SUMMARY REPORT OF THE ROUND-ROBIN NR. TC2 20-1 ON FAÇADES

PERFORMED BY EGOLF WITHIN THE FRAMEWORK OF THE EUROPEAN PROJECT SI2.825082

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Foreword

This theoretical round robin is an integral part of the project for Finalisation of the European approach to assess the fire performance of facades. The results of this RR were essential to detect the possible unclear or problematic parts of the actual draft assessment method. We thank the participating EGOLF laboratories for their conscientious and valuable contributions.

SCOPE

In the frame of the European Commission project SI2.825082, a Consortium of European laboratories is currently (years 2020-2021) working out a new testing method to assess the fire performance of façades. This new testing method – which is the subject of this round robin – intends to assess the fire performance of façades. Strictly speaking, this method doesn't belong to the well-known fields of fire resistance or reaction to fire. It is based on an alternative testing approach. This new method is under development at the time of this exercise.

The first milestone of this EC project was to set up a theoretical round robin on façades within the EGOLF fire testing laboratories. The present document reports the summary of this exercise.

Contrarily to round robins organized within EGOLF in the past, the proposed exercise does not aim to assess the individual abilities of the laboratories in implementing the testing method, but well to assess the intelligibility of this new testing method. Intelligibility here refers to whether the instructions contained in it are sufficiently adequate, unambiguous and clear.

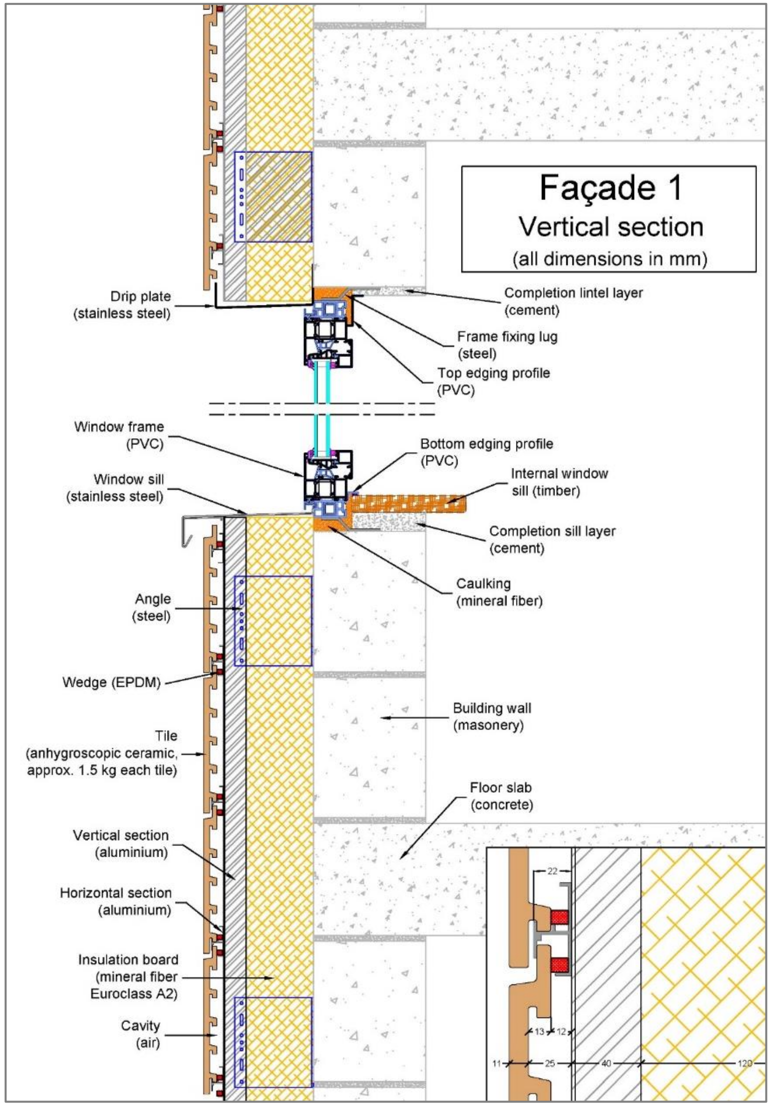
29 laboratories joined to this round robin. All participating laboratories are EGOLF members.

