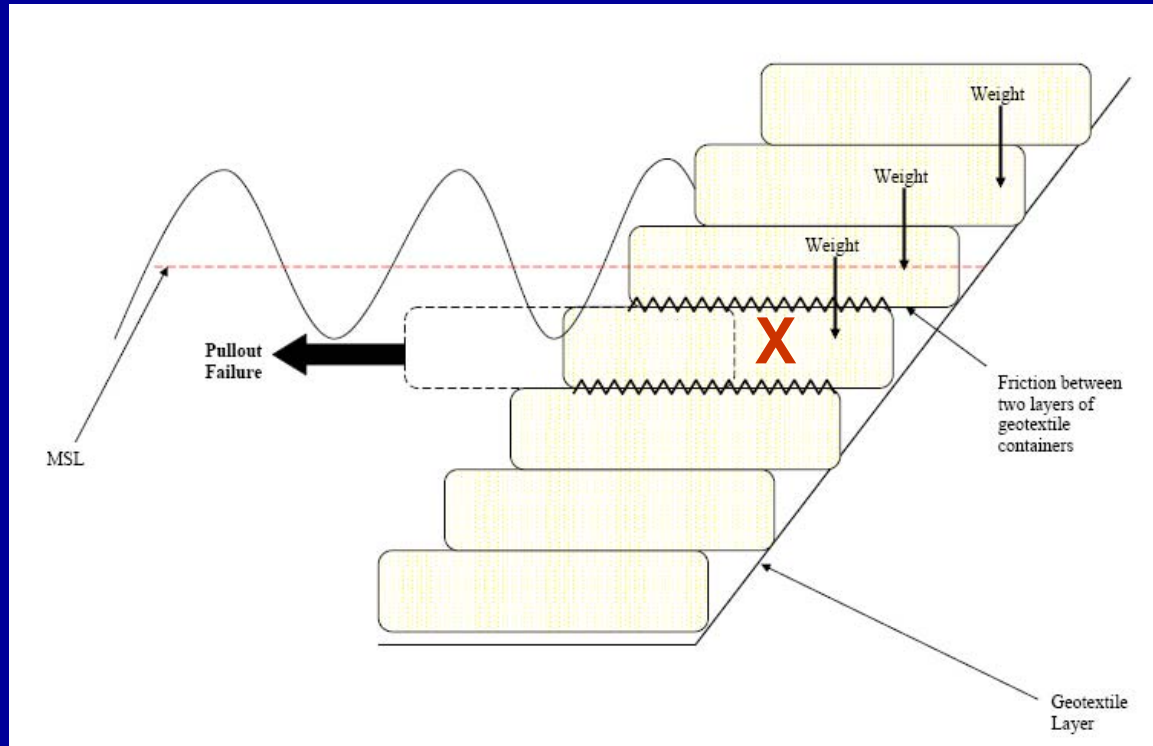
## FORCES ON CRITICAL CONTAINER(S)



### STABILITY WILL BE AFFECTED BY THE FOLLOWING WALL VARIABLES:

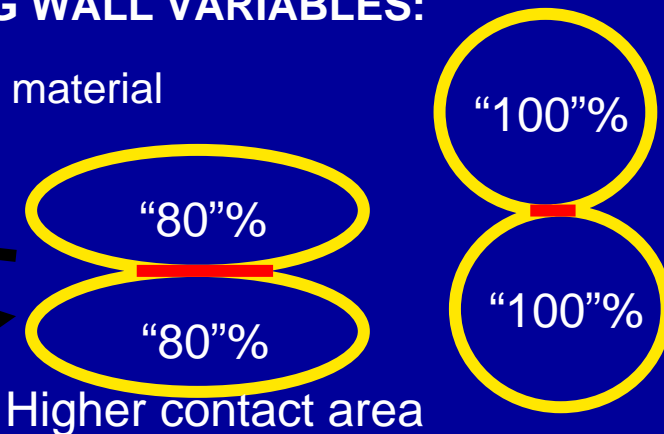
- Permeability of geosynthetic at back of wall and backfill material
- Type of geosynthetic for containers
  - friction coefficient
  - permeability
- **Weight and stacking of containers**
  - **Type of fill**
  - **% full**

