APPENDIX C
CODE CHANGE PROPOSAL
NORTH CAROLINA
BUILDING CODE COUNCIL

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Petition for Rule Making Item Number _____

Granted by BCC	_____	**Adopted by BCC**	_____	**Approved by RRC**	_____
Denied by BCC	_____	**Disapproved by BCC**	_____	**Objection by RRC**	_____

PROPONENT: Kerry Sutton, PE PHONE: (734) 673-2195
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North Carolina State Building Code, Volume 2018 Existing Building Code – Section 606

CHECK ONE: [ ] Revise section to read as follows: [ ] Delete section and substitute the following:
[X] Add new section to read as follows: [ ] Delete section without substitution:

~~LINE THROUGH MATERIAL TO BE DELETED~~ UNDERLINE MATERIAL TO BE ADDED

Please type. Continue proposal or reason on plain paper attached to this form. See reverse side for instructions.

Section 606.1: Add new Section 606.1.1 as follows:

606.1 General

Structural repairs shall be in compliance with this section and Section 601.2, Regardless of the extent of structural or nonstructural damage, *dangerous* conditions shall be eliminated. Regardless of the scope of *repair*, new structural members and connections used for *repair* or *rehabilitation* shall comply with the detailing provisions of the *International Building Code* for new buildings of similar structure, purpose and location.

606.1.1 Repairs to structural concrete. Repairs to structural concrete elements in accordance with ACI 562 shall be permitted.

Exception:

1. Where seismic design governs. ACI 562 shall not be used for evaluation and design.
2. Dwellings and accessory buildings constructed under the NC Residential Code.

Add new referenced standard to Chapter 16 as follows:

ACI American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331

562-16: Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures 606.1.1

Will this proposal change the cost of construction? Decrease [X] Increase [ ] No [ ]
Will this proposal increase to the cost of a dwelling by $80 or more? Yes [ ] No [X]
Will this proposal affect the Local or State funds? Local [ ] State [ ] No [X]
Will this proposal cause a substantial economic impact (≥$1,000,000)? Yes [ ] No [X]

- Non-Substantial – Provide an economic analysis including benefit/cost estimates.
- Substantial – The economic analysis must also include 2-alternatives, time value of money and risk analysis.
- Pursuant to §143-138(a1)(2) a cost-benefit analysis is required for all proposed amendments to the NC Energy Conservation Code. The Building Code Council shall also require same for the NC Residential Code, Chapter 11.

REASON:

Please see attached Reason Statement and supporting information.

Signature:  Date: 01/28/2021 FORM 11/26/19

Signatures for additional proponents are on file and can be provided upon request.

ATTACHMENT

CHAPTER 6 REPAIRS
SEC 606 Structural
Sec 606.1 General

Reason Statement:

Concept – This code change proposal adds ACI 562: *Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures*, to establish minimum requirements for the evaluation, design, construction, repair, and rehabilitation of concrete structural elements in buildings for various levels of desired performance as deemed appropriate for the project. In addition to improved life safety, the requirements clearly define objectives and anticipated performance for the code official, owners, designers, contractors and installers. The proposed language is not exclusive as Section [A] 104.11 of the *North Carolina State Building Code: Existing Building Code* allows for alternative design and methods of construction Citing this reference provides the building official a baseline for considering approval of design requirements and methods of construction. Further the baseline is beneficial for product suppliers, owners, designers, contractors and most importantly the expectation of a reasonable level of safety for the public.

The Exception provides language to appropriately exclude the use of ACI 562 for seismic evaluation, repair and rehabilitation, consistent with the scope of ACI 562. The Exception language is provided so the user does not resort to the ACI 562 where seismic design governors only to discover that its scope excludes seismic resistance.

Background – In 2006, the repair industry approached ACI asking for a concrete repair and rehabilitation code that would improve the overall quality of concrete repairs by establishing common requirements and establishing clear responsibilities between owners, designers, and contractors. This code would also provide building code officials with a reference by which to evaluate rehabilitated concrete structures.