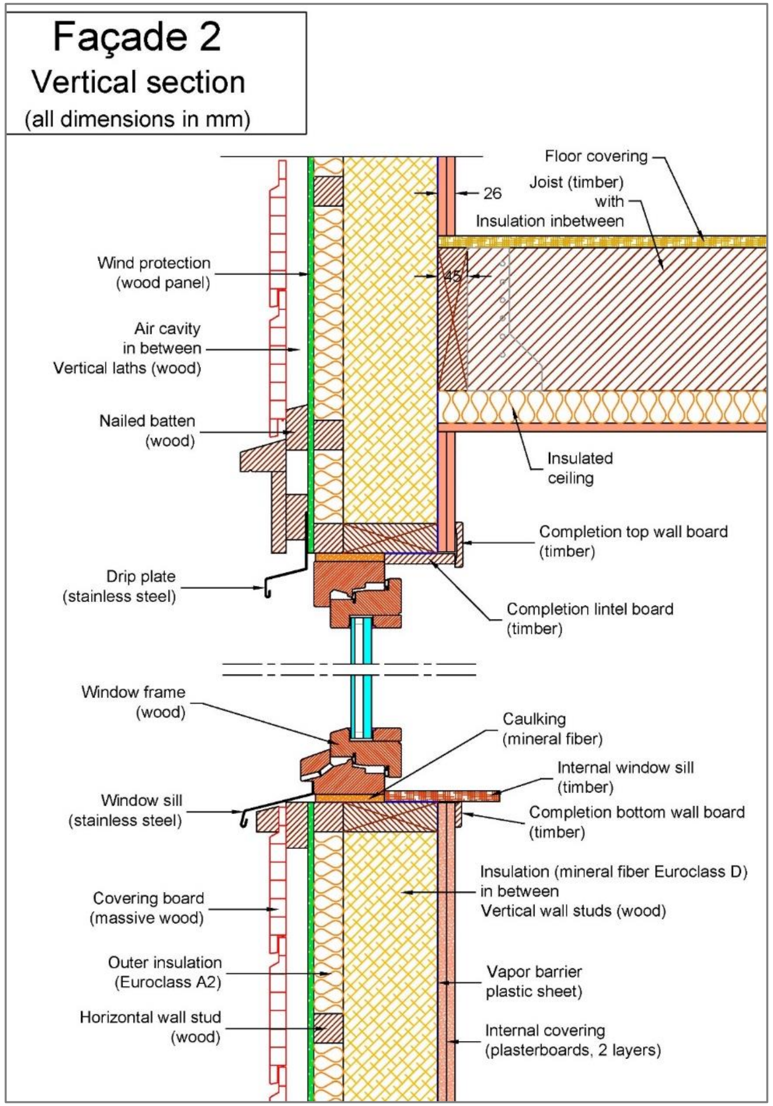
The whole project was managed by a steering group issued from the above Consortium, formed from Fabien Dumont (ULiège), Lars Boström (RISE Sweden), Johan Anderson (RISE Sweden) and Roman Chiva (Efectis France).

TEST SPECIMEN IN SUPPORT AND EXERCISES

This round robin consisted of a theoretical exercise, no tests were performed. Two different fictitious but realistic tests were used in support. The participants received a document package including the full drawings and descriptions of the fictitious test specimen, the fictitious test data, the test configurations (namely Façade 1 submitted to a large fire exposure and Façade 2 submitted to a medium fire exposure), a list of exercises, and an instruction sheet.

The participants were asked to read the assessment method and to put its requirements into practice by answering to 53 exercises related to configuring the test, setting up the equipment, analysing the supplied test data of the tests, expressing the direct field of application… Some of these exercises consisted of open questions allowing the participants to develop their reflections.


Façade 1
Vertical section
(all dimensions in mm)
Drip plate
(stainless steel)
Completion lintel layer
(cement)
Frame fixing lug
(steel)
Top edging profile
(PVC)
Window frame
(PVC)
Bottom edging profile
(PVC)
Window sill
(stainless steel)
Internal window
sill (timber)
Completion sill layer
(cement)
Caulking
(mineral fiber)
Angle
(steel)
Wedge (EPDM)
Building wall
(masonery)
Tile
(anhygroscopic ceramic,
approx. 1.5 kg each tile)
Floor slab
(concrete)
Vertical section
(aluminium)
Horizontal section
(aluminium)
Insulation board
(mineral fiber
Euroclass A2)
Cavity
(air)


Façade 2
Vertical section
(all dimensions in mm)
Floor covering
Joist (timber)
with
Insulation inbetween
26
45
Wind protection
(wood panel)
Air cavity
in between
Vertical laths (wood)
Nailed batten
(wood)
Insulated
ceiling
Completion top wall board
(timber)
Drip plate
(stainless steel)
Completion lintel board
(timber)
Window frame
(wood)
Caulking
(mineral fiber)
Internal window sill
(timber)
Window sill
(stainless steel)
Completion bottom wall board
(timber)
Insulation (mineral fiber Euroclass D)
in between
Vertical wall studs (wood)
Covering board
(massive wood)
Outer insulation
(Euroclass A2)
Vapor barrier
plastic sheet)
Horizontal wall stud
(wood)
Internal covering
(plasterboards, 2 layers)

Finally, the participants were given the opportunity to freely comment the assessment method. They were asked to explain shortly aspects that they find not sufficiently intelligible (i.e. adequate, unambiguous and clear).