# FORCES ON CRITICAL CONTAINER(S)

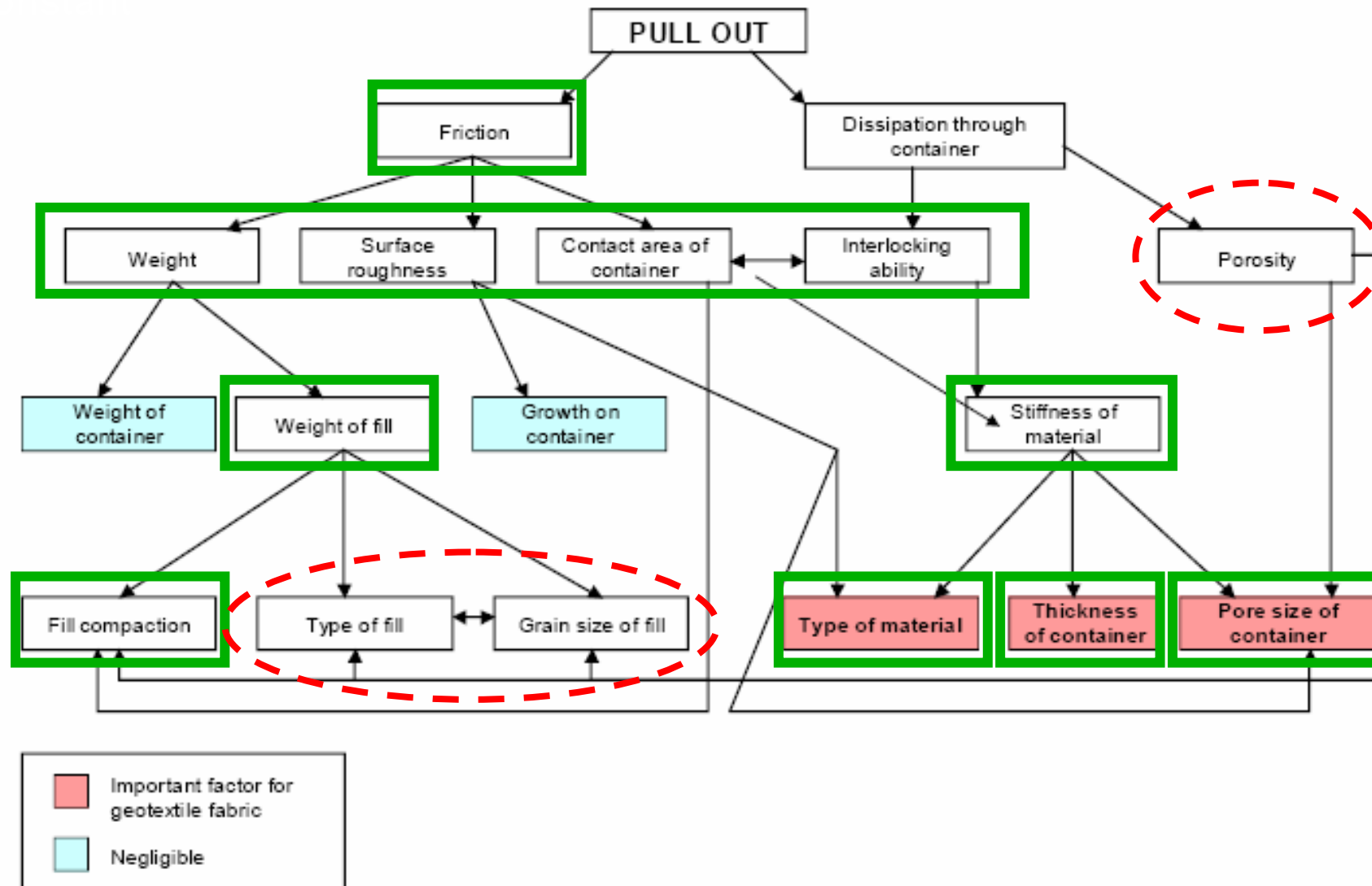


## STABILITY WILL BE AFFECTED BY THE FOLLOWING WALL VARIABLES:

- Permeability of geosynthetic at back of wall and backfill material
- Type of geosynthetic for containers
  - friction [coefficient]
  - permeability
- Weight and stacking of containers
  - Type of fill
  - % full