ACI, following its rigorous American National Standards Institute accredited standards development process assembled a code committee with balanced representation and produced the first official code in 2012. The committee members reviewed and considered numerous reports and publications related to concrete repair and rehabilitation to identify and develop requirements consistent with current industry practice. The committee has received feedback from users of the code and had completed their third version of this code, ACI 562-19.

Scope – ACI 562 complements the North Carolina State Building Code: Existing Building Code by providing specific direction on how to evaluate and design concrete repairs and how to address the unique construction methods and problems associated with repair. This standard helps the designer assess the existing structure. The standard then provides the requirements that bridge the inconsistencies and gaps in acceptable criteria that occur from the two following situations that a designer must solve: one, repairing a structure according to the original building code used at the time it was built using today's construction methods and materials; or, repairing a structure built according to an older building code but repaired according to the latest building code.

Note that ACI 562 does not address the evaluation of lateral-force resisting systems in high seismic areas. ASCE 41 would be the appropriate standard for this situation as stated in ACI 562.

Benefits – There are many benefits that ACI 562 provides for the designer, owner, contractor, materials providers, building code official and the public. A few of these benefits are:

- Provides a level of expectation of life safety to the public in buildings where repairs or rehabilitation is performed on concrete structural elements.
- Provides clearly defined, uniform requirements aimed at extending the service life of existing structures.
- Provides minimum requirements for efficiency, safety, and quality of concrete repair.
- Establishes clear responsibilities between owners, designers, and contractors.
- Provides building code officials with a means to evaluate rehabilitation designs.
- Provides specific repair requirements that often result in less costly repairs compared to repairs required to meet only new construction requirements.

It is noteworthy that ACI has been publishing and making available guidance documents on evaluation and repair of concrete for more than five decades and still it is reported that more than 50% of all structural concrete repairs are found to fail in 20 years or less. Recognizing this as putting the public at risk, ACI Committee 562 saw the need for and developed the *Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures* as an ACI standard intended for adoption in building codes.

Flexibility – ACI 562 permits flexibility in evaluation, design, construction and repair materials to provide economies while establishing expected performance for the service-life of the rehabilitation or repairs.

Resources – Also, there many resources that complement ACI 562. Among these are:

- *Concrete Repair Manual: Fourth Edition 2013*
- ACI 563-18, *Specifications for Repair of Structural Concrete in Buildings*
- MNL-3(16) *Guide to the Code for Assessment, Repair, and Rehabilitation of Existing Concrete Structures*

These resources are readily available to provide greater understanding of assessment, repair and rehabilitation of concrete structural elements. ACI MNL-3 provides case studies demonstrating the ease of use of ACI 562. Numerous technical notes, reports, guides, and specifications that provide background information and technical support are available through other organizations, such as American Society of Civil Engineers, British Research Establishment, Concrete Society, International Concrete Repair Institute, National Association of Corrosion Engineers, Post-Tensioning Institute, Society for Protective Coatings, and US Army Corps of Engineers. Many of these organizations' publications related to concrete repair can be found in the Concrete Repair Manual.

Resiliency – This proposal will increase Resiliency. Use of the ACI 562 standard helps ensure that repairs are properly performed and will satisfy an acceptance service life. Without minimum standards, repairs may not satisfy the intent of the code or the expectations of the owners or public. Proper evaluation and repairs will improve resiliency of the building.

Sustainability - Reference of ACI 562 in the *North Carolina State Building Code: Existing Building Code* will help improve the confidence of owners, builders, and developers regarding effective repairs, upgrades, and reuse of existing buildings in lieu of demolition and replacement. Typically, extending the life of existing buildings is substantially more sustainable than demolition and new construction. Adoption of ACI 562 by reference is needed to help facilitate efforts that conserve energy and resources while maintaining a minimum level of requirements to ensure reasonable levels of life safety, and welfare are afforded to the public.

Bibliography –

- Concrete Repair Manual - 4th Edition: 2-Volume Set, ACI and ICRI, 2013, 2093 pp.
- https://www.concrete.org/store/productdetail.aspx?ItemID=RPMN13PACK&Format=HARD_COPY
- Guide to the Code for Assessment, Repair, and Rehabilitation of Existing Concrete Buildings, ACI and ICRI, 2016, 176 pp. https://www.concrete.org/store/productdetail.aspx?ItemID=MNL316&Language=English

State and Local Adoptions – Several jurisdictions already addressed the need for these requirements. ACI 562 is already being used in several jurisdictions:

Hawaii: Hawaii was the first state to adopt ACI 562 by reference. The following provisions are included in the State Building Code Council HAWAII STATE BUILDING CODE, which became effective on January 1, 2018:

"3401.6 Alternative compliance.

