

NEN

NPR9998

Plan van Aanpak
voor TG1 Module 2
Versterkingsmaatregelen

Memo Ref

Issue | 4 May 2020

This memo takes into account the particular instructions and requirements of our client

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

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2 Introduction

This Plan of Approach is for Task Group 1 (TG1) Module 2 to develop and enhance NEN-NPR9998:November 2018 for the following two aspects and has been split into two phases. The reason for the split is to enable to phase 1 to start and not be hindered whilst the details for phase 2 are being finalised and agreed to.

2.1 Phase 1

1. **Literature review** as described in Section 3.1.
2. **Custom limits.** Propose a methodology for virtual or physical testing to enable custom limits and thus acceptance criteria to be developed for seismic assessments. This may need to be at a component and overall building level. See Section 3.2

As part of this a mechanism will be proposed on how this enabling functionality can be added to the NPR enabling project specific acceptance criteria to be used with the agreement of Authority Having Jurisdiction (AHJ). The custom limits would be able to be used instead of the limits in the NPR9998.

3. **Cyclic loading protocol.** Propose a Groningen specific cyclic loading protocol for use with the testing methodology that will be developed as part of phase 1 task 2. See Section 3.3
4. **Define Phase 2 scope.** See Section 3.4

2.2 Phase 2

5. **Specific Retrofits.** Once specific retrofit details are agreed for further investigation they will be modelled using suitable non-linear analysis models using the methodology defined during phase 1 and custom limits for them determined.
6. **Custom limits for the NPR.** Where possible custom limits (or additional acceptance criteria) will be proposed for the NPR to adopt.

3 Phase 1

3.1 Literature review (Phase 1 Task 1)

1. Identify literature or guidelines for testing (laboratory or virtual) protocols that are used in international codes or practice to allow these to be determined custom displacement limits to be determined for components or buildings. Focus will be to derive cyclic loading protocol for the Groningen region.
2. Review the background documents to the current drift limits in Annex G of NPR9998:November 2018 to understand how the current limits were derived.
3. Review international codes of practice, particularly ASCE 41-17, guidance from the New Zealand Society for Earthquake Engineering, and the current drafts of the new Eurocode 8 Part 3. (Note that the latter is not due for publication and adoption by CEN member countries until around 2025, and therefore the material included in it has not reached a consensus acceptance. Nevertheless, we are aware of specific changes in the URM acceptance criteria that will be relevant to the present study).
4. Any other analytical / theoretical research that may support the use of higher drift levels for retrofitted buildings.

3.2 Custom limits (Phase 1 Task 2)

Develop a methodology by which component specific seismic behaviours can be determined that would then have the status of being able to replace default code acceptance criteria within the NPR9998 on a case by case basis.

3.3 Cyclic loading protocol (Phase 1 Task 3)

The cyclic testing methodology will need a loading protocol. We propose for there to be two ways this can be done.

3.3.1 General cyclic loading protocol for the NPR

In deriving a Groningen specific cyclic loading protocol we will take into account the number of cycles, amplitude of cycles, frequency content and speed of loading that existing URM components should be subjected to given the hazard specifics found in the Groningen region. We propose to do this by studying the pier demand time histories from three buildings modelled using the NLTH methodology using ground motions taken from the webtool for NEN-NPR9998 November 2018 T1 time period. The response histories will be analysed to determine the number of small, medium and large displacement amplitudes that the components experience. From this we will propose a suitable cyclic loading protocol that reasonably envelopes the findings.

3.3.2 Building specific loading protocol for the NPR

The general cyclic loading protocol will be based on enveloping and it is envisaged that this will be adequate in many cases. However, this may be conservative, and it is proposed that a cyclic loading protocol is developed for building specific applications. The benefit of this approach would be that the loading protocol would be closely tuned to the likely dynamic behaviour of the structure being assessed thereby enabling the most accurate possible determination of the

Propose text on how such work can be reviewed and accepted as being able to be used instead of the default code values in the NPR.