# SOME FLUME TESTS DONE WITH SAND FILL, OTHERS WITH GRAVEL FILL - Decided to test sand vs gravel filled containers leaving other variables

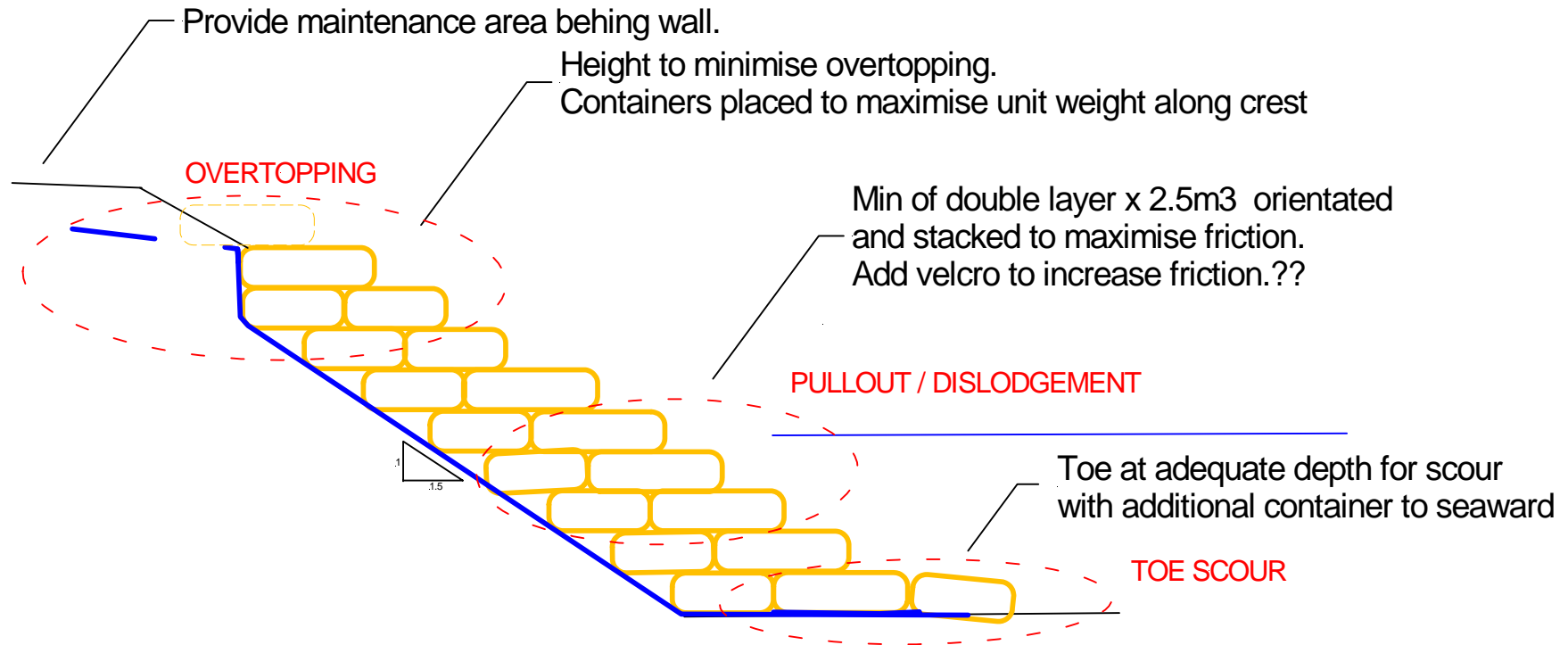




THANKS TO:  
ZOE ELLIOT

# WALL DESIGN FROM STUDIES

Suitable for Gold Coast type wave conditions



TYPICAL WALL X-SECTION

Thankyou