1) Work performed in accordance with the International Existing Building Code shall be deemed to comply with the provisions of this chapter.

2) Work performed in accordance with the 2016 version of the American Concrete Institute Committee 562, "Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures" shall be deemed to comply with this chapter when used as a supplement to the requirements of this chapter or the International Existing Building Code. Wherever the term International Existing Building Code (IEBC) is used in ACI 562-16, it shall mean International Existing Building Code or Chapter 34 of the International Building Code."

Ohio: The Ohio Board of Building Standards Ohio adopted rule changes identified as Amendments Group 95. Included in this group is:

3401.6 Concrete evaluation and design procedures. Evaluation and design of structural concrete repairs and rehabilitation shall be in compliance with Chapter 34 and ACI 562.

Florida: Language has been approved to reference ACI 562 in the 2021 Edition of the Florida Building Code:

301.3.4 Concrete evaluation and design procedures. Evaluation and design of structural concrete in compliance with ACI 562 shall be permitted.

Exception: ACI 562 shall not be used to comply with provisions of this code for seismic evaluation and design procedures.

New York City: The New York City Buildings Department issued *BUILDINGS BULLETIN 2015- 017* in December 2017 Conditions of Acceptance for Fiber Reinforced Cementitious Matrix strengthening systems.

FRCM shall comply with the NYC Construction Codes and the following applicable provisions:

A. Design

1. FRCM system shall be designed in accordance with the ACI 549.4R-132 Guide for the Design and Construction of Externally Bonded Fabric-Reinforced Cementitious Matrix (FRCM) Systems for Repair and Strengthening Concrete and Masonry Structures with properties used for design obtained from tests performed in accordance with AC 434. Fire-resistance-rating and interior finish requirements shall be in accordance with the NYC Construction Codes, manufacturer's recommendations and the conditions of the required listing.

2. For repairs and upgrade achieved with unprotected external FRCM, the increase in flexural or shear strength provided by the external reinforcing system shall not exceed 50% of the existing structural capacity of the member prior to strengthening. This increase should be checked before applying the strength reduction factor.
3. Careful consideration should be given to determine reasonable strengthening limits. These limits are imposed to guard against collapse of the structure should bond or other failure of the FRCM system occur due to damage, vandalism, or other causes. The required strength of a structure without repair should be as specified in in accordance with ACI 562 *Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures* Section 5.5.

Recommendation – ACI, a professional technical society, has developed this ACI 562 in response to industry needs and to help assure minimum levels of life safety, health, and welfare for the public. For this reason and the other benefits identified in this reason statement, ACI recommends this code change proposal for committee approval as submitted.

Cost Impact: The use of this referenced standard should in many cases reduce the cost of repair. Too often in the process of repair, there is insufficient information to determine acceptance criteria that is amicable to both the owner and the building code official. The result is the determination that the repair must meet the latest building code requirements for new construction. This standard increases the options available for repair and provides the acceptance criteria necessary to permit these options. A case study that illustrates this point: "ACI 562 has been referenced in expert reports for litigation cases, resulting in significantly reduced financial settlements. Denver-based J. R. Harris & Company recently used the code as a standard in several litigation reports assessing damages in existing concrete structures. As an approved consensus standard, according to American National Standards Institute (ANSI) procedures, ACI 562-13 has been accepted as the source standard to use for damage assessment and repair on individual projects by Greenwood Village and Pikes Peak Regional Building Departments in Colorado. Based on this acceptance, the consulting engineer was able to cite the code in their recommendation for structural remediation and determination of damages. In one case involving rehabilitation work on four buildings with faulty construction, J.R. Harris was able to reduce the repair costs from $12 million to $3 million, with a repair plan based on the lesser of the demand-capacity ratio based on either the original or current building code per ACI 562."