

## GERMANN INSTRUMENTS

GERMANN INSTRUMENTS, based in Copenhagen, Denmark, in Evanston, Illinois, USA and in Luxembourg has since 1974 been developing, manufacturing and marketing advanced test systems for concrete and reinforced concrete structures.

GERMANN INSTRUMENTS' state-of-the-art test systems relate to testing for:

- **Potential durability of new mixes** (freeze-thaw resistance, resistance to chlorides, chloride diffusion, adiabatic heat development, simulation of hardening cracking, measuring of internal stresses, alkalinity and chlorides)
- **Durability of the finished structure** (air void structure of in-place fresh concrete, strength of the finished cover layer protecting the reinforcement, thickness of cover and cover resistance to chlorides)
- **Early and safe loading operations** (strength development)
- **Integrity** (dynamic stiffness and mobility, thickness, delaminations, cracks, voids, honeycombing, debonding, depth of surface opening cracks, injection of cable ducts, crack movement, compressive and tensile strength, water and gas permeation, cover and size of reinforcement)
- **Service life estimation** (electrical resistance of the cover layer, potentials and corrosion rate of reinforcement, chloride and carbonation profiles, cover layer and visual inspection of remaining cross section of reinforcement)
- **Quality of repairs** (adhesion and shear strength of overlays and CFRP-strips, injection quality, monitoring of moist and continued chloride penetration / corrosion activity, and coring)

The various test systems comprise:

1. Pull-out testing (ASTM C 900-99) with LOK-Test and CAPO-Test for compressive strength
2. Maturity testing (ASTM C 1074-87) with COMA-Meter or the Guardian
3. Electrical resistance to chlorides (ASTM C 1202-97) with the PROOVE' it
4. Determination of the chloride diffusion coefficient (NT BUILD 443 & AASHTO T 259-91) by profiling of the chloride ingress after ponding using the Profile Grinder and RCT
5. Air void analysis of fresh concrete (eqv. to ASTM C 457-89) with the AVA
6. Testing for freeze-thaw resistance by impact-resonance (ASTM C 215-97)
7. Measurement of alkalinity (potassium and sodium ions) with the RAT and chloride content of fresh concrete (AASHTO T 260-98) with the RCT
8. Internal stress monitoring with the Sentinel Sensor
9. Adiabatic heat development with the Heat-Box
10. Simulation of temperatures, temperature gradients and hardening cracking with the 4C-Temp and 4C-Stress Software
11. Impulse-Response for flaw screening with the s' MASH System by measuring the dynamic stiffness and mobility (ACI 228.2R-98)
12. Thickness measurement (ASTM C 1383-98) and flaw detection with the DOCTer Impact-Echo Test System
13. Crack movement with the CMD
14. Tensile and adhesion strength (BS 1881: Part 207: 1992, CSA A 23.2-2B & ASTM D 1144-99) with the BOND-Test

15. Water and gas permeation with the GWT and the GGT
16. Reinforcement position, cover thickness and rebar size (BS 1881: Part 204: 1988) with Rebar Plus, CM52 and CM9 CoverMaster
17. Humidity with the HUM-Meter
18. Electrical resistance and potentials (ASTM C 876-91) with the Great Dane and the Bloodhound
19. Corrosion rate, potentials and electrical resistance with the GalvaPulse
20. Water or acid-soluble chlorides (AASHTO T 260-93) on drilled-out powder with the RCT
21. Carbonation profile on small cores with the Rainbow Indicator
22. Shear strength of plain concrete or overlays with the TORQ-Test
23. Shear capacity of glued-on CFPR-Strips with the DSS-Test
24. Monitoring of chloride penetration and corrosion activity of reinforcement with the cast-in CorroWatch and the ERE probes
25. Coring with the CORECASE

Seminars and courses outlining the test systems, their background, operation, interpretation of test results, calibration and maintenance are recommended and offered to clients as an integral part of delivery of the test systems.

In addition, the test systems are, on special request, demonstrated or implemented on specific projects, either by engineers from GERMANN INSTRUMENTS or by specialized testing and consulting engineering companies with extensive experience in durable concrete structures, deterioration mechanisms, integrity, repairs and GERMANN INSTRUMENTS test systems.

