LARGE FRICTION CONNECTIONS PERFORMANCE & REPARABILITY

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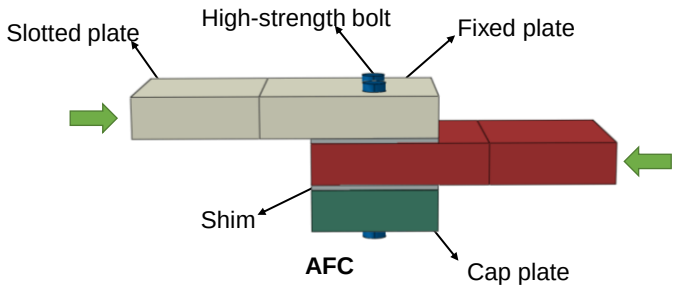
Why Friction connections?

- Cheap construction cost
- Low damage performance
- Perceived reparability



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This project experimentally investigates the below items of large friction connections:

- The performance,
- Post-test performance,
- Reparability

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Issues:

Remained gaps include the lack of:

- Large scale tests on friction connections with big bolt size/different bolt configurations
- Bolt tightening and bolt relaxation effects on the variation in the sliding strengths
- Testing bolts with different lubrication degrees/torque effects
- Different methods of repairing after a major event
- Differences between AFC and SFC

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Objectives:

- Determining the effects of **big bolt size** and number of bolt rows in the performance of friction connections.
- Defining a range of required **turn angle** for tightening the bolts.
- Defining acceptable **lubrication** for the large bolts.
- Determining how a connection may be **reinstated** after an event.
- Seeking a unified theory for friction coefficients for **AFC and SFC** bolts.

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Experimental tests methodology:

1. Tightening tests
2. Sliding test
3. Testing the examined specimens
   (Retesting cooled and damaged specimens)
4. Reparability tests

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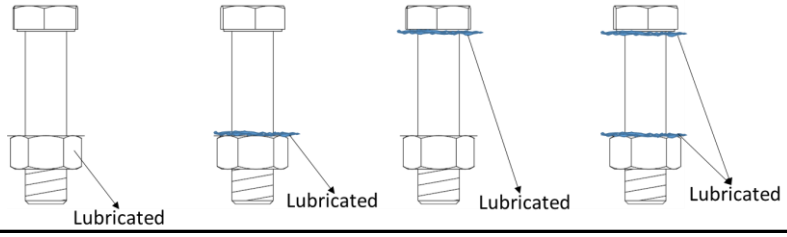
1. Tightening tests

Different lubrication degrees and material effects on tightening

Lubrication degrees	Surface treatment		
	Brushed steel		
	Lubrication material		
	Oil	Grease	Molybdenum
Thread-Nut lubricated	3	3	3
Nut Lubricated	3	3	3
Bolt under head lubricated	3	3	3
Full lubricated	3	3	3



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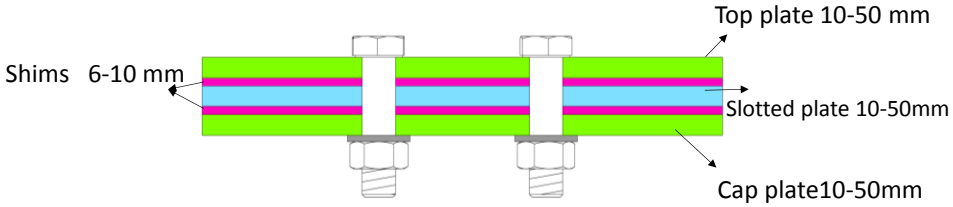
1. Tightening tests

Tests on the bolt size and length effect on tightening

Bolt length mm	Proof load			
	Bolt size			
	M16	M20	M24	M30
85	3	3	3	3
95	3	3	3	3
110	3	3	3	3
125	3	3	3	3
150	3	3	3	3
250	3	3	3	3



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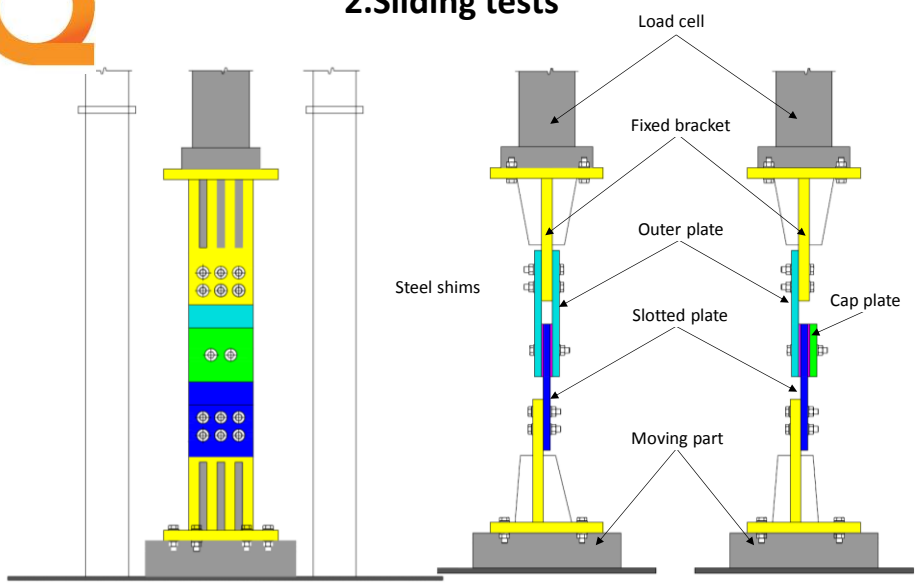
2.Sliding tests



The AFC specimen on DARTEC machine

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2.Sliding tests

Tests on the lubrication and surface treatments effect on friction connections

Lubrication level	Symmetric					Asymmetric
	Surface treatment					Surface treatment
	Mild steel	Flame cleaned	Wire brushed	Sand blasted	Shot blasted	Wire brushed
Dry	-	-	3	-	-	3
Thread-Nut lubricated	3	3	3	3	3	3
Full lubricated	-	-	3	-	-	3

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2.Sliding tests

The performance of friction connections considering different clamping forces

Tightening level	Symmetric				
	Surface treatment				
	Mild steel	Flame cleaned	Wire brushed	Sand blasted	Shot blasted
Snug tighten	-	-	3	-	-
0.5 required turn	3	-	3	-	-
Turn to proof load	BM	BM	BM	BM	BM
1.5 required turn			3		

Tests on the bolt configurations effect on friction connections AFC&SFC

Surface treatment	Bolt Size			
	M16	M20	M24	M30
Brushed surface	3	3	Benchmark	3

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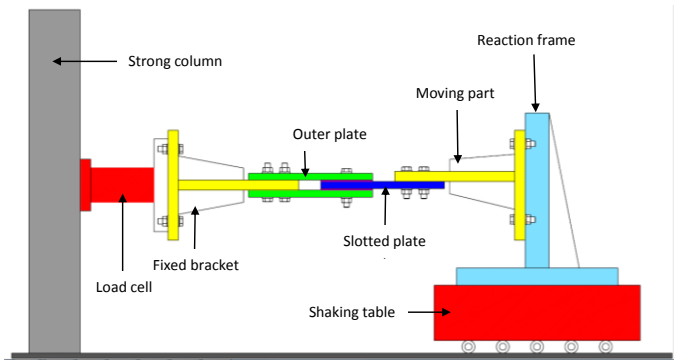
2.Sliding tests

Tests on high rate loading effect on friction connections



High rate loading test setup on shaking table

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