Finalisation of the European approach to assess the fire performance of façades

Draft progress report 3

Project: SI2.825082

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Preface

The progress report presents the results obtained during March 2020 to May 2022 with focus on the second year of the project. The initial stages of this project have focused on establishing the comprehensibility of the assessment method evaluated by a theoretical round robin and the initial testing activities to determine variations and defining the wood cribs to be used for the experimental program.

The results from the theoretical round robin together with input from stakeholders and other liaisons has been used to identify where the readability and comprehensibility of the assessment method needs to be improved. The initial testing activity has benefitted from an extensive literature survey of the parameters influencing the burning of wood cribs and interactions with the combustion chamber. A theoretical study, including numerical modelling, has been performed to investigate the effect on the heat exposure to the specimen when geometrical changes are made on the combustion chamber. The wood crib tests in accordance with the original test plan, as well as some additional wood crib tests, have been performed and analysed. The results from the theoretical investigation and the experimental study have been the basis for a proposal on the appropriate tolerances of the wood cribs and the design of the combustion chamber to be used in the next test series which is the experimental round robin. During 2021, full scale testing with inert and combustible façade materials were performed for both medium and large scale to test repeatability and placement of secondary opening.

Finally, the consortium would like to thank the participants in the theoretical round robin, the stakeholders and liaisons for their valuable input, support and commitment to the project, and the Swedish Wood for supplying the wood for the wood crib tests.
Summary

This progress report summarises the work carried out during the second year in project SI2.825082 financed by the European Commission – DG GROW, with focus on the progress during the latest six months. As reported earlier, the main activities have so far been to perform a theoretical round robin with the aim to analyse how the current draft of the assessment method is interpreted by different laboratories, and to plan and carry out the first and second phase of the initial testing activities where the fire source, the design of the combustion chamber and secondary opening have been investigated. Furthermore, a substantial work has been done to ensure that the project is communicated in a good way to all stakeholders.

The theoretical round robin was performed with 29 participating laboratories, all members of EGOLF. Over 200 questions covering the whole assessment method were asked, and thereafter analysed. The results show clearly which parts of the assessment method needs to be improved and clarified, as well as some practical details regarding the test method that needs to be handled.

The first phase of the initial testing program defined the requirements of the fuel source and the combustion chamber. A large quantity of wood, of two different wood species (spruce and pine), has been acquired and thereafter characterised by measurement of dimensions, weight and moisture content. Over 4000 sticks have thus been density graded. After the selection of sticks to the different wood cribs a series of tests have been performed, mainly in accordance with the original test plan. Some modifications to the test plan were made during the course of the experimental study, e.g. tests with a crib platform with either a grated or a solid floor. Also, a theoretical study through numerical modelling has been made to study the impact of changes of the combustion chamber geometry on the heat exposure to the test specimen. The simulations showed only small deviations between the regular and the enlarged combustion chamber. The changes of the geometry of the combustion chamber for the large exposure test can be done according to the results from the experimental program, it is beneficial for two reasons: it would make the preparatory work when mounting the test specimen simpler and it would ensure that falling parts will not damage the wood crib during a test.

Based on the results obtained a proposal has been made on the characteristics of the fuel source and the geometry and design of the combustion chamber.

During the second phase of the initial testing activities large and medium scale testing was performed on full façade geometries. The testing program including three repeatability tests in addition to gathering information on variation in volume flow of the fan in medium scale as well as effects of the modified combustion chamber and wind in large scale. From the repeatability tests it was decided to keep a constant height of the wood crib in large scale due to otherwise large variations in fuel source. Furthermore, the wind effects on the façade temperatures were significant even with a moderate wind of 1-2 m/s. At the end of the second phase three tests in medium and three tests in large scale were done to investigate the effect of a secondary opening, it was indicated that asymmetrically placed opening would be the most appropriate placement.

A short test series on alternative fuel source was also performed where a propane diffusion burner was used instead of wood cribs. It was shown that if the combustion
chamber would be reduced in height similar exposure to the façade could be achieved using the propane burner. There are several benefits with decreased height, less cleaning, higher safety and therefore less costs associated to testing.

An update of the assessment method was made to take into account the latest information such as the repeatability tests and the second phase of the testing program. These changes such as the placement of the wood crib and the secondary opening will be evaluated in the coming experimental round robin. A description of the changes made can be found in section 2.5.

In tandem to this work, two surveys on falling parts were performed in particular to find out the needs of MS and setting criteria to be used during the round robin. Furthermore, an inquiry on the capacities of different testing laboratories connected with EGOLF was made and is reported here.

The work on the experimental round robin has started and a short presentation of the tests and specimens to be used are discussed in this report.

The project has been communicated through different channels. The project web page is the main communication channel where all reports and other documentation is published (https://www.ri.se/en/what-we-do/projects/finalisation-of-the-european-approach-to-assess-the-fire-performance-of-facades). In addition to the webpage a youtube channel is available showing a few of the tests and recent seminars, see webpage for a link. Several web-based meetings have been held with different stakeholders. A discussion and an extra meeting with the steering group of the project has been held where some fundamental questions were raised and answered. One important outcome was to arrange more frequent meetings with the steering group, especially when important decisions are needed for the continuation of the project. A Comment Handling Document has been made, and so far, almost 500 comments have been received. These comments are handled continuously and communicated on the above-mentioned web page.

Due to the Corona pandemic, it has not been possible to work as efficiently as expected, and therefore the original time schedule has not been possible to follow as it was planned. It is mainly the initial tests that have been affected at present. There is a risk that further delays can be expected if the pandemic continues, especially regarding the experimental round robin where travelling between different countries is needed.
1 Introduction

The present report is the third in a series of progress reports in the project SI2 25082 financed by the European Commission. The report will present the progress and current status of the project. The conclusions as well as proposals made at this stage may be changed at a later stage in the project when more information is available.

The main activities performed so far in the project are the following:

- Establishment of an information transfer platform
- Execution of the theoretical round robin and analysis of the results
- Planning and start of initial tests
- Wood crib tests and analysis of results
- Proposal on wood crib characteristics and design of the combustion chamber
- Questionnaires on falling parts and capacities of test laboratories within EU.
- Updated assessment method document
- Additional tests in medium scale
- Secondary opening tests
- Test specimens for the experimental round robin

Since inception of the project several reports have been published on the project homepage (https://www.ri.se/en/what-we-do/projects/finalisation-of-the-european-approach-to-assess-the-fire-performance-of-facades), these are listed below in different categories.

Project reports

1. Inception report
2. Progress Report 1
3. Progress Report 2

Test reports

1. Test Report Large Wood Crib Test
2. Test Data Large Exposure Crib
3. Test Report Medium Wood Crib Test
4. Test Data Medium Exposure Crib
5. Test Report Large Scale
6. Test Data Large Scale Tests
7. Test Report Medium Scale
8. Test Data Medium Scale Tests
9. Role of secondary opening in large exposure tests
10. Medium scale testing including secondary opening

Questionnaires and round robin reports

1. The Theoretical Round Robin Report
2. Theoretical Round Robin Summary Report
3. Summary Questionnaire on Falling Parts 2021 09 08

Assessment method documents

1. Assessment method - dated 2020 05 07 - SI 2 825082
2. Assessment method - dated 2020 11 18 with comments
3. Assessment method - dated 2022 05 12 - SI 2 825082

Comments Handling Documents and Q&A

1. Comments Handling Document - dated 2020 07 22
2. Comments Handling Document - dated 2020 10 23
3. Comments Handling Document - dated 2020 11 18
5. Steering Group Meeting Q&A
6. Answers on questions on the facade assessment project - REV1
7. Comments Handling Document - dated 2021 12 03
2 Theoretical round robin and assessment method

2.1 Aim

The aim with the theoretical round robin was to evaluate whether the assessment method is written in such way that it is interpreted similarly and correctly, and to identify the parts where different interpretations were observed. Thereafter, improvements to the assessment method to minimize different interpretations are made. A discussion on the questionnaires and the updated assessment method is also included.

2.2 Status of the theoretical round robin

The theoretical round robin has been finalized and reported in Progress report 1. The comments and conclusions from the exercise have been used when updating the Assessment method. Although, several comments still need to be addressed in the Assessment method, and this will be done later when more information and practical experience is available.

2.3 Questionnaire regarding capacity of test laboratories with EU

In the comment handling document, some members of the steering group raised the interesting question of how many laboratories would be able to perform indoor or outdoor façade testing when the assessment method will be released.

To answer this question, the EGOLF members have been surveyed. EGOLF has 64 member laboratories, 61 being located in Europe, the 3 non-European ones being in Hong Kong, Israel, and UAE.

2.3.1 Indoor testing on facades

Current situation of the existing facilities

To date, 12 labs are equipped with indoor test rig. The façade heights that can be tested ranges from 3 m to 13 m, according to the following frequency distribution:
In other words, 12 labs are able to test facades up to 3 m high, 6 labs are able to test facades up to 7.5 m high, 1 lab is able to test facades up to 13 m high. These 12 labs are located in the 11 countries identified in blue on the map below.

**Future intentions**

In the case where a new European method would be published in the future, 19 labs would eventually develop facilities to perform indoor tests on façades. Among them, 11 labs would plan a maximum testing capacity less than 8 m in height, and 8 labs a maximum testing capacity of 8 m in height or more.
These 19 labs are located in the 14 countries identified in blue on the map below, as well as in Hong Kong.

Figure 3. Geographical distribution of labs with intentions to reach ability of façade testing with at least 8 m height.