ANALYSES OF THE DATA

The analyses were carried out according to the 5 steps below.

The STEP 1 consisted of determining what elements should be submitted to evaluation. Indeed, the received answers contained a substantial amount of information. Each of the 53 proposed exercises was considered as an element to evaluate, the more complex out of them being split into several items of interest when useful or necessary. This process led to identify 210 items selected for detailed evaluation.

The STEP 2 consisted of determining the correct expected answer for each evaluated item. The steering group worked out the “accepted reference values” to which the received answers shall be compared.
As a result of this step, 58 items out of 210 turned out to be not suitable for evaluation, these items being therefore not assessable. Those ones divided into 55 “ungradable items” and 3 "inaccurate items". For the first group, no correct answer could be defined by the steering group due to remaining lacks in the current version of the assessment method. For the second group, it appeared that the wording of the related questions was not accurate enough, with the unwanted consequence that various acceptable answers could be issued. It was decided to keep these unsuitable items in the list of exercises because some interesting information could be learned from the answers of the participants facing these questions, and this information will help improve the method. Finally, 13 items out of 210 were related to questions which specifically intended to collect open information about the need or the experience of the labs, these 13 "informative items" being not assessable.
The same classification into gradable, ungradable, inaccurate or informative could then be assigned to each question based on the classification of their constitutive items. As a result, the 53 questions broke down into:

- 44 gradable questions
- 3 ungradable questions
- 2 inaccurate questions
- 4 informative questions

The STEP 3 consisted of assigning numerical points to the answer of each lab for each evaluated item, in order to allow the forthcoming graphical and numerical processing. For that purpose, the following predefined 2-level grading was set up and used by the steering group: 1 point was given to correct answers and 0 point was given to incorrect answers. For the purpose of the analyses, the answers graded as being "I don't know", irrelevant, incomprehensible or missing were considered as "incorrect answers".

The STEP 4 consisted of computing global scores to questions. For each gradable question, a score was computed as being the average – expressed in percent – of the labs' points to the items related to that question. The scores are a picture of the level of agreement between the participants on the correct answer. The higher the score, the more intelligible the question can be assumed, so does the related requirement of the assessment method.

The STEP 5 consisted of assigning ranks to questions. For each gradable question, a rank was then deduced from the questions' scores by assigning the rank 1 to the question having the smallest score, rank 2 to the question having the next upper score… up to rank 44 to the question having the highest score. The rank-sorting provides a simple method to identify the questions having the most extreme results. They will be used to set an order of priority in the requirements of the assessment method to be improved, by starting to focus on the questions with the lowest ranks.

> *Note:*
> *The ungradable questions point out existing deficiencies in the current version of the assessment method, hence they should be handled with some kind of priority to be improved. For this reason, while no score is computable for them, the ungradable questions were conventionally ranked at 0.*

RESULTS

The 5-step data processing presented above was carried out, resulting in scoring and grading the 44 gradable questions. Some graphical and numerical basic processing were implemented to allow deducing a clear picture of the intelligibility of each evaluated question.

For convenience, a 3-level colour code has been applied to the scores, making it easy to locate the highest and the lowest scores at a glance. Note that this 3-level colour code has been chosen purely arbitrarily, the aim is to allow a quick overview of the results. The following frequency distribution for the scores of the 44 gradable questions:

0% ≤ score ≤ 50%	→ 4 questions (with a poor intelligibility, minority of agreement)
50% < score < 75%	→ 13 questions (with a questionable intelligibility, low majority of agreement)
75% ≤ score ≤ 100%	→ 27 questions (with a good intelligibility, strong majority of agreement)

The global mean score computed on the gradable questions is 76,2%.

Out of the 29 participants, 16 reported detailed practical experience with façade testing according to national methods, while 13 did not. In order to know if such experience could have any influence on the results of this round robin, scores were computed for each participant as the average of their points to each item. On average, the experienced labs were found to have a 7,3% higher score than the inexperienced labs. A Student's t-test concluded that there was indeed a significant difference between the means of these two groups: the average of the experienced labs was significantly higher than the average of the inexperienced labs, experienced labs were thus very likely to have a higher score than the inexperienced labs.

