

**Approval & Reception Procedure**

<b>DG – Geotechnical Department</b>	
<b>Cement Deep Mixed Columns</b>	<b>Document No.:</b> ARP/DG/022
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**1. Reference Standard**

Technical code for ground treatment of buildings (JGJ 79-2012)

Technical code for testing of building foundation soils (JGJ 340-2015)

Code for Foundation Design on Port and Waterway Engineering (JTS 147-2017)

Technical specification of jet grouting for hydropower and water resources projects  
(DL/T 5200-2004)

REGULAMENTO DE FUNDAÇÕES

**2. Information to be submitted**

2.1 Geotechnical information (site investigation) ;

2.2 Site condition (including location 、 elevation 、 size 、 site boundaries 、 terrain 、 slope 、  
access 、 limitation 、 excavation depth 、 ground water level and tidal information, etc.) ;

2.3 Design drawings and technical specifications for the project ;

2.4 Method statement of construction ;

2.5 Construction Record :

- Cement mixing column reference number
- Elevation of top and bottom of each cement mixing column
- Used amount of cement of each cement mixing column
- Injection pressure of cement grout
- Rotating and lifting speed of stirring shaft

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Besides the above mentioned points, any information listed in JGJ 79-2012 would be required.

Site investigation report, required information listed in Artigo 42 and 43 of 《REGULAMENTO DE FUNDAÇÕES》 and clause 5.2 of EN 1536:1999 should be submitted.

### **3. Cement Material**

Cement grout used in cement mixing column must be conformed with required component and water-cement ratio by the design drawings. Trial Mixed must be verified by LECM, and submit the following test result:

- compression test of minimum 3 cement cubes at the age of 14 days ;
- compression test of minimum 3 cement cubes at the age of 28 days ;

All cubes must be produced from same batch of cement grout.

In the process of constructing cement mixing column, minimum 3 cement cubes at the age of 28 days should be made for compression test in each batch of cement grout.

### **4. Construction Control**

According to ‘Technical code for ground treatment of buildings’ (JGJ 79-2012) :

- Injection pressure should not remain less than 5.0 MPa ;
- Shaft should keep stirring at least 30s as cement grout injected, uplift the shaft when stirring finished ;
- Uplift height should not excess 15mm after each stirring.

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According to the various geology condition and design requirement, trial test should be performed before construction as reference for parameter during construction.

**5. Construction Monitoring**

According to ‘Technical code for ground treatment of buildings’ (JGJ 79-2012) :

- Deviation of drilling position cannot excess 50mm ;
- Deviation of verticality cannot excess 1% ;
- Check the diameter of stirring head frequently, its abrasion wear cannot excess 10mm.

**6. Testing**

According to the project requirement, the following test shall be performed :

- Integrity test of cement mixed column ;
- For any bearing capacity is required in the project, loading test should be performed ;
- For any seepage or permeability property is required in the project, permeability test should be performed ;
- According to the project requirement, verification test should be performed for the treatment effect on soil between columns.

**6.1 Integrity test of cement mixed column**

6.1.1. Select randomly 1% of the total cement mixed columns for excavation to check the integrity, with a minimum number of 3 cement mixed columns ;

6.1.2. Mechanical core test for the integrity of cement mixed columns :

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- The number of selected samples for test should be 1% of total cement mixed columns, a minimum number of 3 tests would be undertaken ;
- Total Coverage Ratio should be more than 85% in normal condition ;
- For any strength is required for the column, minimum 3 samples should be selected for compression test in each tested column ;
- Dynamic penetration test can be carried out according to the projected requirement.

**6.2 Bearing capacity of cement mixed columns**

- Select randomly 1% of the total cement mixed columns, with a minimum number of 3 points, to perform the composite foundation bearing capacity test, plate load test can be chosen ; ;
- For any single column bearing capacity is required for the project, static load test can be performed.

**6.3 Permeability property of cement mixed columns**

- Permeability test can be carried out according to the projected requirement.

**6.4 Verification test on soil between columns**

- Suitable test shall be carried out to verify the treatment effect, such as CPT, SPT, field vane shear test and/or laboratory soil test.

**7. Acceptance criteria**

Test results should comply with the requirements specified in technical specification