### 2.3.2 Outdoor testing on facades

**Current situation of the existing facilities**

To date, 7 labs are equipped with indoor test rig. The facade heights that can be tested ranges from 2.4 m to 20 m, according to the following frequency distribution:

![Outdoor testing distribution](image)

Figure 4. Number of labs able to perform outdoor testing.

In other words, 7 labs are able to test facades up to 2.4 m high, 5 labs are able to test facades up to 9 m high, 1 lab is able to test facades up to 20 m high.
These 7 labs are located in the 6 countries identified in blue on the map below, as well as in Hong Kong.

![Geographical distribution of labs able to perform outdoor testing.](image)

**Future intentions**

In the case where a new European method would be published in the future, 12 labs would eventually develop facilities to perform indoor tests on façades. Among them, 3 labs would plan a maximum testing capacity less than 8 m in height, and 9 labs a maximum testing capacity of 8 m in height or more.

These 12 labs are located in the 9 countries identified in blue on the map below, as well as in Hong Kong.
2.4 Questionnaires regarding falling parts

Stakeholders were asked to fill out a Questionnaire regarding the future measurement and assessment of falling parts. This questionnaire contained six questions covering a wide range of topics about falling parts as weight, area and burning/non-burning of the parts as well as past experiences with falling parts and requirements. Background of the need for a second Questionnaire was that in the previous round of questions, the project team got 12 answers from the Stakeholder group on the questionnaire about the further development to assess falling parts in the European assessment method. Seven countries sent an answer as well as five associations. Further exploration on the specifics of the falling parts was indicated from the answers and discussion. The questionnaire was used to determine the appropriate criteria for falling parts to be used in the round robin. Note that these may be updated after the round robin to take into account the experimental findings.

Basis of the questions was the draft proposal in its then current status in chapter 11.2 which is given here for completeness:

11.2 Falling parts
Falling parts include all solid or liquid material falling from the test specimen.
The registered time is the time in completed minutes for which any parts falling from the test specimen do not constitute a risk for the evacuation, the rescue personnel nor the fire brigade, or for fire spread downwards. The failure of the falling parts performance is deemed to have occurred when one of the criteria below has failed.

11.2.1 Mass
The failure of mass criterion occurs when:
- any individual falling part exceeds 1 kg in mass, or
- the cumulated falling parts since the commencement of the test exceeds 20 kg in mass.
The time of failure shall be reported as the time at which the falling part touches the ground; i.e. the falling part shall have completely broken off from the façade, without being still hung somewhere. The mass criterion is assessed by a load cell platform (still to be described in Annex A).

11.2.2 Sustained flaming

The failure of sustained flaming criterion occurs when any burning material on the ground produces a continuous flaming during a period of time greater than 10 s. The time of failure shall be reported as the time at the end of this 10 seconds burning period; i.e. when the observation is finally made. The sustained flaming criterion is assessed by visual observations, possibly supported by video recording.

The Questionnaire contained the following six questions:

1. What should be the levels to be used in the method?
   - Any individual falling part exceeds 1 kg in mass. Should this be 1 kg or 3 kg?
   - The failure of sustained flaming criterion occurs when any burning material on the ground produces a continuous flaming during a period of time greater than 10 s or 30 s?

2. If scientific evidence is present suggesting other limits or the possibility of easy assessment of the size, different masses or methods to assess falling parts can be provided. Furthermore, if by providing good evidence for a different position regarding the number of classes a different classification system for falling debris may be suggested.

3. In case the regulations or standards contain clauses related to falling parts or debris resulting from buildings on fire, could you please provide a detailed description of the motivation (why) to have such clauses?
   - Could you please provide details as to from which time during the fire development and until which time these clauses apply?
   - In the case there are specific restrictions as regards weight or sizes, could you provide the background of (and possibly even the research behind) these criteria?
   - In the case there are specific restrictions as regards melted and/or flaming parts and droplets, could you provide the background of (and possibly even the research behind) these criteria?
   - In the case there are specific criteria as regards the (non) tolerated distance or area from the façade, could you provide the background of (and possibly even the research behind) these criteria?
   - In the case this is considered relevant by you, and not yet provided in the answers above, could you indicate if and how the importance or relevance of the criteria are ranked?

4. Are there any specific fire incidents that have led to the adoption of such clauses? If so, could you please provide some details and references to these events?
5. Falling parts and debris may also result from other than fire incidents (e.g. gas-explosion, wind gusts, deterioration of fixings, accidental damage due to cleaning, etc.), in which case occupants and by-passers are likely to be even less-prepared. In how far should fire regulations and standards be more or less strict compared to other incidents?

6. Besides fire testing on and classification or certification of façade assemblies and products, there are potentially also other ways to mitigate the risk of falling parts and debris as a result of a building fire. E.g. rules of engagement and protection equipment of the fire brigade, and covered in- and/or egress paths of occupants. In how far is your regulation allowing for such approaches?

Summary of answers from stakeholders:

For 1. question:
For the first questions about the weight of falling parts that should be assessed, half of the answers stated that they think that no quantitative criteria are possible because of lack of research at present time. The other half of the answers for divided between 1 and 5 kg and most of the answers recognised the need of several steps, i.e. 1 and 5 kg. Several answers regarded the total weight of the falling parts as necessary to assess as it would give an indication of the mechanical stability of the façade.
Note: the weight of the falling part is assessed if the part is not burning.

If the part is assessed as burning falling part the test is failed.
With regard to the note it was important to clarify when a part is considered as burning part. On the one hand, a tiny part could probably be ignored even if sustained flaming occurs. On the other hand a bigger part only burning for a very short time wouldn’t need to be counted as burning probably as well. Regarding this topic the Questionnaire asked for recommendations about the time after which a part is considered as burning, the result was that most answers recommended 30 s as sufficient time for sustained flaming of a falling part.

Two countries recommend to assess the area of falling parts as well, Austria and Sweden as they currently have regulations for the maximum allowed areas of falling parts: 0,4 m² (Austria) and 0,1 m² (Sweden). This has to be discussed further after the Round Robin exercise.

For 2. question:
There are no regulatory requirements in Germany regarding the limitation of the mass of non-burning falling parts of external wall cladding. However, es explained to no. 1.), a possible limit could be "lower or equal to 5 kg for any individual falling part".
On the other side, there is an expectation (especially from German fire brigades) that mechanical collapsing of a tested façade is limited to that area of the façade being directly exposed by the flames of the primary fire source (cf. answer to question no. 3b). But the assessment of the size of this area is always a case-by-case evaluation. No specific criteria can be given for that.

The time of given “part falling off”. In general, in case of fire, after the time required for the rescue teams to arrive (secure the area, navigate the evacuation), the threat is relatively less serious. The 5 kg criteria make sense because it is connected to how fire fighter helmet is designed and how it is tested for impact of falling part.
The area of single “part falling off”. Falling parts of relatively small masses may fly tens of meters away from façade when they area is big enough. We propose 0,25 m$^2$ as a limit.

A proposal could be to calculate the energy of the impact (force) of the falling parts when touching the cell platform as this could provide additional information, like for example the height of the falling parts.

For 3. question:

a. Safety objective of the national test method is to consider the second floor above the floor where the fire occurs primarily. The time scale is based on the experimental results (Kothoff at all, MATEC Web of Conferences 9, 02010 (2013, DOI: 10.1051/mateconf/20130902010) which can be summarized such, that the vertical fire spread from floor to floor takes place every 10 to 15 minutes, even in a fully non-combustible façade-environment.

Falling parts are therefore detected during the entire test duration of 30 min

From flashover through a window until the fire load in the test is finished. In a real fire about the same time evacuation is possible and until the fire brigade can apply water from the outside, about the first 30 minutes of the fire.

Large enough to allow some miner parts of rendering etc. to fall off due to spalling, but not as big as they become a major threat to people’s safety.

b. No specific regulation on facades and burning droplets, but some general rules apply to the entire building. The background for these are from the principals in the ID II document and the annex to CPR/CPD “The generation and spread of fire and smoke within the works are limited”. This is the same basis as the burning droplets in the Euroclass system and SBI method.

c. Regulations are never ranked against each over. All relevant rules must be fulfilled in order to follow the entire building code.

In the Netherlands Euroclass B (and in the future some A2) without droplets subclass

d. These parts are not allowed according to the Austrian test standard in order to avoid a possible fire propagation caused by the flaming parts onto combustible substances on the floor area (such as bushes, ...).

e. In Polish national regulations we have the following requirement: Elements of façade claddings should be fixed to the building in a manner preventing their falling out during a fire in a time shorter than resulting from the required fire resistance rating for an external wall, (...) correspondingly to the fire resistance rating of the building to which they are mounted.

This provision, in unchanged form, is existing in Poland since 2002.

We believe the existence of “falling parts” criteria is necessary to have a practical tool to check if the basic provisions for buildings ( CPR 305/2011: ANNEX 1 / BASIC REQUIREMENTS FOR CONSTRUCTION WORKS / 2. Safety in case of fire /(c) the spread of fire to neighbouring construction works is limited; (d) occupants can leave
the construction works or be rescued by other means; (e) the safety of rescue teams is taken into consideration.) are met.

There is a demand in Finland's fire regulations (848/2017), that falling of large parts of façade wall must be prevented in case of fire.

From our point of view, only the large-scale failure and falling off of the facade must be reliably prevented. This can be derived very well from qualitative statements and images in the test report.

Conclusions for 2. and 3. questions:

Several countries acknowledge the danger from falling parts to people, fire fighters and that they can cause spread of fire. It is agreed that spread of fire should not be allowed. Total instability of the façade is acknowledged as a problem that needs prevention as well. Several countries have regulations to prevent falling parts that can harm people.