Among the major applications and projects implementing GERMANN INSTRUMENTS test systems are the following:

1. Early and safe removal of jump-forms on cooling towers tested by the LOK-Test pull-out testing, Research Cottrell Inc., New Jersey, USA
2. Early and safe stripping of flying forms on high-rise buildings in Canada tested by LOK-Test pull-out and COMA-Meter maturity testing, Trow Group Ltd., Toronto, Canada
3. Timing of early post-tensioning of a 6-mile segmental bridge tested by LOK-Test pull-out testing, ACE/Black Joint Venture, Hawaii, USA
4. Testing for compressive strength by the CAPO-Test pull-out testing of pre-cast tunnel lining elements of the French-British Channel Tunnel, Trans-Link Joint Venture, Isle of Grain, United Kingdom
5. Testing for air void structure of the fresh concrete of highway pavement with the AVA, The Swedish Road Directorate, Stockholm, Sweden
6. Simulation of hardening cracking of the Øresund project concrete structures with the 4C-Temp and 4C-Stress software, A/S Øresund Link, Copenhagen, Denmark
7. Quality control of the finished cover layer of the concrete structures of the Great Belt Link - Denmark by LOK-Test and CAPO-Test pull-out testing, A/S Great Belt Link, Copenhagen, Denmark
8. Strength testing by LOK-Test of the finished structure, Hibernia Platform Project, Nova Scotia, Canada
9. Adhesion testing of repairs by BOND-Test on the Western Bridge Structure of the Great Belt Link, Project, ESG, Nyborg, Denmark

10. Adhesion testing of repairs by BOND-Test on the Øresund Project, A/S Øresund Contractors, Malmö, Sweden
11. Adhesion testing of repairs by BOND-Test on Norwegian concrete platforms, Norwegian Contractors, Hinna, Norway
12. Adhesion testing of applied overlays on industrial floors by BOND-Test, Densit A/S, Aalborg, Denmark
13. Special investigations of Danish Highway Bridges with RCT, Bloodhound, DOCTer, CAPO-Test, CM52 and BOND-Test, The Danish Road Directorate, Copenhagen, Denmark
14. Special investigations of Norwegian Highway Bridges with RCT, Bloodhound, DOCTer, CAPO-Test, CM52 and BOND-Test, The Norwegian Road Directorate, Oslo, Norway
15. Special investigations of Swedish structures with RCT, Bloodhound, DOCTer, CAPO-Test, CM9 and BOND-Test, Skanska Teknik AB, Malmö / Stockholm, Sweden
16. Special investigations of Highway Bridges in Luxembourg with RCT, Bloodhound, DOCTer, CAPO-Test, CM52 and BOND-Test, Ponts-et Chaussees, Luxembourg
17. Special investigations of Saudi Arabian Highway Bridges with RCT, Bloodhound, DOCTer, CAPO-Test, CM52 and Bond-Test, The Ministry of Transportation, Riyadh, Kingdom of Saudi Arabia
18. Special investigations of Mexican Highway Bridges with RCT, Bloodhound, DOCTer, CAPO-Test, CM52 and BOND-Test, Directorate General de Construcciones y Conservation, Mexico City, Mexico
19. Investigation of existing Polish Highway Structures with CAPO-Test, BOND-Test, GWT, Rainbow Indicator, RCT, Profile Grinder, CM52 and CM9 CoverMasters, Bloodhound and the DOCTer, The Polish Road Directorate, Warsaw, Poland
20. Testing of the new, finished Polish Highway Structures using the COMA-Meter, LOK-Test, CAPO-Test, BOND-Test, GWT, PROOVE' it, CM52 / CM9 CoverMasters and the DOCTer Impact-Echo, The Polish Road Directorate, Warsaw, Poland
21. Equipped testing van for diagnosing damaged structures to establish optimum repair strategies, Estonian Building Research Institute, Tallinn, Estonia
22. Detection of cracks by DOCTer impact-echo testing of nuclear containment walls, Syd Kraft A/S, Sweden
23. Detection of delaminations of airport runways with the DOCTer impact-echo, New York Port Authority, New York, USA
24. Detection of delaminations in the anchor blocks of the Great Belt Link suspension bridge with the DOCTer impact-echo, A/S The Great Belt Link, Copenhagen, Denmark
25. Detection of delaminations with the DOCTer impact-echo of highway slabs near construction joints of the Rotterdam - Den Haag Highway, HTC, Breda, The Netherlands
26. Detection of the depth of surface opening cracks of a fire damaged slab with the DOCTer impact-echo, Union Brau, Düsseldorf, Germany
27. Detection of debonding of noise barrier element on German Highways with the DOCTer impact-echo, Züblin, Galdbeck, Germany
28. Detection of tunnel lining integrity with DOCTer impact-echo, Bilfinger + Berger, Mannheim, Germany
29. Detection of cable duct injection quality with the DOCTer impact-echo, Armtton A/S, Copenhagen, Denmark
30. Early age strength assessment of concrete on site with Lok-Test, The European Concrete Building Project at Cardington, UK, British Cement Association, British Research Establishment, Construct Concrete Structures Group, Reinforced Concrete Council & DETR, UK