Example rule categorisation from Flemish accessibility regulation (VTV).

From a conceptual point of view, we identify six categories of rules or constraints to be tested, in ascending order of complexity: information availability, value range, relational, mathematical, conditional and expert checking. Those categories are also reflected in the compliance checking module. To get a thorough sense of the strengths and weaknesses of the different approaches, we distilled project rules from the Flemish accessibility regulation (VTV) (Vlaanderen en Enter sd) onto the six flavours of constraints:

i. Information availability constraint

The first check should be to evaluate if the required information is available in the building data, to ensure that an element is not skipped in the checking procedure if the required property is not present.

VTV: *Each door should have exactly one door width property*.

ii. Value constraint

Value constraints allow you to check whether a value is more/less than or equal to a nominal value as defined in the building regulations. The value to be checked is either present in the building information or is calculated in advance using a mathematical constraint (category 4).

VTV Art. 22 §2: *The structural dimensions of entrances or doorways must be at least 105 cm wide, so that after finishing, a free and level passage width of at least 90 cm is guaranteed*.

iii. Relational constraint

Relational constraints are a means of checking whether a component is present in relation to another component.

VTV Art. 20§4: *A railing must be provided on both sides of the staircase, ...*

iv. Mathematical constraint

Building codes often constrain the result of a mathematical formula that can be calculated using several properties defined in the project data. If the result is already present in the building data, the constraint is a value constraint (category 2) rather than a mathematical constraint.

VTV Art.20 §3: *The sum of two times the riser and once the tread of each step should be between 57 and 63 cm or a multiple thereof*.

v. Conditional constraint

Conditional constraints are used to define multiple cases of boundary values of one property. The legislation is often written in an 'if...then...' sentence in this case.

VTV Art. 19 §1: *The slope is at most:*
* *10 percent for level differences up to 10 cm;*
* *8.3 percent for level differences between 10 cm and 25 cm;*
* *6.25 percent for level differences between 25 cm and 50 cm;*
* *5 percent for level differences of 50 cm or bigger*.

vi. Expert constraint

A domain expert is needed to verify this part of the (sub)requirements, which is difficult to automate compared to the previous categories. Examples are complex geometric analysis (directions/positions, shapes), but also more sophisticated simulations in general (e.g., structural safety, acoustic comfort, energy efficiency, etc.) that no longer fit into a single simple equation. A third group that fits into this category are the less tangible requirements related to visual appearance in urban planning and heritage conservation.

VTV Art. 20§4: *A railing must be provided on both sides of the staircase, continuing at intermediate landings. Before the start and at the end of the stairs, the handrail must continue horizontally for at least 40 cm. If the handrail is not continuous, it should be rounded to the ground or wall*.