Note: Measurement of area of falling parts is seen as a challenge by the project team as parts can break when they fell and are generally not easy to be assessed during the test. This is even more complicated for the recommended measuring of impact of the falling part. It is not clear how that could be practicably done.

4. Question:
Balconies and loggias can favour the action of rescuing people, L or T-shaped buildings increase the risk of fire propagation. Although very limited number of events were mentioned, several countries acknowledge that falling parts are included in their building regulations, often qualitative.

5. Question:
Most countries think the safety level should be the same in fire and other incidents regarding falling parts.

6. Question:
Several countries answer that mitigation of risk through other measures may be allowed under certain circumstances, several mention that the regulation of building safety should not regulate how a possible fire fighters intervention have to be designed.

2.5 Updates of the assessment method

The assessment method has been updated in several aspects, e.g. the tolerances on the fuel source and the placement of the secondary opening have been set. A methodology for assessing falling parts is presented based on two questionnaires, the suggested criteria are implemented in the assessment method. In this report the main changes of the method will be discussed however there are many smaller changes in wordings and more specific language throughout the document which will not be discussed further here.
2.5.1 The combustion chamber

The combustion chamber to be used in the round robin is now fixed with the following specifications, see Table 1. Note that no change has been done to the medium fire and that the size of the large combustion chamber has been tested accordingly after the preliminary computer simulated design, see chapter 3.3.

Table 1. Specification of combustion chambers.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Medium fire exposure</th>
<th>Large fire exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance of combustion chamber opening from finished corner (mm)*</td>
<td>0</td>
<td>250 ± 10</td>
</tr>
<tr>
<td>Height of combustion chamber opening (mm)</td>
<td>1000 ± 50</td>
<td>1900 ± 50</td>
</tr>
<tr>
<td>Width of combustion chamber opening (mm)</td>
<td>1000 ± 50</td>
<td>2000 ± 50</td>
</tr>
<tr>
<td>Internal height of the combustion chamber (mm)</td>
<td>1000 ± 50</td>
<td>2100 ± 50</td>
</tr>
<tr>
<td>Internal width of the combustion chamber (mm)</td>
<td>1000 ± 50</td>
<td>2400 ± 50</td>
</tr>
<tr>
<td>Depth of combustion chamber (mm) (inside back wall to front surface)</td>
<td>800 ± 50</td>
<td>1300 ± 50</td>
</tr>
<tr>
<td>Opening for Forced Ventilation</td>
<td>Round of 300 mm in diameter A fan shall be located behind the rear wall of the combustion chamber and blow 400 ± 40 m³/h fresh air in the combustion chamber</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

* To fulfil this requirement for any thickness of the tested façade, it is recommended to design a flexible test rig (see note in assessment method document 4.2).

The combustion chamber walls and roof shall be made of a non-combustible construction. The inner surfaces of the combustion chamber shall be cladded with insulation (ceramic or equivalent).

2.5.2 Fuel source

The fuel source consists of a wood crib detailed in Table 2 below and located in the combustion chamber defined as in section 4.5 of the assessment method. The fuel source is similar to the cribs presented in Progress Report 2 where the medium crib is as specified in the DIN 4102-20, regarding the large crib we have, however, also imposed a height restriction to the large crib as 110 ± 2.5 cm to reduce the variation in fire load in the method.

2.5.3 The secondary opening

The objective of the secondary opening is to simulate the presence of any kind of feature – such as windows - at levels above the fire source opening. The main face of the test specimen and of the test rig (structural frame/supporting construction) shall incorporate a secondary opening as described below. The secondary opening is asymmetrically placed in relation to the fuel source.
Large scale

The secondary opening shall be 1200 mm width, 1200 mm height. It shall be located 1500 mm above the top of the combustion chamber and 1250 mm from the finished corner. See figure 10a in the assessment method.

Medium scale

The secondary opening shall be 1200 mm width, 1200 mm height. It shall be located 1000 mm above the top of the combustion chamber and 500 mm from the finished corner. Note that the secondary opening for medium scale is moved closer to the fuel source.

The objective is, both in medium and large scale, thus to be able to test the interaction between the secondary opening fittings, wall cladding and the fuel source.

2.5.4 Falling parts

A weighing load cell platform with an accuracy of ± 50 g shall be used to measure the mass of falling parts during the test. A plate that covers the rectangular area which is defined by the main face and the wing as shown in Figure 7 shall be used on top of the weighing cell platform to collect falling parts during the test. A software shall be used that allows the automatic and continuous measurements and recording of the weight. The weight over time shall be documented.

Figure 7. Placement of measurement platform for falling parts.

After evaluation of the questionnaire on falling parts the following improvements on the criteria in the Assessment method are recommended:

- Limits for individual falling part (not burning), mass of 1 and 5 kg.
• Total amount is either less than 10 kg or other sufficient criterion to prevent total mechanical failure of the façade.
• Time (sustained flaming) to recognise a falling part as burning: 30 s.

Note 1: The limits for the weight of the falling parts are only applied to non-burning falling parts as burning parts are recognised as failure criterion for the test.

Note 2: As a tiny falling burning part would lead to failure of the test a minimum required weight / area is thought to be introduced after the Round Robin.

### 2.5.5 Uplift

It was determined from the full inert tests (section 3.3.1.1) that several combustible materials such as paper, XPS or polyethylene, ignited at 1-2 m distance from the façade using a 0.5 m uplift. It is also concluded that collapse of the crib at the later stages will destroy assessment of the falling parts even if they have not ignited previously. Therefore, it was decided that the falling parts should be assessed at the moment they touch the floor and that there therefore is no need for an uplift. This will also save considerable costs to the test facilities and increase the number of labs that can perform the test.

### 2.5.6 Mounting and specimen

In general, the test specimen shall be installed on both the main wall and the wing as in practice. Among others, it shall be mounted with access only from areas that are actually accessible in real buildings and be installed as far as possible by the same method and procedures as in practice. It is not allowed to mount the specimen on the main face and the wing separately, and afterwards assemble the main face and the wing, since such mounting would not be possible in any real building.

The openings on all sides of the secondary opening and the left, right and top edge of the combustion chamber should be closed as similar to end use as possible. In case end use conditions are not known, a general closing may be used such as thin aluminium or steel plate, that would allow for different details to be fitted at the edge.
3 Introductory tests

3.1 Literature survey

The literature survey was published in Progress report 1. The content of the survey constituted the basis for which the initial testing program was planned and conducted.

3.2 Wood crib tests

The main part of the wood crib tests was originally published in Progress report 2, it is here summarized for completeness since it is a part of the initial testing activities. The initial aim was to have as similar as possible characteristics of the fuel source for the medium and large heat exposure tests. It has been shown that this will be difficult to achieve, and at the same time have a cost-effective test procedure.

A test program including 4 medium wood cribs and 9 large wood cribs has been performed and analysed. Furthermore, numerical simulations of the fire dynamics and the effects of the size and shape of the combustion chamber have been done. The aim of these studies has been to define the wood cribs and combustion chamber for the following test series. Table 2 summarizes the proposed fuel source and combustion chamber, as well as a reference to the chapter discussing the actual parameter. Here, the effect of moisture and density is primarily a delay in the growth phase of the fire thus for the whole test procedure this is of smaller importance than e.g. height of the wood crib. Note that a part of the façade (> 1 m) was added above the combustion chamber in order to be able to assess the impact on the façade. The crib for the medium heat exposure test is much smaller and more sensitive to changes in density, and probably also to cross-sectional dimensions of the sticks, and therefore stricter tolerances and requirements are proposed.

The crib for the large heat exposure crib is proposed to be made of spruce, which is a deviation from BS 8414 which states pine. The tests show that with spruce the HRR and temperatures are significantly lower compared with cribs of pine. Although, the spruce cribs are shown to be in accordance with the tolerances and the target values given in BS 8414. Other full-scale tests with real fires also show that the values on HRR and temperatures reached with spruce cribs are representative for a severe fire.

