2006ECL: I-7
CELMN-ED-DR (CELTM

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

CELMN-ED-DD 18 November 1988

MEMORANDUM FOR: President, Lower Mississippi Valley Division,
ATTN: CELMV-ED-T

SUBJECT: I-Wall Deflection

Enclosed are minutes of the meeting held at the New Orleans District on 28 October 1988 to discuss the subject stated above. Approval of the enclosed minutes is requested.

FOR THE COMMANDER:

1 Encl
as

FREDERIC M. CHATRY
Chief, Engineering Division

...S OF MEETING

SUBJECT: I-Wall Deflections

1. A meeting was held on 28 October 1988, at the New Orleans District between representatives from the New Orleans District and LMVD. A list of the attendees along with a copy of the agenda for the meeting are attached.

2. The meeting was opened by Mr. Marsalone who welcomed everyone and made a brief statement concerning the purpose of the meeting. He stated that a huge amount of floodwall design and construction in the New Orleans District began around the mid 60's and involved foundations mostly in soft clays. The criteria for the design of these walls were agreed upon by representatives of OCE, LMVD, and NOD, and part of that criteria was a limit on the amount of deflection. The limit placed on the allowable deflection at the top of the floodwall was 2 inches. A floodwall along the west bank of the IHNC where its deflection exceeded 2 inches was redesigned using buttress or "kicker" piles to limit the deflection. Many miles of floodwall have been constructed using this deflection criteria; deflections for these walls were computed using the classical methods of analyses.

What we have learned from the E-99 floodwall test and the analyses of the deflections using finite elements is that the deflections are much higher than those predicted using the classical methods; and we must decide how we should adjust to this new information.

Mr. Marsalone also stated that the floodwalls along the Mississippi River levees were in much better foundation conditions and he thought that the E-99 test did not apply to those conditions. Mr. Dubuisson agreed that the E-99 test and subsequent finite elements analyses applied only to soft clay foundations.

3. Mr. Dubuisson added to Mr. Marsalone's remarks by saying this meeting was not expected to resolve all questions but the discussion, with possible new directions, was important. He also stated that the recent tests showed that deflections would occur in soft clays regardless of the sheet pile size. The important questions to be answered are how can we handle the deflection and what can we live with?

4. Mr. Cave stated that the WES Finite Element Method (FEM) report had only been complete for a short time and his office was still reviewing it. Should additional comments arise at a later date, another meeting may be necessary to discuss those issues.

Bill Caver of NOD then gave a brief description of the E-99 test section. He described the test itself, the loading conditions, surveys and instrumentation, how the test section failed and results of the test.

6. A presentation was then given by WES (John F. Peters and Dan Leavell) concerning the draft report on the "The Development of Finite Element-Based Design Procedure for Sheet Pile Walls". The presentation provided an explanation of the results of the report. It was pointed out, however, that the test results were not intended for every case because geometry of the levee, loading conditions, and soil stratification are important variables that will have an effect on the results. Recommendations made by WES are included as an attachment.

7. The next portion of the meeting involved a discussion of deflections. Mr. Guggenheimer stated that past deflection calculations involved only structural deflections. No acceptable methods have been available in the past that could also determine lateral soil movement (deep seated soil movement and pile rotation). However, based on the recent E-99 test and the referenced WES report, everyone agrees that this total pile movement is an important consideration. Structural deflection limitations presently used in I-wall designs are 3 inches of deflection for a factor of safety of 1.3 and 1.5 inches of deflection for a factor of safety of 1.0. While soil movements in soft soils are recognized as important considerations, stiffer soils would involve less lateral soil movement and deflections would be more solely of a structural nature. Mr. Baumy gave results from a recent analysis utilizing the CSHTSSI program for PZ-27 and PZ-40 sheet pile in soft and stiff soils. For PZ-40, the deflection was reduced from 6.85 inches to 1.95 inches for soft and stiff soils. Mr. Baumy noted that his analysis was only one dimensional and did not account for the deep seated movement caused by vertical surcharge. The results, however, did indicate for stiffer soils a less overall deflection and a greater effectiveness of stiffer piling to reduce deflection.

