DIĀDICA Ingeniería

Diádica Infrastructure · Diádica Synthetic Core

Consulting and design · Construction management · Computational research · Medellín, Colombia

Capabilities dossier · general presentation · November 2026

Diádica is a civil engineering firm with its office in Barbosa, Antioquia, serving primarily Medellín and its metropolitan area. It also takes on projects elsewhere in Colombia and abroad, under the codes in force in the country where the project is built. The work is organized in two divisions: Diádica Infrastructure, which provides consulting in structural design, geotechnics, pavements and BIM coordination together with construction management, and Diádica Synthetic Core, the computational research division. The scope of each service line, the portfolio and the BIM model viewer are available at www.diadicaing.com.

DESIGN LICENCES AND IN-HOUSE CODE

Building analysis and design are carried out with CYPE and RFEM 5 licences. Some checks fall outside the scope of those programs and arise only a few times a year, such as a moment connection, the stability of a slope by strength reduction or the buckling of a bracing diagonal. For these the firm uses its own Python routines, without acquiring specialized software for occasional use. The formulation and intermediate results remain available to whoever reviews the calculation, and each result is delivered with the reference against which it was verified.

CONSULTING AND DESIGN

- Structural design in concrete, steel, masonry, timber and bamboo (guadua) under NSR-10, audited against ACI 318 and AISC 360. Bridge design under CCP-14, audited against AASHTO LRFD.
- Geotechnical studies, shallow and deep foundations, earth-retaining structures and slope stability under NSR-10 Title H.
- Pathology and seismic vulnerability assessment of existing structures under Title A.10, with the design of the retrofit.
- Life safety under Titles J and K, fire protection and means of egress, for the building permit process.
- Independent review of structural designs under Law 1796 of 2016.
- Design of flexible, rigid and segmental pavements under the INVÍAS manuals and the 1993 AASHTO Guide.
- Structural BIM coordination in IFC4 under the DÍADA BIM protocol, with issues in BCF format.
- **Post-processing in Python.** CYPE output feeds in-house routines that check, design and write the calculation report. Completed case: confined and reinforced masonry in a five-storey building with 53 walls.

CONSTRUCTION MANAGEMENT

- Project management, delegated administration and owner's representation under the PMBOK Guide, 8th edition (2025), from planning through to handover.
- Unit-price budgeting with in-house technical specifications, and cost control with earned value.
- Critical path scheduling and production control with Last Planner.
- Technical coordination between design and construction on the BIM model, when the project has one.
- Advice to the owner on the execution of the works and on the hiring and control of labour, without providing it directly.

COMPUTATIONAL RESEARCH

- Computational mechanics: finite elements with material and geometric nonlinearity, dynamic analysis and probabilistic analysis.
- Physics-informed artificial intelligence: physics-informed neural networks, neural operators and surrogate models.
- Uncertainty quantification: propagation, global sensitivity and prediction intervals with verified coverage.
- Inverse problems and parameter identification from observed data.
- Modelling of other systems governed by differential equations, within and beyond civil engineering.
- In-house calculation tools and engineering applications, grouped under CIVILTech.
- **Joint research.** The partner defines the phenomenon, the problem and the actual conditions of the case; the Laboratory is responsible for the formulation and the verification of the computation.

VALIDATION PROTOCOL

- **1 · Formulation.** The governing equation is written and the acceptance criteria are set before any results exist. If the base case has a closed-form solution, that is the reference.
- **2 · Calibration.** Where no analytical solution exists, the reference is built with work and energy methods: virtual work, minimum potential energy, Castigliano or Rayleigh-Ritz.
- **3 · Training.** The data cover the full domain of the phenomenon and exclude the phase 2 reference case, which is reserved for verification.
- **4 · Verification.** The result is measured against the phase 1 criteria: relative L2 error, equation residual and error in the quantities on which the decision depends.

- **5 · Review.** The model is reviewed by someone other than the person who built it. Under NASA-STD-7009B this is internal review, level 2 (tables 10 and 19); level 3 requires a reviewer external to the organization, and the documentation is prepared so that one can be added without redoing the work.

RESPONSIBILITY AND VERIFICATION

- Every result is signed by a licensed civil engineer, who is responsible for it under Colombian law.
- The validation references are external. The beam work uses the closed-form solutions and the Green's function stiffness method published in Engineering Structures and the European Journal of Mechanics.
- Professor Juan Camilo Molina Villegas, PhD, researcher at Universidad EAFIT and author of those solutions, set the specifications of the work and audits it.
- The firm also accepts an audit by a reviewer chosen by the client, with criteria set in advance and access to the data and the code.

LIMITS OF SCOPE

- Diádica is not a certifying body. It verifies that the deliverable complies with the code through its design, review and audit layers; approval rests with the competent authority.
- Internal review is identified as such. Under NASA-STD-7009B, independence is measured with respect to the organization; when an external reviewer takes part, the firm states who it is and the status of the review.
- A review in progress is reported as in progress, and no conclusions are attributed to an external reviewer before they are issued.
- Codes are cited with their edition, and only verifiable references are used.
- The method is chosen according to the problem, with preference for the simplest one that solves the case to the required accuracy.
- Enquiries outside the firm's scope are referred to whoever is appropriate.

PREVIOUS WORK

- **Portfolio.** More than 1,000 consulting and construction management projects, totalling more than 500,000 m². www.diadicaing.com/infraestructura/proyectos presents a selection of the most representative ones.
- **Structural masonry verification engine under NSR-10** (reinforced, confined and partially reinforced), coupled to CYPECAD. Seventeen comparisons against external sources, all within the acceptance criterion, and application to a five-storey building with 53 walls. In technical discussion with CYPE Ingenieros.
- **Bernoulli-Timoshenko beam on elastic foundation with physics-informed AI.** A physics-informed network trained without access to the reference solution, compared with a closed-form solution verified by four methods, with an error of 5.2×10^{-4}. Surrogate shape functions for non-uniform elements, with a median stiffness-matrix error of 9.2×10^{-5}. The formulation is by Dr. Juan Camilo Molina Villegas, of Universidad EAFIT, who supervises the development.
- **Reduced beam section (RBS) moment connection** by elastoplastic plane-stress finite elements. The hinge forms within the cut and the moment at the column face differs by 4.5 % from the AISC 358 value.
- **Slope stability by strength reduction** with elastoplastic finite elements; the failure surface emerges from the yielded zone without being assumed in advance. Factor of safety of 1.439 against 1.468 by simplified Bishop, a 2.0 % difference.
- “Evaluación de la confiabilidad estructural en cimentaciones profundas: un enfoque basado en desempeño y simulación de Monte Carlo” (Evaluation of structural reliability in deep foundations: a performance-based approach and Monte Carlo simulation). XII National Congress of Earthquake Engineering, Bogotá, June 2026. Reviewed by the scientific committee and published in the proceedings.
- Site response of mudflow deposits over saprolite of the Antioquia Batholith: 480 nonlinear finite element analyses and comparison of five AI surrogates. Paper accepted at the XIX Colombian Geotechnical Congress.
- **Learned shape functions for non-uniform beams** (in progress). A neural network that generates the shape functions of Euler-Bernoulli and Timoshenko elements with variable EI(x), in a degree-50 Legendre basis. The loss function is the strain energy alone, so the reference plays no part in training. Relative error of the order of 2×10^{-4} in the stiffness matrix, patch test at machine-epsilon level and no negative energy in 600 cases.
- Contracted research in progress, under confidentiality: validation of alternative pavements with physics-informed AI, and assessment of a prefabricated sandwich panel as a structural wall under NSR-10.

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