After the wood crib tests it was proposed that in both the medium and large heat exposure tests to use a target weight of the wood crib, i.e. it is not defined the number of sticks to be used as in BS 8414. For the large heat exposure, the method for determining the number of layers to be used in the crib is proposed based on height, instead of only weight since it was found that after additional testing in the large scale fire it is evident that the height of the crib is significant in determining the fire impact on the façade, thus finally a nominal height of 110 cm is proposed, as is discussed in 3.2 in Progress report 2.
Table 2. Proposal on fuel source and geometry of combustion chamber, argument refers to the chapter in Progress report 2.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Medium test</th>
<th>Large test</th>
<th>Argument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood species</td>
<td>Spruce (Picea abies)</td>
<td>Spruce (Picea abies)</td>
<td>Chapter 3.2.3</td>
</tr>
<tr>
<td>Cross section of sticks</td>
<td>$40 \times 40 \text{ mm}^2 \pm 1 \text{ mm}$</td>
<td>$47 \times 47 \text{ mm}^2 \pm 3 \text{ mm}$</td>
<td>Chapter 3.2.9</td>
</tr>
<tr>
<td>Length of sticks</td>
<td>$500 \pm 5 \text{ mm}$</td>
<td>Long: $1500 \pm 5 \text{ mm}$</td>
<td>Chapter 3.2.9</td>
</tr>
<tr>
<td>Nominal density of sticks</td>
<td>$475 \pm 25 \text{ kg/m}^3$</td>
<td>$500 \pm 100 \text{ kg/m}^3$</td>
<td>Chapter 3.2.5</td>
</tr>
<tr>
<td>Weight of crib</td>
<td>$30 \pm 1.5 \text{ kg}$</td>
<td>$350 \pm 20 \text{ kg}$</td>
<td>Chapter 3.2.5</td>
</tr>
<tr>
<td>Number of sticks per layer and number of layers</td>
<td>6 sticks per layer</td>
<td>Long: 10 sticks/layer</td>
<td>Chapter 3.2.9 and RISE Report 2021:85.</td>
</tr>
<tr>
<td>Joining of sticks</td>
<td>Nailing</td>
<td>Nailing</td>
<td>Chapter 3.2.8</td>
</tr>
<tr>
<td>Moisture content</td>
<td>$11 \pm 2 %$</td>
<td>$11 \pm 2 %$</td>
<td>Chapter 3.2.4</td>
</tr>
<tr>
<td>Surface finish</td>
<td>Planed</td>
<td>Sawn or planed</td>
<td>Chapter 3.2.6</td>
</tr>
<tr>
<td>Floor for crib</td>
<td>Grating</td>
<td>Solid</td>
<td>Chapter 3.2.7</td>
</tr>
<tr>
<td>Size of combustion chamber</td>
<td>Width x Height x Depth $1.0 \times 1.0 \times 0.8 \text{ m}^3$</td>
<td>Width x Height x Depth $2.4 \times 2.2 \times 1.3 \text{ m}^3$</td>
<td>Chapter 3.2.10</td>
</tr>
<tr>
<td></td>
<td>Opening dimension $1.0 \times 1.0 \text{ m}^2$</td>
<td>Opening dimension $2.0 \times 2.0 \text{ m}^2$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No apparent lintel</td>
<td>200 mm height lintel at the top of the opening</td>
<td></td>
</tr>
</tbody>
</table>
3.3 Exposures to full façade structures

3.3.1 Experimental procedure for large fire exposure

For the 2nd stage of the initial testing the exposure and effects of the method was investigated using the full dimensions of the façade rig. Tests were done on an inert (incombustible) façade, indoors and outdoors, as well as on facades using combustible material and alternative fuel sources.

3.3.1.1 Parametric study using full inert façade

In a series of tests, the repeatability of the test method and the sensitivity to different variations were investigated. The details and full results are reported by Sjöström et al. (2021b) and can be found on the project webpage. Seven tests were performed whereof one was a test on unburnt construction, three were aimed for repeatability, one was with a shallower combustion chamber, one was with applied wind and one was using smaller stick sections for the wood crib, Table 3.

Table 3. Test parameters of the tests on a full-scale inert façade.

<table>
<thead>
<tr>
<th>Test number</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section size (mm)</td>
<td>47.6±0.5</td>
<td>47.7±0.5</td>
<td>47.6±0.7</td>
<td>47.5±0.7</td>
<td>47.7±0.7</td>
<td>47.5±0.8</td>
<td>44.9±0.8</td>
</tr>
<tr>
<td>Layers</td>
<td>24</td>
<td>23</td>
<td>25</td>
<td>24</td>
<td>23</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>Crib height (cm)</td>
<td>114</td>
<td>110</td>
<td>119</td>
<td>114</td>
<td>110</td>
<td>114</td>
<td>117</td>
</tr>
<tr>
<td>Density (#sticks probed)</td>
<td>469 (24)</td>
<td>454 (32)</td>
<td>421 (74)</td>
<td>423 (105)</td>
<td>442 (65)</td>
<td>436 (70)</td>
<td>448 (80)</td>
</tr>
<tr>
<td>Total mass (kg)</td>
<td>382</td>
<td>355</td>
<td>358</td>
<td>343</td>
<td>347</td>
<td>351</td>
<td>353</td>
</tr>
<tr>
<td>Total mass (kg)</td>
<td>Probed</td>
<td>Probed</td>
<td>Probed</td>
<td>Probed</td>
<td>Probed</td>
<td>Probed</td>
<td>Probed</td>
</tr>
<tr>
<td>Load cells</td>
<td>-</td>
<td>-</td>
<td>352</td>
<td>340</td>
<td>N.A.</td>
<td>-</td>
<td>349</td>
</tr>
<tr>
<td>MC (%) #sticks probed</td>
<td>14.0 (24)</td>
<td>13.84 (32)</td>
<td>13.12 (303)</td>
<td>12.19 (105)</td>
<td>13.44 (65)</td>
<td>11.35 (70)</td>
<td>12.94 (80)</td>
</tr>
<tr>
<td>Nailing</td>
<td>2nd layer, 3rd joint</td>
<td>2nd layer, 3rd joint</td>
<td>all layers, 2nd joint</td>
<td>all layers, 3rd joint</td>
<td>all layers, 1 m deep comb</td>
<td>Applied wind</td>
<td>Smaller stick section</td>
</tr>
<tr>
<td>Variation</td>
<td>Unburnt structure</td>
<td>Repeatability</td>
<td>Repeatability</td>
<td>Repeatability</td>
<td>MC</td>
<td>Applied wind</td>
<td>Smaller stick section</td>
</tr>
</tbody>
</table>

Spruce was used for all tests and density as well as moisture content was probed for a number of sticks from each crib (n = 24 – 106). In Test 4 the combustion chamber was only 1 m deep (as in BS 8414) instead of 1.3 m in the other tests. Thus, the crib was positioned such that the front face was outside of the façade external surface. In test 5, wind was applied using a number of fans. The wind direction was towards the façade corner and the speed close to the façade was between 1.5 and 2.5 m/s (maximum at 1 m height above the CC) during a central vertical line 1 meter from the façade, see the report for details (Sjöström et al., 2021b). Square sticks with roughly 47.5 mm side were used...
for all tests except test 6 where 45 mm sticks were used. The moisture content and density varied according to Table 3.

For all test the average mass loss rate of the cribs were highly similar, regardless of the variations in parameters, 0.212 ± 0.02 kg/s, Table 4. Test 2, 3, 4 and 6 were all similar with regards to the temperatures along the façade with test 1 at 65 – 80 °C lower temperatures. Test 5, with applied external wind, exhibited considerably less exposure to the façade.

The results suggest that wind has the absolutely largest influence on both flame height and temperatures recorded by both plate thermometers and thermocouples on the façade. It is worth noting that despite the reduction in temperatures, the mass loss rate of the crib was 5 % higher in the wind test compared to tests 1 – 3. Additionally, the change in stick size made very little difference, except that the time to when substantial amount of the crib fell in front of the combustion chamber was shorter. Regarding the crib properties, Test 1-3 all had similar total mass but varying the moisture content (within 1.5 % points) and the density (within 30 kg/m$^3$) had less influence on the result than the crib height (within 9 cm). A less deep combustion chamber also increased the temperatures on the façade, mostly on the lower parts Figure 8.

Table 4. Some key results from the inert façade test series.

<table>
<thead>
<tr>
<th></th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Test 5</th>
<th>Test 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flame height (m) $^1$</td>
<td>3.0</td>
<td>3.4</td>
<td>3.5</td>
<td>3.8</td>
<td>2.6</td>
<td>-</td>
</tr>
<tr>
<td>First crib parts on the floor (min) $^2$</td>
<td>23:30</td>
<td>24:20</td>
<td>22:20</td>
<td>22:00</td>
<td>23:25</td>
<td>20:05</td>
</tr>
<tr>
<td>First crib collapse (min) $^2$</td>
<td>21:00</td>
<td>19:40</td>
<td>19:45</td>
<td>19:40</td>
<td>22:00</td>
<td>19:00</td>
</tr>
<tr>
<td>Average mass loss rate (kg/s) $^3$</td>
<td>-0.204</td>
<td>-0.206</td>
<td>-0.202</td>
<td>(-)</td>
<td>-0.213</td>
<td>-0.220</td>
</tr>
<tr>
<td>Max TC at 2.5 m above opening (°C)</td>
<td>906</td>
<td>956</td>
<td>936</td>
<td>965</td>
<td>616</td>
<td>915</td>
</tr>
<tr>
<td>Max TC at 5 m above opening (°C)</td>
<td>479</td>
<td>509</td>
<td>503</td>
<td>556</td>
<td>284</td>
<td>498</td>
</tr>
<tr>
<td>Max PT temp at 2.5 m (°C)</td>
<td>723</td>
<td>784</td>
<td>768</td>
<td>790</td>
<td>516</td>
<td>760</td>
</tr>
<tr>
<td>Max PT temp at 5 m (°C)</td>
<td>359</td>
<td>399</td>
<td>382</td>
<td>417</td>
<td>178</td>
<td>369</td>
</tr>
<tr>
<td>Av. heat flux to HFM facing the combustion chamber (kW/m$^2$) $^1$</td>
<td>116</td>
<td>116</td>
<td>115</td>
<td>106</td>
<td>67</td>
<td>94</td>
</tr>
<tr>
<td>Max heat flux to HFM in façade (kW/m$^2$) $^{1,3}$</td>
<td>144</td>
<td>143</td>
<td>133</td>
<td>123</td>
<td>85</td>
<td>110</td>
</tr>
</tbody>
</table>

$^1$Averaged between 5 and 20 minutes from ignition.
$^2$From time after ignition.
$^3$30 s average. 1 m above the CC.
3.3.1.2 Outdoor vs indoor testing

An inert façade was also tested in outdoor conditions. Details of this test can be found in the test report (Efectis, 2022) and are summarized here. The ambient weather conditions were temperatures between 1 °C and 2 °C and relative humidity between 80 % and 86 %, Table . The wind was 0.5 – 1.7 m/s, measured at 5 m height. These conditions are acceptable for testing using the BS8414 and Lepir 2 but not for the MSZ 14800-6 method for which the wind speed limit at 2 m height is 1 m/s. The inert lightweight concrete structure had been placed outdoors for a long time and was, at least on the surface, in equilibrium with the outdoor climate (therefore moist).