8. The next discussion involved an explanation by Mr. Romero concerning the methods of analysis presently being utilized for hurricane protection. That analysis assumed sheet pile fixed at the tip and lateral pressures applied along the pile. Lateral soil movement is not considered. Our design of steel sheet piling accounts for stresses and deflection utilizing the S-case, F.S. = 1.2 with water to the still water level, and the Q-case, F.S. = 1.0 with water to freeboard. The critical moment obtained is used to calculate stresses.

concerning loading conditions, Bill Caver stated that the design criteria provided to NOD by CEMRC-ED-GS letter of 23 December 1987 were being followed for I-wall design. It has resulted in substantial reductions of sheet pile penetration.

Some discussion followed concerning cyclic loading, as associated with hurricanes. The comment was made that much of the E-99 movement came as a result of creep due to the length of time the loading was actually on the wall (52 days). It was stated that this type of loading would not be experienced by a hurricane protection floodwall and therefore the movements would be less. The point was made that the constant impact by waves during a hurricane, however, could be an even more severe loading case. It was generally felt that wall movements as a result of a hurricane would still be high, but probably less than the E-99 loading condition. The best way to determine this would be to perform another test and find out what would happen.

Permanent set of the soil due to wall movement was also addressed. It was stated that in most instances this would not be visible to the general public and that aesthetics should not be of concern for this situation. Uniform movement of an I-wall would be taken up at each monolith joint and would also not be of concern. The maximum permanent set would be achieved only for the design storms (hurricane or flood). All lesser loading conditions would result in very small permanent set.

Mr. Marsalone stated that as a rule I-walls should not exceed 8 feet of stickup, and that we were asking for trouble if we built them higher than this in soft soil foundation conditions. There was unanimous concurrence in this. We should also consider using "kicker" pile walls which could reduce deflections and provide greater stability. In many instances the use of "kicker" piles would provide a more economical wall design since the length of the sheet piling and maybe the section modulus of the sheet piling could be reduced. The design of the "kicker pile wall" would be similar to an anchor bulkhead design; the concrete cap would act as the structural wale between piles, and the sheet pile would have to provide enough tension capacity in the ground to counterbalance the vertical component of the "kicker piles". This type of wall should be considered when appropriate.

10. The maximum allowable movement for an I-wall was then discussed. It was decided, that a flexible connection could be designed for those monolith joints that would experience the most relative movement with regards to adjacent monoliths (joints at P.I.'s and between I-wall and T-wall). In addition, slope protection should be provided behind these joints.

agreed that deflection should not control the selection of the size of steel piling in the future for soft clays. Stress and stability should govern the design. Similarly, deflection should not be a basis for going from I-wall to T-wall.

Mr. Dubuisson stated that more testing may be needed to answer some questions still remaining. He stated NOD should formulate a design for such tests and have them performed. Also, flood fight personnel should be made aware of these critical joint connections and they should be closely monitored. However, seepage was not as big of a concern on hurricane protection projects as it should be for flood control projects.

11. Recommendations:

For soft clays, the findings of the WES report should be used to estimate deflection by utilizing the CANWALL program. The procedure described in the WES report and discussed at the meeting should be followed.

Penetrations and moments should be computed the same way it has been done in the past.

Consideration should be given to using kicker piles where appropriate.

Slope protection and flexible joint connections will be designed for those joints where the relative movement between joints is considered critical.

Consideration should be given by NOD to perform additional tests for cyclic loading, stiffer soils, etc. How and when the test would be done will also be for NOD to decide. The load to be applied for the test would either be a water load or a direct pull type of loading. A scope of work should be prepared and WES would provide any assistance needed.

~~It should be documented in future DM's that heavier sheet~~ pile does not reduce deflections in soft soils.

It was stated that all considerations at this meeting are for new designs. Also, NOD should evaluate existing walls and make a recommendation in the future concerning the problem areas discussed at the meeting.

AGENDA FOR MEETING ON I-WALL DEFLECTIONS

OCTOBER 28, 1988

I. BACKGROUND

A. E-99 TEST

B. REVISED FACTORS OF SAFETY, LETTER FROM MRC-ED-GS, 23 DEC 87

* C. CELMV-ED-GS MEMORANDUM DATED 7 SEPT 88

II. WES PRESENTATION OF FINITE ELEMENT ANALYSIS

III. DEFLECTIONS

A. LATERAL SOIL MOVEMENT

B. STRUCTURAL MOVEMENT

C. PRESENT DEFLECTION LIMITATIONS

D. DEFLECTIONS IN STIFFER SOILS

IV. METHODS OF ANALYSIS

A. CONVENTIONAL METHODS

B. OTHER METHODS

V. LOADING CONDITIONS

A. S-CASE

B. Q-CASE

C. APPLICABILITY OF E-99 TEST RESULTS TO HURRICANE PROTECTION PROJECTS

VI. MAXIMUM ALLOWABLE MOVEMENT

A. PROBLEMS FOR CONSIDERATION

1. WATERSTOPS
2. SHEET PILE INTERLOCKS
3. PERMANENT SOIL DISPLACEMENT
* 4. RELATIVE MOVEMENT AT JOINTS (TRANSITION LOCATIONS)

