



# ONE DAY GEOTECHNICAL SYMPOSIUM Kuching, Sarawak, Malaysia

# The Innovative Design of Piled Through Mass Gravity Stone<sup>®</sup> Strong Wall Homestead Gully Bridge Rehabiliation

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### The Location of Homestead Gully Bridge



Bribie Island

Brisbane

### Approximate 520km north of Brisbane



#### **Existing Timber Bridge**



Three-span bridge supported on driven timber piles, which was constructed in 1960's.





Thousands of timber bridges built before & after WWII needs replacement OR upgrade

### These bridges do not conform to current standards & safety requirements







dynamic engineering through innovation

#### Layout and Boreholes



# 2. Geological & Geotechnical Information

### Geology:

### **Quaternary Flood Plain (Qa)**

- Alluvium Clay, Silt and Gravel
- Rocks of the Jurassic
  Evergreen Ironstone,
  Sandstone, and Siltstone.

## Geotechnical Profile(BH01):

- 0.0-5.0m firm to stiff Sandy CLAY (alluvium)
- 5.0-14.0m very stiff CLAY / Silty CLAY (alluvium)
- ✤ 14.0-19.0m residual soil;
- 19.0-21.0m moderately weathered, low strength Argillaceous SANDSTONE.



















TYPICAL STEEL PILE DETAIL















# **The Innovative Solution**



# **GE** INVENTIONS 5. ULS and SLS Check

### **Ultimate Limit State(ULS)**



# Earth Pressure behind the Retaining Wall

### Hypothesis:

- Norminal surcharge of 20kPa is assumed to be at the top of the embankment;
- Soil pressure behind the bridge headstock is not transferred to the retaining walls;
- Passive soil resistance is not considered according to Clause 13.3.1 of AS5100.3 – 2004.
- All bending moments are transferred to the bored piers beneath the concrete footing;
- □ Bore piers have spacing of 2.44m.



### **Ultimate Limit State(ULS)**



Load transferred to each bored pile: F<sub>v</sub>=175.0kN; F<sub>H</sub>= 111.0kN; M=179.0kNm

# **GE** INVENTIONS 5. ULS and SLS Check

### **Ultimate Limit State(ULS)**



Bored pile length was determined by using Brom's Method (1965) and 5.0m was adopted.

Taking geotechnical strength reduction factor,  $_{g}$ =0.55, the design geotechnical strength of a pile,  $R_{d,g}$ , is,

 $R_{d,g} = (Q_b + Q_s) \times \varphi_g = 574.5$ kN > F = 175.0kN (OK!)

# Earth Pressure behind the Retaining Wall



### **Serviceability Limit State(SLS)**

#### The Allowable Displacement: 70mm





#### Maximum Displacement = 26mm





# **Construction Methodology**





# **Construction Methodology**















### **Advantages**

- ✤ Greater degree of flexibility to accomodate the hybrid solution
- Minimise the space required for abutments to achieve the optimum cost
- ✤ A better option compared to conventional spill through wall
- Accelerated construction program with precast blocks
- Aesthetic chisel sandstone facade

Limitations

- Fixed spacing at 2.44m or 1.22m for piled foundation
- Required accurate pile position & verticality control to sleeve thru the blocks







# If you can't reduce a difficult engineering problem to just one $8 \frac{1}{2} x 11$ -inch sheet of paper, you will probably never understand it

Ralph B. Peck