There was also a slight change in combustion chamber geometry where plate that supports the crib now was a full solid floor. Thus, the 40 cm void under the plate was absent in the outdoor test, Figure 9.
Figure 9. Photos from the outdoor test. The lower photos compare the combustion chamber from the indoor and outdoor test.

Table. Test characteristics during the outdoor test.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>1 – 2</td>
</tr>
<tr>
<td>Relative humidity (%)</td>
<td>80 – 86</td>
</tr>
<tr>
<td>Windspeed (m/s)</td>
<td>0.5 – 1.7</td>
</tr>
<tr>
<td>Crib height (cm)</td>
<td>105</td>
</tr>
<tr>
<td>Crib moisture (%)</td>
<td>9.9</td>
</tr>
<tr>
<td>Stick density (kg/m³)</td>
<td>447</td>
</tr>
<tr>
<td>Stick dimensions (mm)</td>
<td>48 x 52</td>
</tr>
<tr>
<td>Crib mass</td>
<td>355</td>
</tr>
<tr>
<td>Mass loss rate, average 5-20 min (kg/s)</td>
<td>0.195</td>
</tr>
</tbody>
</table>

The result from the test showed significantly reduced temperatures along the horizontal line above the combustion chamber. The difference is around 150 - 200 °C for the TCs and 100 – 200 C for PTs, Figure 10. The differences cannot be entirely attributed to the wind condition. The façade surface had been acclimatized to the outdoor conditions and was therefore quite moist, close to the surface (something that had shown little effect from test 0 to test 1 in the indoor test). There are also differences in the combustion chamber which might have changed the air supply. On the other hand, the mass loss rate of the crib was only 5 % lower than during the three repeatability indoor tests, 4.
3.3.1.3 Position of the secondary opening

From the countries which include a secondary opening in their test methods the experience is that it is often at these openings where the weakest point of the façade can be found. Thus, it was planned to investigate how the existence of such opening and its position would influence the exposure to the façade. However, different system might be more or less influenced by the opening, in particular systems involving cavities or many layers have been found to exhibit the highest disadvantage of such opening. Using a real façade system could therefore produce results which were valid only for that system. We therefore tested a combustible, homogeneous material with the assumption that such system would have the least disadvantage of an opening where no combustible material is present.

The supported construction was therefore cladded with a 100 mm thick combustible insulation material with Euroclass C-s2, do as per EN 13501-1 and its nominal density 35 kg/m³. Three tests were executed, one without an opening, one with an opening placed eccentrically over the combustion chamber and one with an opening placed symmetrical over the combustion chamber opening. The opening size was 1200 by 1200 mm and cantered 2100 mm above the combustion chamber, Figure 11.
Figure 11. The three combustible façades, with and without secondary openings at different positions before testing. Note that the curvatures of the walls are due to the camera not having a flat projection.

Details of the tests can be found in the report on the project website (Sjöström and Anderson, 2022). The three cribs were close to identical and mass loss rate was the same within the scatter. All test had the same evolution where the first 10 minutes were characterised by a lack of substantial contribution to the flaming from the façade material itself. After 15 minutes, however, temperatures increased significantly as the façade material itself burnt.
Figure 12. The average TC temperatures during early (left) and late (right) stages of the test for horizontal lines of TCs at 2.5 mm (upper panels), 4.5 m (central panels) and 5 m (lower panels) above the CC. The x-axis in each panel is the distance from the façade corner and the y-axis denote the average temperatures. The yellow interval represent the width of the combustion chamber whereas the blue and red interval represent the lateral position of the opening in the symmetric and asymmetric case.

The main result of the tests are the average TC temperatures before and after flaming of the façade material in three vertical arrays above the combustion chamber, Figure 12. The only place where the test without an opening clearly showed higher temperatures was at the lowest array, which actually passes through the opening, and this happened only when considerable flaming from the façade material occurred. For all other times and positions the three tests showed similar results. The small, but systematic, changes that
could be noted was that temperatures above the opening were somewhat increased at the exact positions of the openings. The behaviour was noticed both for the early phase, without significant involvement of façade flaming, and (even more clear) for the latter phase of the tests, Figure 12.

3.3.1.4 Alternative fuel source

Using 350 kg of wood crib as fuel source for the large exposure is associated with a number of problems. It is the interests of authorities, the industry and labs to keep costs of testing low as that will favour testing of systems. Cutting, conditioning, controlling and building the crib is a time consuming and highly expensive task. The crib also requires a very large combustion chamber, which therefore requires a very tall structure, something which inherently implies higher costs and fewer labs that can perform the test. In addition, the cribs can never be completely identical and the variations in burning will always differ. They will collapse at some point and sometimes this occurs during the tests period. The collapse will produce a lot of glowing char in front of the façade, possibly obstructing assessment of falling parts. Finally, the heat source is very difficult to instantly supress which put higher requirements on safety during the tests and more work on cleaning the combustion chamber after the test.

In the first version of the BS 8414 there was an option of alternative heat source which should be assessed with three water cooled Schmidt-Boelter heat flux meters (HFMs) flush to an inert façade 1 meter above the combustion chamber opening. The criterion for adhering to the standard was a heat flux measurement between 45 and 95 kW/m² for a continuous 20 minutes period. This alternative was removed in later versions of the standard.

We performed tests using a 150 cm wide and 100 cm deep sand diffusion burner of steel. The burner consists of a 15 cm high rectangular steel pan och 10 cm high supports. The pan is filled with sand and gravel. A pipe is connected to the pan fuelling it with propane regulated by a mass flux meter which in turn is calibrated under an oxygen consumption calorimeter. The propane diffuses in the sand forming relatively homogeneous flaming over the whole sand surface.

Placing the burner at 10 cm from the back wall of the combustion chamber and running it at a constant 3 MW HRR yielded both TC and PT temperatures that were 200 – 300 °C below the once from the timber tests at ≥1 m from the combustion chamber top. The readings below 1 m were, however, higher than during the timber tests, Figure 13. For the following test the pan was pushed forward such that it extruded 40 cm in front of the façade surface. Two tests, one with 3 MW and one with 3.3 MW were run but temperatures were still considerably below that of the timber tests, Figure 13.
Figure 13. Height from the combustion chamber top vs. the average TC (lines) and PT (square symbols) temperatures of the tests (5 – 10 min for the timber tests).

Figure 14. Photo from the gas test using 100/80 cm high combustion chamber/opening and a mass flow corresponding to 2.2 MW.

The combustion chamber was therefore rebuilt in order to reduce its volume and thereby creating more flaming in the external pluming. The full width was kept but the height of the chamber was reduced to (1) 100 cm, with an opening height of 80 cm and (2) 80 cm, with an opening height of 60 cm. The burner was again placed 10 cm from the back wall.
Figure 15. Comparing the timber tests with the gas tests using a reduced combustion chamber. (a) Average TC and PT temperatures along the height of the combustion chamber. (b) Average TC temperatures for one the horizontal lines at 2.5 and 5 m height for one of the gas tests and the average of the timber tests. (c) HFM measurements at 1 m height from the (obsolete) BS 8414 and three of the gas tests. (d) time evolution of the PT temperatures during the timber and gas tests.

Key results from the tests using a reduced combustion chamber show that there is very good potential to control the temperatures on the façade to correspond to the timber tests. Both a chamber of 100/80 cm using 2.2 MW and 80/60 cm using 1.6 MW showed TC and PT results that were right among the timber tests. Only at ≤1 m height could some deviations be found. However, the HFM showed very good resemblance to the timber tests, also at 1 m height (Figure 15).
3.3.2 Experimental procedure for medium fire exposure

Similar tests were also performed for the medium fire exposure. All the tests are detailed in the test report (BRE, 2022) which is also available on the project website.

The experimental programme for the medium fire exposure consisted of ten tests and aimed to explore reproducibility (Test series D), the influence of air flow into the combustion chamber (test series E-F) and the position of the secondary opening for a combustible material (Test series K). An overview of the tests is shown in Table 5 below.

Table 5. Proposed experimental programme and the associated parameters.