B. SOLUTIONS

1. KICKER PILES
2. T-WALLS
3. FLEXIBLE CONNECTION AT SHEET PILE INTERLOCK
* 4. ARMOR PROTECTION AT TRANSITION JOINT LOCATIONS (STONE, CONCRETE SLAB, ETC.)

C. EXISTING FLOODWALLS (NEED FOR REPAIRS AFTER LOADING)

VII. FUTURE CONSIDERATIONS OR ACTIONS TAKEN

A. ADDITIONAL TESTS (STIFF CLAYS)

B. METHOD OF ANALYSIS

C. ALLOWABLE DEFLECTION CRITERIA

D. STRUCTURAL CRITERIA

* ADDITIONS RECOMMENDED BY CELMV-ED

ATTENDANCE RECORD

DATE(S)	SPONSORING ORGANIZATION	LOCATION
28 Oct. 88	U.S. ARMY CORPS OF ENGRS.	NEW ORLEANS DISTRICT

PURPOSE FLOODWALL DEFLECTION

PARTICIPANT REGISTER *

NAME	ORGANIZATION	TELEPHONE NUMBER
Carl R. Guggenheimer	NOD, Engr. Div., Des. Br.	x-2643
Frank N. Johnson	CELMV-ED-TS	X-5935
Victor M. Agostinelli	" "	EXT-5932
Roland J. Dubuisson	CELMV-ED-T	5919
John F. Peters	USAEWES GE-SR	634-2590
Dan Leavell	USAE WES-GE-SR	634-2496
Richard Jackson	CELMV-ED-GS	634-5898
Jim Richardson	CELMN-ED-FS	x-1031
Bill Caver	CELMN-ED-FD	x 1002
Rodney P. Picciola	CELMN-ED-F	x 2975
Lawrence H. Cave Jr	CELMV-ED-GS	~~634-5897~~
Jorge A. Romero	CELMN-ED-DD	x 2645
Walter Baumy	CELMN-ED-ID	X 2656
D. Vann Stutts	CELMN-ED-SP	X 2614
Jack E Bardwell	CELMV-ED-PG	634-5925
Fred Caver	CELMV-ED-P	634-5904
Daniel Margalonc	CELMN-ED-D	862-2760

LMV FORM 583-R
(replaces LMN 906)

* If you wish to be furnished a copy of the attendance record, please indicate so next to your name.

CELMV-ED-TS (CELMN-ED-DD/18 Nov 88) (1105-2-10c) 1st End Mr. Johnson/jm/5935
SUBJECT: I-Wall Deflection

DA, Lower Mississippi Valley Division, CE, Vicksburg, MS 39181-0080

28 DEC 88

FOR: Commander, New Orleans District, ATTN: CELMN-ED-DD

The minutes of the 28 Oct 88 meeting, held in the New Orleans District office to discuss I-wall deflections, are approved subject to the following comments:

a. Para 5. The word "performed" should be substituted for "failed" in the second sentence, since it is open to debate as to whether the test wall actually failed.

b. Para 7. The 7th sentence is not clear and should be rewritten to include the project, soil conditions, and sheet pile section used in the CSHTSSI deflection calculations.

c. Para 8. Although this paragraph may be what was stated by Mr. Romero at the meeting, it is not obvious that the most critical conditions are being considered in the design of the steel sheet piling for stresses and deflection as set forth in guidance contained in CEMRC-ED-GS letter, 23 Dec 87, subject: Sheet Pile Wall Design Criteria, and additional guidance contained in paragraph 2 of CEMRC-ED-TS, 1st Endorsement to CELMV-ED-DD memorandum, 26 Jan 88, subject: Phasing in of New I-wall Design Criteria into New Orleans District's Design/Construction Program, as discussed in comments on paragraph 9 below. For example, there is no mention if the following cases are also being considered in the design of the hurricane protection I-Wall:

