



United States
Department of
Agriculture

Soil
Conservation
Service

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NATIONAL ENGINEERING MANUAL
NM210-V - AMENDMENT NO. 17

SUBJECT: PART NM536 - STRUCTURAL ENGINEERING

Purpose. To supplement Section 536.20, Design criteria for reinforced concrete, and to transmit revised Contents page for Subchapter D and revised Contents page for Part NM536.

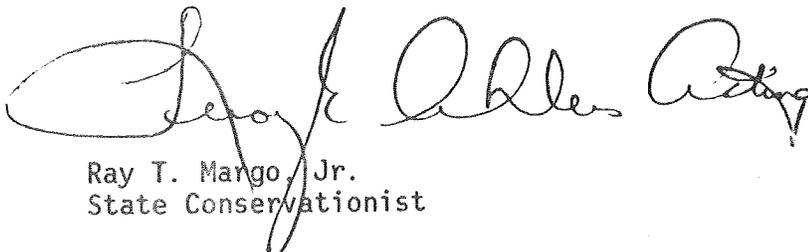
Effective Date. This supplement is effective on the above date.

Background. This New Mexico supplement to the National Engineering Manual supersedes and cancels NM BULLETIN NO NM210-2-10 dated April 2, 1982. This supplement provides guidance to the designer-specification writer and the project engineer regarding the substitution of different grades of reinforcing steel. Substitution of higher grade steel cannot arbitrarily be made for lower grade steel.

National Design Note 21 contains additional detailed procedures and examples which are also to be used.

Filing Instructions. File this supplement behind the page labeled DU/ESA - 12/4/80, 2/2, issued by National Headquarters. Remove and replace Contents page Under Subchapter D; remove and replace Contents page under Part NM536.

After posting receipt to the New Mexico Tabulation Sheet, this transmittal may be destroyed.



Ray T. Mango, Jr.
State Conservationist

Attachments



The Soil Conservation Service
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Part NM536 - Structural Engineering

NM536.20(e)(2)(i)

NM536.20 Design criteria for reinforced concrete.

(e) During design, the designer has the option of:

(1) Designing for and requiring Grade 40 steel. If this is done, the Items of Work and Construction Details (blue sheets) for Specification No. 34 must include the following paragraph:

"In Section 2, MATERIALS, the grade of steel reinforcement as specified in Material Specification 539 shall be Grade 40. Grades 50 and 60 shall not be substituted for Grade 40."

(2) Designing and providing for the substitution of Grades 50 and 60 steel for Grade 40. If this is done, the provisions of paragraph (g) must be met and the Items of Work and Construction Details (blue sheets) for Specification No. 34 must include the following paragraph:

"In Section 2, MATERIALS, the grade of steel reinforcement as specified in Material Specification 539 shall be Grade 40, Grade 50, or Grade 60, but in no case shall the anchorage lengths, splices, hooks, etc., be less than that shown on the drawings."

(f) During construction the project Engineer may need to evaluate the substitution of Grades 50 and 60 steel for Grade 40. If this is done the provisions of paragraph (g) must be met.

(g) In the design and construction of Service structures, assurance must be given that if Grades 50 and 60 steel are substituted for Grade 40, the mode of failure--should it occur--will not be rapid or destructive (i.e., collapsing walls due to loss of anchorage, bond, or concrete failure), but will be a ductile failure with ample warning of distress.

(1) This can be assured by rigorous and confident load analysis, by restricting steel ratios, and/or by extra anchorage lengths, splice lengths, etc., or by combinations, depending on the type of structure and the design procedure used in design.

(2) If, during design or construction, it is intended to provide for substitution of Grades 50 and 60 steel for Grade 40, the following conditions must be met and documented:

(i) Service hydraulic structures designed in accordance with NEH 6 (Working Stress).

NM536-9(1)

(NM210-V-NEM, Amend. 17, Sept., 1983)

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NM536.20(e)(2)(ii)[A]

[A] Direct substitution will be allowed only if all potential loads are accurately and fully accounted for to a high degree of confidence and certain technical requirements are met. As a minimum, this includes:

[1] Positive sidewall and slab drainage is assured by free draining drain fill, weeps, and/or perforated drain pipes. "Positive" is defined as a minimum of 1/3 the wall height and a 6-inch minimum thickness under the slabs.