<table>
<thead>
<tr>
<th>Test ref.</th>
<th>Wood crib parameters</th>
<th>Moisture content (%)</th>
<th>Air flow (m³/h)</th>
<th>Uplift (m)</th>
<th>Secondary opening location</th>
<th>Test specimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>497</td>
<td>11.6</td>
<td>400</td>
<td>0.5</td>
<td>Eccentrically (50 mm deep)</td>
<td>Inert</td>
</tr>
<tr>
<td>D2</td>
<td>504</td>
<td>12.5</td>
<td>400</td>
<td>0.5</td>
<td>Eccentrically (50 mm deep)</td>
<td>Inert</td>
</tr>
<tr>
<td>D3</td>
<td>499</td>
<td>11.8</td>
<td>400</td>
<td>0.5</td>
<td>Eccentrically (50 mm deep)</td>
<td>Inert</td>
</tr>
<tr>
<td>E1</td>
<td>504</td>
<td>11.9</td>
<td>360</td>
<td>0.5</td>
<td>Eccentrically (50 mm deep)</td>
<td>Inert</td>
</tr>
<tr>
<td>E2</td>
<td>506</td>
<td>12.8</td>
<td>440</td>
<td>0.5</td>
<td>Eccentrically (50 mm deep)</td>
<td>Inert</td>
</tr>
<tr>
<td>F1</td>
<td>505</td>
<td>13.6</td>
<td>420</td>
<td>0.5</td>
<td>Eccentrically (50 mm deep)</td>
<td>Inert</td>
</tr>
<tr>
<td>F2</td>
<td>495</td>
<td>13.2</td>
<td>380</td>
<td>0.5</td>
<td>Eccentrically (50 mm deep)</td>
<td>Inert</td>
</tr>
<tr>
<td>K1</td>
<td>476</td>
<td>10.8</td>
<td>400</td>
<td>0.5</td>
<td>Without</td>
<td>PIR</td>
</tr>
<tr>
<td>K2</td>
<td>463</td>
<td>10.8</td>
<td>400</td>
<td>0.5</td>
<td>Symmetrically</td>
<td>PIR</td>
</tr>
<tr>
<td>K3</td>
<td>458</td>
<td>10.1</td>
<td>400</td>
<td>0.5</td>
<td>Eccentrically</td>
<td>PIR</td>
</tr>
</tbody>
</table>

As for the large exposure tests, the investigation regarding position of the secondary opening (series K) used a homogeneous combustible material (PIR) outside the field of application recommended by the manufacturer. The reasoning behind this approach is to allow the fire to spread and to understand the potential influence of the secondary opening on the thermal attack and vertical flame spread. The secondary opening is 1200 by 1200 mm with its centre placed 2100 mm above the combustion chamber top 500 mm from the façade corner.

Examples of the temperatures measured on the façade are the PT measurements at 2 m above the combustion chamber for series D (repeatability) and E-F (air flow variations), see Figure 16.

---

Figure 16. Plate thermometer (PT) measurements at 2.0 m above the combustion chamber. The numbers after the labels refer to the airflow into the combustion chamber during the tests.

The repeatability tests, all using 400 m³/h for the airflow into the combustion chamber, are summarised in Figure 17 where the total spread in average TC- and PT-temperatures (during the peak burning rate between 5 - 15 minutes) is about 100 °C just above the combustion chamber, but less than 50 °C for heights >1 m from the opening.

The variations on the façade surface temperatures when varying the airflow into the combustion chamber are summarized in

No large variations can be noted for the 10 minutes average temperatures, 440 m³/h yields the highest temperatures and the tests with lower values (360 – 420 m³/h) are more or less identical, Figure 18. The largest effect of changing the airflow is closest to the combustion chamber and that the maximum values increase with increasing airflow, but the duration of the high temperature period is simultaneously reduced, Figure 16.
Figure 18. Temperature distribution on the central axis above the combustion chamber (CC) for varying airflow (test series E-F an average of series D). Lines and symbols represent TC- and PT measurements, respectively.

The three tests in the K-series investigated the position of a secondary opening had a large impact on the resulting temperatures. A 100 mm thick homogeneous combustible PIR-material was used and tests without opening (K1) as well as with opening placed symmetrically (K2) or eccentrically (K3). Snapshots at 5 and 10 minutes after the ignition show that the impact on the façade material is highly similar for the three tests, Figure 19.
Figure 19. Photos at 5 and 10 minutes after ignition for the three different tests in the K-series.

Average temperatures during the tests are shown along the height of the façade below, Figure 20. Again, no large differences can be found between the three cases and we
conclude that the void of combustible material is not something that impedes the spread of fire and if used, the eccentric (asymmetrical in relation to the combustion chamber) placement is preferrable in order to both keep a continuous façade and an opening above the combustion chamber.

Figure 20. Temperature distribution on the central axis above the combustion chamber for test series K. K1-without opening, K2-Symmetric opening, K3-Eccentric opening.

3.3.3 Conclusions exposure to full façade structures

The combination of reports and tests using full façade structures can be summarized to the following conclusions:

**Large exposure**

The large exposure tests show good repeatability, at least when performed indoors. Data on exposure in terms of TC and PT temperatures are available from the tests performed in the project.

The exposures to the façade show that a constant height rather than a constant mass of the crib is more important to minimising variations. We therefore change the assessment method to define the height of the crib to 110 ± 2.5 cm in height. Also, the ranges of stick section (47 ± 3 cm), timber density (500 ± 100 kg/m³) and timber moisture content (11 ± 2 %) of the cribs is acceptable for the variations as long as the start of the test is defined by a start criteria of the lower horizontal line of TCs.

We decide to increase the combustion chamber depth to 1300 mm between the insulation at the back of the combustion chamber to the front surface of the supporting constriction.

The same thermal impact to an incombustible façade could also be achieved using a diffusion gas burner and a reduced height of the combustion chamber.

The existence of a secondary opening indices a little increase in temperatures above the opening for a homogeneous combustible material and is not likely to reduce temperatures above the combustion chambers for most façade systems. Based on our
tests we suggest to include the secondary opening of 1200 by 1200 mm centred 2100 mm above the combustion chamber top and 1850 mm from the façade corner.

**Medium exposure**

Performing tests using the medium exposure indoors showed very good reproducibility using 400 m$^3$/h airflow into the combustion chamber.

Changing the airflow to the combustion chamber have only limited impact on the average temperatures measured on an inert façade. Only the highest airflow (440 m$^3$/h) showed substantial increase in the average temperatures. However, the airflow does affect the duration of the intensive burn period for the crib and the heat flux measured in front of the combustion chamber, see report for details (BRE, 2022).

As for the large exposure, only small differences could be noticed with regards to the placement of the secondary opening. Similar or higher impact was detected for the areas above the opening and we suggest to include the opening in the asymmetric position relative to the combustion chamber.
4 Experimental Round Robin

4.1 Selection of specimen

A properly designed Round Robin for both medium and large fire exposure is key to finalising the test and assessment method. The purpose of the round robin is two fold, first to assess the repeatability of the method and outdoor testing possibility; second to calibrate the criteria in the new method to as far as possible match the safety level set by the previous recognized methods in the EU member states.

To be able to calibrate the assessment method it is necessary to add the measurement points used in the BS 8414-2 in the large scale method.

Figure 21. The measurement locations in the round robin for the large scale testing.
These measurements will be at the surface only and to be used to obtain the starting time and surface temperatures that can be compared with those found in the test reports.

The "Technical Proposal" submitted by the consortium for the tender included:

"At least three different laboratories shall perform tests in accordance with the method defined in Task 2.5. Each of the chosen laboratories shall perform tests with four different façade systems:

- Rainscreen and render
- ETICS
- Solid wood with ventilation gap
- Inert façade

The number of systems that can be tested in the planned Round Robin is limited, partly due to the time and financial resources required for the tests and due to the high cost of the test specimens. Therefore, it is necessary to select such systems that are expected to provide the most usable and relevant results and experience. Systems which have previous results from similar test set-ups are highly preferable.

The consortium approached stakeholders to contribute in the selection of the façade systems to be included in the Round Robin:

"The project consortium has a very good knowledge on fire dynamics and testing procedures but need additional support from the European industry regarding façades and façade systems. Your input will enable the final method to be suitable and applicable for the requirements of different types of facades.

Several façade tests will be conducted in the project, and for these tests we will need suitable test specimens. We are now looking for three different types of systems to be included in the test program;

- Rainscreen with render
- ETICS
- Ventilated wooden façade

The tests to be conducted shall be on systems which are on the borderline on the failure criteria, i.e. the systems shall not be too good or too bad with respect to the fire spread on or within the system. Therefore, we must ensure before the choice of the systems to be included in the test series that we will get relevant results. It is advantageous if the systems to be used have been tested in accordance with at least one relevant national test method in the past which show that the system is on the borderline of acceptance."

Some sample figures were included in the consortium's letter and several comments were received.

The implementation of the Round Robin (and the baseline studies) will impose a considerable burden on the consortium members, as the tender did not provide the funds to build the testing equipment and to purchase the test models.
It is very important to underline that all stakeholders have shown considerable interest in the progress of the project and were ready to offer not only the specimens of façade kits but also their installation and mounting on the test rig.

4.2 Selected specimen types

The consortium decided that all the round robin tests would be carried out on a "supporting wall". The reason for this was that most of the expected façade tests will be ETICs and ventilated cladding. In April of 2022, the façade types included in the façade survey were finalised as follows:

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Medium exposure</th>
<th>Large exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facade system</td>
<td>System A</td>
<td>System B</td>
</tr>
<tr>
<td>ETICs (white EPS based)</td>
<td>HPL system has been proposed</td>
<td>ventilated aluminum facade</td>
</tr>
<tr>
<td>Exposure</td>
<td>System A*</td>
<td>System B*</td>
</tr>
<tr>
<td>Facade system</td>
<td>ETICs (grey EPS based)</td>
<td>Timber facade</td>
</tr>
</tbody>
</table>

It should be noted that due to financial and time constraints, the scope of the RR could not include curtain walling or the self-supporting façade solutions to be tested on structural frame, however in tandem tests with curtain walls will hopefully be performed. The effect of the slab connection, which is an optional test in the current form of the test method, is not investigated.

The systems selected for scoping were reported by the consortium at the steering group meeting on January 28th 2022.