(1) Q CASE; F.S. = 1.5; still water level

(2) Q CASE; F.S. = 1.25; still water level plus waveload

Bending moments used for the design of the I-Wall hurricane protection sheet piling should be computed from the same analysis and assumptions used to compute the required penetration contained in guidance referenced above. The paragraph should be revised accordingly.

d. Para 9. The first paragraph mentions design guidance for I-wall design provided to New Orleans District by CEMRC-ED-GS letter, 23 Dec 87. For completeness, and to avoid any misunderstanding, the paragraph should include not only a reference to this guidance, but also to additional guidance furnished in paragraph 2 of CEMRC-ED-TS 1st Endorsement to CELMN-ED-DD memorandum, 26 Jan 88, subject: Phasing in of New I-wall Design Criteria into New Orleans District's Design/Construction Program to document that this guidance is being followed for I-wall design.

CELMV-ED-TS (CELMN-ED-DD/18 Nov 88) (1105-2-10c) 1st End 28 DEC 88
SUBJECT: I-Wall Deflection

e. Paras 10 and 11. In these paragraphs, the term "slope protection" should be replaced by "slope and underseepage protection," since subsurface joint leakage may also be a concern at some locations. This matter was discussed at the meeting.

f. Para 11.

(1) The second subparagraph should be rewritten to avoid ambiguity and misunderstanding. It should state that moments and penetrations used in the design of the hurricane protection I-walls would be calculated using the conventional limit-equilibrium approach as used in the past and would be based on the most critical loading case as set forth in guidance contained in paragraph 3 of CEMRC-ED-DG memorandum, 23 Dec 87, subject: Sheet Pile Wall Design Criteria and in paragraph 2a of CEMRC-ED-TS 1st Endorsement to CELMN-ED-DD memorandum, 26 Jan 88, subject: Phasing in of New I-wall Design Criteria in New Orleans District's Design/Construction Program.

(2) Subparagraph 6 should be revised to state that the heavier sheet pile does not "significantly" reduce deflections in soft soils.

FOR THE COMMANDER:

Encl
wd

FRED B. BAYLEY III
Chief, Engineering Division

CELMN-ED-DD (CELMN-ED-DD/18 Nov 88) 2d End Mr. Guggenheimer/sa/2643
SUBJECT: I-Wall Deflection

DA, New Orleans District, Corps of Engineers, P. O. Box 60267, New Orleans, LA 70160-0267 18 January 1989

FOR: Commander, Lower Mississippi Valley Division,
ATTN: CELMV-ED-TS

1. We have reviewed the comments provided in your 1st End and offer the following comments:

a. We concur with the recommendations made in paras. a, b, d, e, and f.

b. We concur with your comments in para. c. However, it should be noted that recent correspondence from your office (para. j. (3) of CELMV-ED-PG, 1st End to CELMN-ED-SP letter, Subject: Westwego to Harvey Canal, Louisiana Hurricane Protection Project, General Design Memorandum No. 1, Advance Supplement, Harvey Canal Floodwall) provides different criteria from that provided in CEMRC-ED-GS letter 23 Dec 87, Subject: Sheet Pile Wall Design Criteria. The guidance concerning the Harvey Floodwall states that the "S-Case" is considered inappropriate. In order to satisfy your comment in para. c for determining the most critical condition, whether to use the "S-Case" for hurricane protection projects is an important consideration. We would appreciate a clarification on this issue.

c. The minutes of the 28 Oct 88 meeting have been revised and a copy is enclosed.

FOR THE COMMANDER:

1 Encl
Added 1 Encl
2. as

FREDERIC M. CHATRY
Chief, Engineering Division

CELMN-ED-DD

MINUTES OF MEETING

SUBJECT: I-Wall Deflections

1. A meeting was held on 28 October 1988, at the New Orleans District between representatives from the New Orleans District and LMVD. A list of the attendees along with a copy of the agenda for the meeting are attached.

2. The meeting was opened by Mr. Marsalone who welcomed everyone and made a brief statement concerning the purpose of the meeting. He stated that a huge amount of floodwall design and construction in the New Orleans District began around the mid 60's and involved foundations mostly in soft clays. The criteria for the design of these walls were agreed upon by representatives of OCE, LMVD, and NOD, and part of that criteria was a limit on the amount of deflection. The limit placed on the allowable deflection at the top of the floodwall was 2 inches. A floodwall along the west bank of the IHNC where its deflection exceeded 2 inches was redesigned using buttress of "kicker" piles to limit the deflection. Many miles of floodwall have been constructed using this deflection criteria; deflections for these walls were computed using the classical methods of analyses.