3.4 Defining Phase 2 scope (Phase 1 Task 4)

Feedback from TG1 has been to focus on the out-of-plane (OOP) behaviour of Unreinforced Masonry (URM) walls. Further feedback from the task group has revealed that there is still debate on the amount of details, options, variations and extent of work wanted for this phase of the works.

An initial suggestion has been made to that the phase 2 works could focus on the following four URM details for which displacement capacities will be determined for the following retrofitted URM components using the methodology from the first phase as listed below and shown conceptually in Figure 1.

1. URM walls with no retrofits within a typical Groningen building.
2. URM walls with timber strong backs to improve out of plane response of URM piers
3. URM walls with one sided application of FRP to a conventional cavity wall.
4. URM walls retrofitted with reinforcement vertically or horizontally within existing mortar joints.

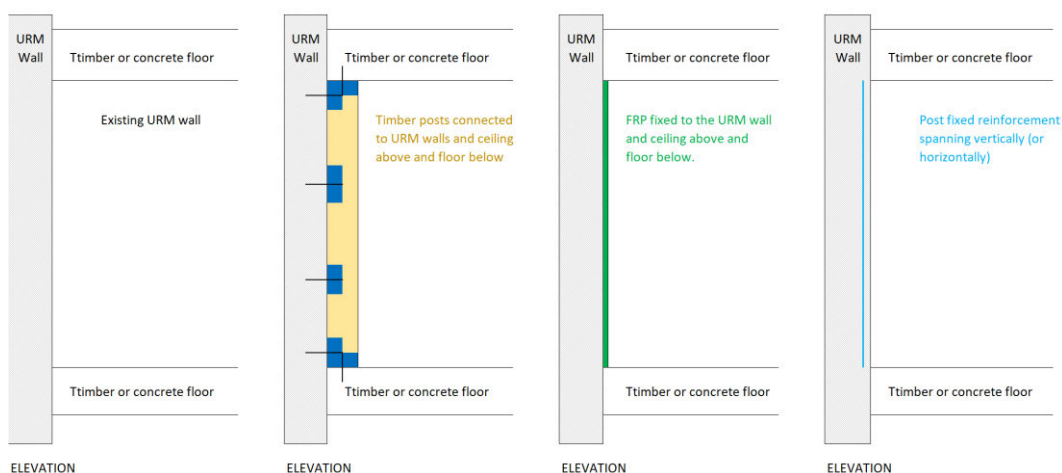


Figure 1 Proposed details for determining custom limits

It is proposed that this URM retrofit conditions are initially evaluated as standalone component models looking at the OOP behaviour only. For the

purposes of this work it is assumed that the connections are strong and are therefore excluded.

Then these retrofit details will be applied to a typical URM building and subjected to strong motions to confirm the improved behaviour within the context of a real building.

It is proposed that this work will be carried out using non-linear analysis models using LS-DYNA.

Once this work is completed appropriate acceptance criteria will be proposed for these retrofitting details.

Further consultation and alignment could be carried out with the members of TG1 to determine if the proposed retrofit details are the ones that should be further progressed. Alternatively, these could be started and further scope defined for consideration by NEN.

4 Phase 2

The works proposed for the Phase 2 works will be defined as part of the phase 1 scope.

5 Deliverables

5.1 Phase 1

A report will be developed to present findings for the four tasks from the proposed Phase 1 scope. The main objectives of the report will be to provide model text to be included in the next edition of the NPR9998.

5.2 Phase 2

The deliverables for phase 2 will be proposed as part of the ongoing efforts to define the scope for the phase 2 work.

6 Time Line

It is proposed that the phase 1 scope is issued in draft format for comment to TG1 and the Werkgroep aardbevingen by Friday 15th May 2020.

It is envisaged that the phase 2 work would commence after agreement on the phase 2 scope and the time line for it can then be mutually agreed noting the fixed end date in NENs current planning.

7 Hours

The hours presented below is the hours has been taken from NEN.

[Redacted]	[Redacted]
[Redacted]	[Redacted]
[Redacted]	[Redacted]