4.3 Detailed description of the selected systems

**System A**

- EPS white, apparent density: 20 - 30 kg/m³, insulation thickness: 300 mm
- Fixing method: bonded with adhesive, without supplementary anchors
  - mortar; mineral binder; outer ribbon and additional dabs; 3.5 kg/m²
• Reinforced base coat

• Organic binder, reinforcement: glass fibre mesh, 160 g/m², Layer thickness (applied stage): 3 mm - 4 mm

• Finishing coat Organic binder, 3 mm layer thickness

• Fire protective measures 1 fire break, MW lamella strips, Apparent density: 90 kg/m³, Height of strips: 200 mm, Thickness: 300 mm, Fully bonded without anchors

**System A***

• Insulation EPS grey, apparent density: 15 – 17 kg/m³, Insulation thickness: 250 mm,

• Fixing method: bonded with adhesive mortar; mineral, binder; outer ribbon and additional dabs, Without supplementary anchors • Reinforced base coat Mineral binder, Layer thickness (applied stage): 2.5 mm - 3.0 mm,

Reinforcement: glass fibre mesh, 145 g/m²

• Key coat Yes

• Finishing coat Organic, colored, 2 mm layer thickness

• Decorative coat no

• Fire protective measures 3 fire breaks (each floor level), MW-HD strips, Apparent density: 140 kg/m³, Height of strips: 100 mm, Thickness: 250 mm, Fully bonded without anchors

**System B**

An HPL system has been proposed no details available at the moment.

**System B***

A wooden façade designed as a rainscreen design composed of pure wood cladding boards and ventilating battens. The system is classic by principle.

The cladding is made of spruce or pine and can be provided as non-treated or preservative impregnated against rot. Full scale fire tests did not show significant variations between treated or non-treated. The cladding does not have any fire retardant. The board profile is halflap without grooves so cladding is flat on both sides. Thickness of boards are specified to assist in preventing fire spread on outer plain wooden surfaces and match fire resistance of cavity battens. The halflap joints are designed to slide during movements due to thermal or drying effects, without creating through gaps. Board joints offer tracks to accept seals when specified.

**System C**

• External cladding – cassettes, solid aluminium (2mm)
• Supporting system – Aluminium profiles
• Fixing brackets – Aluminium profiles
• Wall fixations – Screws + plastic anchors
• Joints – open joints
• Insulation – Rockwool (180mm thickness)
• Horizontal fire barriers w/o intumescent at each level
• Edges of specimen closed

System C*
Is similar to C.

System D
Inert façade such as the supporting construction.

System D*
• 4mm-thick ACM FR plate
• Supporting system – Aluminium profiles
• Fixing brackets – Aluminium profiles
• Wall fixations – Screws + plastic anchors
• Insulation – Kooltherm K15 (100mm-thick)
• Edges of specimen closed
• Cavity depth 50mm between insulation and facade
• Vertical cavity barriers RSV 90/30 vertical cavity barriers (75mm-thick x 155mm-deep)
• Horizontal cavity barriers RH25G 90/30 horizontal open state cavity barriers (75mm-thick x 125mm-deep)

5 Time schedule

5.1 Task 1 – theoretical round robin

The task has been finalized and reported, and all comments received have been handled.
5.2 Task 2 – initial studies

Due to the Corona pandemic it has not been possible to follow the original time schedule as initially planned, and there is some delay. The laboratories have been partly closed and due to rescheduling of other commercial test activities also tests within this project has been moved forward in time, see Table 6.

Table 6. Updated time schedule for Task 2 – Initial studies.

<table>
<thead>
<tr>
<th>Task</th>
<th>Initial plan</th>
<th>Updated plan</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature survey</td>
<td>May 2020</td>
<td>January 2022</td>
<td>Literature will be studied throughout the project. An update will be included in each progress report and the final conclusions will be presented in the final report of the project.</td>
</tr>
<tr>
<td>Wood crib tests</td>
<td>May 2020</td>
<td>February 2021</td>
<td>The wood crib tests will start this month. The analysis of the results and reporting of the tests will be done in October.</td>
</tr>
<tr>
<td>Large tests with inert façade</td>
<td>September 2020</td>
<td>June, 2021</td>
<td>The laboratory is booked in June 2021 to perform the first part of tests with an inert façade. There has been a difficulty to get access to the laboratory due to rescheduling of other commercial activities caused by the pandemic.</td>
</tr>
<tr>
<td>Large tests, secondary opening</td>
<td>September 2020</td>
<td>Q2, 2022</td>
<td>It is proposed to await the results from the first tests on an inert façade before continuing with the remaining initial tests. This gives the opportunity to make eventual changes in the test program, and also some time to define which type of test specimen to be used when examining the effect of the secondary opening.</td>
</tr>
<tr>
<td>Medium tests</td>
<td>September 2020</td>
<td>Q3, 2021</td>
<td>The laboratory is booked in October-November to perform the tests. There may be a risk that the tests need to be moved forward in time if the timber for the wood cribs cannot be delivered in time (the time schedule here is very tight).</td>
</tr>
<tr>
<td>Analysis</td>
<td>December 2020</td>
<td>Q1, 2023</td>
<td>The analysis will be performed continuously, and it is expected that some time can be gained. Although, to carry out this task efficiently physical meetings are needed, and thus the situation with the pandemic may affect the time schedule.</td>
</tr>
</tbody>
</table>
# Risk assessment

Table 7. Risks and proposed mitigation measures for the remaining of the project.

<table>
<thead>
<tr>
<th>Description of risk</th>
<th>Task involved</th>
<th>Proposed risk mitigation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposal on fuel source and design of combustion chamber not accepted by the steering group.</td>
<td>Task 2</td>
<td>No major changes have been proposed for the medium heat exposure crib and combustion chamber. It is therefore a very limited risk that the proposal is not accepted. For the large heat exposure test some major changes have been proposed. The arguments for these changes are backed up with experimental evidence and numerical work and also by economic reasons, i.e. to avoid labours work. If the proposal is not accepted, the coming test plan needs to be revised. An alternative is that the proposal is accepted at present and the first average tests are performed after which another meeting is arranged with the steering group before a final decision on the fuel source is decided. This would affect the time plan further, and also have an economic impact since the laboratories are now booked for tests in June, and if no replacing clients can be found the project must pay for the rental of the lab.</td>
</tr>
<tr>
<td>Cost and availability of wood for the wood cribs</td>
<td>Task 2</td>
<td>The proposal on wood for the cribs has been done so it shall be possible to find suitable material in most Member States. It is especially important for the large crib since the amount of material needed is large. Therefore, nominal timber dimension is proposed to be within the span 44-50 mm. A method has been developed to determine the number of layers needed for the large crib, and this procedure will minimize the labor needed to produce the cribs, and still ensure cribs with similar characteristics. For the medium crib the proposal is to use planed wood, as currently required in DIN 4102-20, and it should not be any difficulties to find suitable material in most Member States.</td>
</tr>
<tr>
<td>Time schedule</td>
<td>Task 2</td>
<td>There is already a delay in the task due to the Corona pandemic. There are also indications that the delivery of wood to the cribs can be difficult due to a large demand of wood at present at the sawmills.</td>
</tr>
</tbody>
</table>
Further delays are foreseen since the steering group will be more involved in the project. There is a risk the even more delays may occur if the proposals made by the project team are not accepted. Therefore, the proposals made will be as far as possible well prepared with good evidence and arguments.

The measurement technique necessary for measurement of falling parts will be complicated and/or expensive.

| Task 2 | New types of measurement techniques will be introduced in the assessment method that is not commonly used by fire laboratories. The foreseen new techniques to be introduced are weight measurements with load cells and possibly image analysis for determination of falling parts. These techniques are commonly used in other fields, and there are many low-cost solutions available with enough accuracy for the measurements to be made. Therefore, the risk is very low. |
| Poor repeatability and/or reproducibility of the test method | Task 2 | Task 3 | There are several factors that can lead to a poor repeatability and/or reproducibility. Firstly, the assessment method must be written so everyone using it, interprets and performs the tests in the same way. This has been dealt with in the theoretical round robin, where parts of the assessment method has been identified that may be interpreted differently, and thus needs to be reworked.

The other factors are mainly the fuel source, dealt with above, and the environmental conditions. The wood crib tests performed show that the repeatability is good regarding the fuel source. Further tests will be performed in the next stage of the project when the average tests are performed on an inert façade. Since no major changes has been made on the medium heat exposure test the same repeatability will be obtained as has been previously. Regarding the large heat exposure test more restrictions are proposed which would lead to a better repeatability.

A study will be performed on the effect of the environmental conditions in order to define the tolerances needed to give good enough repeatability. |

| Unforeseen effects due to synergy effects of different factors in the test method. | Task 2 | Task 3 | In the initial test program, Task 2, the effect of individual factors is studied in order to ensure that the heat exposure to the test specimen is within certain limits independent of where or who carries out the test. The present study does not consider the fact that synergy effects might be present, i.e., that two or more factors acting together can give an unpredicted result. Although historically many studies have been done, and through the literature review, and by using fire dynamics calculations, the risk for unforeseen effects will be reduced. |


effects will be reduced. Any eventual effects will likely be found in Task 3, the experimental round robin. By having good control of all variations between the tests, any eventual synergy effects will show up, and it will be possible to fine-tune the method further to ensure that the method is robust and deliver good repeatability and reproducibility.