The bar-plot below gives a clear and direct overview of which aspects are affected by poor or questionable intelligibility (lower and intermediate scores). In particular, the questions appear from the bottom to the top of the graph in ascending order of score and thus in descending order of rank.

The aspects having a poor or questionable intelligibility allowed to list the most defective sections of the current assessment method. A deeper analysis pointed out the following ones which particularly need to be improved in priority:

Chapter in the assessment method	Object
7.1 – 7.3	Fixation of the test specimen on the test rig

7.3	Configuration of the interface between the test specimen and the edges of openings, including the presence of the frame
7.4	Practical configuration of the façade-to-floor junction (when assessed), especially the exact positions where the thermocouples shall be placed
8	Way to manage the conditioning of the test specimen, including the use of a mock-up
9.1.3	Practical configuration of the internal thermocouples, especially the identification of the layers where thermocouples should be placed
11 – 12.I	Assessing the test results according to the definitions of the performance criteria, both fire spread and falling parts performance criteria give rise to errors
13	Declaration of the direct field of application, especially the kind of frame that can be fitted around openings

RECOMMENDATIONS

The analyses carried above, the errors and misunderstandings that have been detected in the answers, the comments received, and the discussions within the steering group members were used to draw up recommendations to improve the assessment method. The main proposals are presented below, each one is referencing to the related section in the assessment method.

4.3 Structural frame

The assessment method should propose a description of a harmonised structural frame, including: drawings, materials, cross sections, mounting, position of the transoms in relation to the floor levels (in any relation…), any protection of the frame from heat in case of failure.

4.5 Combustion chamber

The assessment method should give details on how to configure the junction between the test rig and the walls of the combustion chamber (when the structural frame is used alone, and when both supporting construction and structural frame are used together).

7 Mounting of the test specimen

The assessment method should provide detailed practical rules for the configuration of the interface between the test specimen and the edges at the combustion chamber on the one hand and at the secondary opening on the other hand. Practically, it should be acknowledged that some differences could appear between both openings.
It also turns out that the current DIAP rule that allows "any kind of frame at the openings if the test has been performed without any frame" may be non-conservative. An idea could be to use standardised frames to configure the test specimen. For this purpose, a combustible frame and a non-combustible frame should be defined.
Examples should be given in drawings in annex.

7.1 Selection of the test rig

In cases of façade systems consisting of a full stand-alone external wall, it should be mentioned that the test specimen shall be mounted directly on the structural frame, and that mounting on a supporting construction is not allowed in that case.

7.3 Test specimen

Detailed explanations should be given about the fixation of the test specimen on the test rig. An idea to investigate could be to recreate the building floor slab noses at appropriate heights by means of horizontal beams of the same material and thickness as in practice (concrete, timber…) fixed to front side of the structural frame, the whole façade can then be mounted as in practice.
Examples should be given in drawings in annex.

7.4 Junction between façade and floor (optional test procedure) and Annex D

The annex D requires the roof of the combustion chamber to be replaced by the representative floor intended to be used in practice. Examples of such configuration should be given in drawings.
The exact positions where the thermocouples shall be placed should be exemplified by some examples given in drawings in annex.

8 Conditioning of test specimen

It should be made clear that in presence of any hygroscopic materials, the stabilization of the moisture content shall be followed up by means of a mock-up, and if not then the conditioning shall be made in accordance with the test sponsor's specifications. A logical decision-making list could be proposed to insist on this simple requirement.
This will also imply to give a non-ambiguous definition and examples of hygroscopic materials.
Dimensions of the mock-up and the faces to cover in plastic should be exemplified in drawings.

9.1.3 Internal thermocouples

The assessment method requires to position internal thermocouples at the mid-depth of each combustible layer and air cavity, and a reminder that "combustible" is defined in chapter 3. The assessment method should insist that when no information on reaction to fire is available for a layer of material, then it is mandatory to place thermocouples in this layer.
Examples should be given in drawings in annex.

11 Performance criteria and 12.l Test report

The criteria could be based on the absolute temperature instead of the temperature rise.
Several simple numerical examples should be given in annex regarding the application of the criteria definitions. Examples with and without the occurrence of a failure should be given.

13 Direct field of application

The direct field of application is of first importance for the industry and should be clarified. It will probably need to be handled by future extra-works.

14 Classification

Several simple numerical examples should be given regarding the application of the classification definitions.