[2] Earth and hydrostatic loads are determined in accordance with EDS-FWS.

[3] All potential surcharge loads are fully accounted for or physically prevented from the structure.

[4] The properties of the backfill (classification, density, and strength) within a given prism from the base of the walls are supported in design by actual test data and inspected during construction by field test data. The given prism is defined by a line beginning two feet horizontally from the base of the wall and up on a 1:1 slope to the original or backfilled ground surface.

[5] All foundation soil properties used in design are supported by actual test data.

[6] Moment redistribution is not employed in the design. This is not allowed even when using Grade 40 steel.

[B] If all of the above conditions are met and documented, direct substitution will be allowed. If all of the above conditions are not met the following must be verified:

[1] The steel ratio p/p_b must be less than 1.0 where: $p = A_s$ divided by bd actually used at critical sections and $p_b =$ the balanced steel ratio, using the maximum allowable concrete and steel stress values permitted by Appendix B of ACI 318-77 for the steel grade to be substituted.

[2] All anchorage lengths, splices, hooks, etc., required for the higher grade steel must be provided for.

[3] Moment redistribution must not be used in the design. This is not allowed even when using Grade 40 steel.

(ii) Service hydraulic structures designed in accordance with TR-67 (strength design).

[A] Direct substitution will be allowed only if all potential loads are accurately and fully accounted for to a high degree of confidence and certain technical requirements are met. As a minimum, this includes:

NM536-9(2)

[1] Positive sidewall and slab drainage is assured by free draining drain fill, weeps and/or perforated drain pipes. "Positive" is defined as a minimum of 1/3 the wall height and a six-inch minimum thickness under the slabs.

[2] Earth and hydrostatic loads are determined in accordance with EDS FWS.

[3] All potential surcharge loads are accounted for or physically prevented from the structure.

[4] The properties of the backfill (Classification, density, and strength) within a given prism from the base of the walls are supported in design by actual test data and inspected during construction by field test data. The given prism is defined by a line beginning two feet horizontally from the base of the wall and up on a 1:1 slope to the original or backfilled ground surface.

[5] All foundation soil properties used in design are supported by actual test data.

[6] Moment redistribution is not used in the design.

[B] If all of the above conditions are met and documented, direct substitution will be allowed. If all of the above conditions are not met the following must be verified:

[1] The steel ratio p/\bar{p}_b must be less than 0.75.

Where: \bar{p}_b = A_s divided by bd actually used at critical sections, and p_b = the balanced steel ratio from Table 1, page 43 of TR-67 for the steel grade to be substituted.

[2] All anchorage lengths, splices, hooks, etc., required for the higher grade steel must be provided for.

[3] Moment redistribution must not be used in the design.

(iii) Other structures with controlled environment - designed in strict accordance with ACI 318-77.

Direct substitution of Grades 50 and 60 steel is not allowed. Substitution will be allowed only if the following conditions are met:

[A] The steel ratio p/\bar{p}_b must be less than 0.75 where moment redistribution has not been used and less than 0.50 where it has been used.

Where \bar{p}_b = A_s divided by bd actually used at critical sections, and p_b = the balanced steel ratio from Table 1, page 43 of TR-67 for the steel grade being substituted.

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NM536.20(e)(2)(iv)[B]

[B] All anchorage lengths, splices, hooks, etc., required for the higher grade steel must be provided for.

(iv) Other structures with uncontrolled environment - designed in strict accordance with ACI 318-77.

Direct substitution of Grade 50 or 60 steel for Grade 40 is not allowed. Substitution will be allowed only if the following conditions are met:

[A] The steel ratio, p/\bar{p}_b , must be less than 0.5 regardless of whether or not moment redistribution was used.

Where: p = A_s divided by bd actually used at critical sections, and
 \bar{p}_b = The balanced steel ratio from Table 1, page 43 of TR-67 for the steel grade being substituted.

[B] All anchorage lengths, splices, hooks, etc., for the higher grade steel must be provided for.

NM536-9(4)

(NM210-V-NEM, Amend. 17, Sept., 1983)