<table>
<thead>
<tr>
<th>Time restraint due to delivery of wood cribs and/or test specimens.</th>
<th>Task 2</th>
<th>Task 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>We will be dependent on different manufacturers on the delivery of different materials in the different test series. We will work towards as early ordering of materials as possible to avoid loss of time. Recent indications are that the saw mills have quite full order books, and that they may have difficulties to make fast deliveries, and thus this may affect the time schedule.</td>
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<tr>
<td></td>
<td>If the proposed fuel source is accepted, it will be easier to find suitable material for the fuel source.</td>
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</tr>
<tr>
<td></td>
<td>The façade systems to be used in the round robin have to be delivered on time to the laboratories. Some delay is foreseen.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Travel restrictions due to corona virus (or other unforeseen events)</th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
<th>Task 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At present it is unknown how long time we will have travel restrictions. Our meetings can be held via skype or another similar tool. This is not as efficient as physical meetings, but it shall not hinder the progress of the project, but it may lead to more delays in deliverables.</td>
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<tr>
<td></td>
<td>In the experimental round robin, we also rely on witness from other laboratories. If we have travel restrictions, this can also be solved with video links, not as good but it is manageable.</td>
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<tr>
<td></td>
<td>Travel restriction may also disturb the access on site of the team in charge of the installation of the façade system, since the initial idea was to try to work with the same team for all labs. If such issue occurs, a reinforced control of the installation will be performed by the welcoming lab on the basis on a detailed installation report performed by the lab performing the first test</td>
<td></td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Tests cannot be carried out at a test lab</th>
<th>Task 2</th>
<th>Task 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>If a lab, for some reason, cannot perform the tests as planned, we have other labs that can take these tests instead. We have three labs at present who can perform the tests indoors, RISE, Sweden, RISE Fire Research, Norway, and BRE, UK.</td>
<td></td>
</tr>
</tbody>
</table>
Some changes have been made. BAM cannot perform the crib tests with measurement of HRR, and therefore these tests will be made by Efectis. This will also change how the budget is divided between the project members, which has been updated.

A change in laboratory was necessary when performing the large wood crib tests. The tests had to be moved to Efectis Ireland. This change led to a delay in the testing activities. At present, it is not expected to be any other changes regarding location of the coming tests.

<table>
<thead>
<tr>
<th>Changes in personnel</th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
<th>Task 5</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

We cannot foresee any risks regarding eventual changes of personnel. We have a good redundancy in all Task teams, and the management is done in a team.

The project leader, Lars Boström, will retire at the end of March 2021. He will be replaced by Johan Anderson who has been deeply involved in both the previous project as well as in the present project.

<table>
<thead>
<tr>
<th>Difficulty in reaching an agreement of the classification method</th>
<th>Task 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

An important outcome of the project is a classification system. This will be in the same format as the classification system for reaction to fire for building products, i.e. the Euroclass system. By using this type of classification makes it possible to include a number of features used in the assessment, i.e. falling parts, duration of fire exposure, intensity of heat exposure, detailing and other aspects that may be needed. This will make it possible to include all criteria used, beyond the already existing classifications, for assessing facades. There are, however, different opinions on how a classification system shall be built, from a very simple classification to a complex classification where several different failure criteria are utilized. In the end a compromise must be achieved, and the solution to this is a very close contact and discussion with regulators and stakeholders throughout the project in order to find the best solution.

<table>
<thead>
<tr>
<th>Low acceptance of the proposed methodology by the Member States</th>
<th>Task 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

The main risk with the project is that the results are not accepted by the regulators in the MS. In order to minimize this risk, the regulators will continuously be informed about the progress in the project, and they will have the opportunity to give their input. The European industry, through the group of stakeholders will also be able to continuously give their input to the project.

It has been decided to have more frequent meetings with the steering group. Meetings will be arranged before critical decisions are made, i.e., when the fuel source is decided,
when questions regarding the secondary opening is decided and when test specimens for the experimental round robin is decided.

<table>
<thead>
<tr>
<th>Difficulty incorporating the different regulatory requirements in the preferred solution</th>
<th>Task 4</th>
<th>The test methods used for assessing facades, beyond reaction to fire and fire resistance, are generally similar. It is a flat surface (façade) exposed to a fire coming from an opening below the test specimen, or at the lower part of the specimen. The main differences between the test methods used are the severity and length of the heat exposure to the façade, whether detailing such as windows are included in the test, and where the required measurements are made. A classification system will be developed so it covers the different requirements presently used in the Member States regulations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance by the European industry</td>
<td>Task 4</td>
<td>There are some different factors that may hinder the acceptance by the European industry. The methodology shall as far as possible be applicable for all present and future façade systems. There will be systems that cannot be assessed with this methodology due to factors such as the geometry of the products, and for these systems alternatives needs to be developed, which is outside the scope of this project. The framework of the present methodology was fixed from the start, although we will try to make the methodology as flexible as possible. Another factor is the economy, i.e., the cost to perform the tests. We will try to make the method as simple as possible and allow for testing in different environmental conditions in order to make it possible for as many laboratories as possible to carry out the tests. Although, we must ensure that the methodology has good enough repeatability and reproducibility. We will also try to minimize the dimensions of the test set-up in order to reduce the cost of the test specimens and make it possible for more laboratories to carry out the test. In the end a harmonized methodology will reduce the testing costs for the industry since it is enough to test once to get an approval for all Member States.</td>
</tr>
<tr>
<td>Acceptance by the Member States</td>
<td>Task 4</td>
<td>The introduction of this new harmonized assessment method will not affect the regulations in the Member States. The new assessment method has approximately the same level of safety as the current national methods used in the Member states who have such and will offer several new possibilities to MS who do not have yet. In the end it is up to each Member State to regulate and chose which of the available classes to be used.</td>
</tr>
</tbody>
</table>
7 Communication

7.1 Project group

The project group have biweekly video meetings where the progress of the project is followed up. In addition to the project group are also some other stakeholders, who are working on research projects related to the present project, invited. At present DBI from Denmark and Imperial College from UK take part in the meetings.

Technical meetings are also frequently held, where specific technical questions as well as test results are discussed.

The project group has also been invited to participate in all experimental tests performed via video, which has been of great value.

7.2 Steering group

A meeting was held with the steering group on September 15, 2020, where the first progress report was presented.

During the progress of the project it was indicated that, at least parts of the steering group, would like to have more frequent meetings and be more involved in decisions to be made. Furthermore, the project group had some fundamental questions to the steering group that needed answers for the progress of the project. Therefore, a questionnaire was sent to the steering group with six questions. The following tables show the questions as well as the response received divided in responses from Member States (generally regulators) and Stakeholders (generally industrial associations). Formal steering group meeting have been arranged after each progress report have been published and also informal meetings have been arranged to discuss results from testing and the questionnaires on falling parts.

7.3 Stakeholders

Regular video meetings have been held since the inception report was published. The meetings were held with different stakeholders, mainly different associations, with the aim to have more discussions. The project team have presented the current status and progress of the project, and stakeholders have had the opportunity to give their input and get answers on their questions. These meetings have been of great value for the project group.

7.4 Other communication

The project has been presented at two webinars, one organised by the Royal Netherlands Standardization Institute in, 2020 and 2021, see Webinar facade fire safety (nen.nl). Webinar was arranged by Fire Safe Europe on October 13, 2021, see WEBINAR: Assessment of facades fire performance in the future | Fire Safe Europe. In addition to this webinar Fire Safe Europe also recorded a podcast. The project has been presented at several scientific conferences IAFSS 2021, AOFST 2021 and ELIPYKA in 2022.

Due to the Corona pandemic has no physical meetings been possible. All meetings have been held as video meetings.
A web page have been launched where all documentation in the project will be made available, https://www.ri.se/en/what-we-do/projects/finalisation-european-approach-assess-fire-performance-facades

Two webinars have been held where all stakeholders were invited. An introduction to the project was held on April 1, 2020. The second webinar was held on July 8, 2020, where the progress of the project was presented as well as some clarifications on some questions sent to stakeholders on the façade systems to be used in the test program. On May 16th 2022 a Brandforsk webinar on this project was arranged presenting the latest results in the testing program.

Follow-up meetings are held bi-weekly in the project group. In parallel many remote meetings are performed with each task group.
8 Literature

Test standards

PN-B-02867:2013
BS 8414-1:2015 and BS 8414-2:2015
BS 8414-1:2020 and BS 8414-2:2020
BR 135
DIN 4102-20:2017
ÖNORM B 3800-5
Prüfbestimmung für Aussenwandbekleidungssysteme Technical regulation A 2.2.1.5 (Sockelbrand)
LEPIR 2
MSZ 14800-6:2009
MSZ 14800-6:2020
SP Fire 105
Engineering guidance 16 (unofficial test method)
ISO 13785-2:2002
ISO 13785-1:2002

Test reports


Test reports UK websites

https://www.bre.co.uk/page.jsp?id=3694

https://www.gov.uk/guidance/building-safety-programme

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Investigations of test methods


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Smolka, M.; Anselmi, E.; Crimi, T.; Le Madec, B.; Móder, I.; Park, K.W.; Rup, R.; Yoo, Y.; Yoshioka, H. (2016); Semi-natural test methods to evaluate fire safety of wall claddings:
Investigations of wood cribs


Appendix A – Comments Handling Document

The comments handling documents are available on the web page. The following documents have been published (dated accordingly):

- Comments Handling Document - dated July 22 2020
- Comments Handling Document - updates October 23 2020
- Comments Handling Document - updates November 18 2020
- Comments Handling Document - updates December 11 2020
- Comments Handling Document – updates December 3rd 2021

As well as the Q&A from the Steering Group meeting and the Answers on questions on the facade assessment project - REV1.
Appendix B – Updated assessment method

The updated assessment method is published on the web page, the latest draft “Assessment method - draft 1 dated May 7 2020 - SI 2 825082” and a version where all received comments are added “Commented version of the Assessment method November 18 2020”. All questions and issues will be taken into account during the testing phase of the project. The updated version of the Assessment method where the results found during the initial testing program was published May 12th 2022.