What we have learned from the E-99 floodwall test and the analyses of the deflections using finite elements is that the deflections are much higher than those predicted using the classical methods; and we must decide how we should adjust to this new information.

Mr. Marsalone also stated that the floodwalls along the Mississippi River levees were in much better foundation conditions and he thought that the E-99 test did not apply to those conditions. Mr. Dubuisson agreed that the E-99 test and subsequent finite elements analyses applied only to soft clay foundations.

3. Mr. Dubuisson added to Mr. Marsalone's remarks by saying this meeting was not expected to resolve all questions but the discussion, with possible new directions, was important. He also stated that the recent tests showed that deflections would occur in soft clays regardless of the sheet pile size. The important questions to be answered are how can we handle the deflection and what can we live with?

4. Mr. Cave stated that the WES Finite Element Method (FEM) report had only been complete for a short time and his office was still reviewing it. Should additional comments arise at a later date, another meeting may be necessary to discuss those issues.

CELMN-ED-DD
SUBJECT: I-Wall Deflections

5. Bill Caver of NOD then gave a brief description of the E-99 test section. He described the test itself, the loading conditions, surveys and instrumentation, how the test section performed and results of the test.

6. A presentation was then given by WES (John F. Peters and Dan Leavell) concerning the draft report on the "The Development of Finite Element-Based Design Procedure for Sheet Pile Walls". The presentation provided an explanation of the results of the report. It was pointed out, however, that the test results were not intended for every case because geometry of the levee, loading conditions, and soil stratification are important variables that will have an effect on the results. Recommendations made by WES are included as an attachment.

7. The next portion of the meeting involved a discussion of deflections. Mr. Guggenheimer stated that past deflection calculations involved only structural deflections. No acceptable methods have been available in the past that could also determine lateral soil movement (deep seated soil movement and pile rotation). However, based on the recent E-99 test and the referenced Wes report, everyone agrees that this total pile movement is an important consideration. Structural deflection limitations presently used in I-wall designs are 3 inches of deflection for a factor of safety of 1.3 and 1.5 inches of deflection for a factor of safety of 1.0. While soil movements in soft soils are recognized as important considerations, stiffer soils would involve less lateral soil movement and deflections would be more solely of a structural nature. Mr. Baumy presented results utilizing the CHTSSI Program to compare sheet pile performance for both soft and stiff soils. The soft soil condition utilized the E-99 design stratification (cohesions of 200, 350, & 500), an 8.3 ft. head of water, a sheet pile 31.0 ft. in length, and 8.3 ft. of stick-up above the ground line. Structural analysis was performed for PZ-27 and PZ-40 sheet piling with resulting deflections of 7.8 and 6.9 inches respectively. A stiffer soil condition was simulated by increasing the cohesion by a factor of 3. The geometry and loading condition was identical to that of prior analysis and deflections for the PZ-27 and PZ-40 were 2.40 and 1.95 inches respectively.

Mr. Baumy noted that his analysis was only one dimensional and did not account for the deep seated movement caused by vertical surcharge. The results, however, did indicate for stiffer soils a less overall deflection and a greater effectiveness of stiffer piling to reduce deflection.

CELMN-ED-DD
SUBJECT: I-Wall Deflections

8. The next discussion involved an explanation by Mr. Romero concerning the methods of analysis presently being utilized for hurricane protection. That analysis assumed sheet pile fixed at the tip and lateral pressures applied along the pile. Lateral soil movement is not considered. Our design of steel sheet piling accounts for stresses and deflection utilizing the guidance contained in paragraph 3 of CEMRC-ED-DG Memorandum, 23 Dec 87, Subject: Sheet Pile Wall Design Criteria and in paragraph 2a of CEMRC-ED-TS 1st Endorsement to CELMN-ED-DD Memorandum, 26 Jan 88, Subject: Phasing in of New I-Wall Design Criteria in New Orleans District's Design/Construction Program. The critical moment obtained is used in the design.

9. Concerning loading conditions, Bill Caver stated that the design criteria provided to NOD by CEMRC-ED-GS letter of 23 December 1987 and additional guidance furnished in para. 2 of CEMRC-ED-TS 1st Endorsement dated 26 Jan 88 were being followed for I-wall design. It has resulted in substantial reductions of sheet pile penetration.

Some discussion followed concerning cyclic loading, as associated with hurricanes. The comment was made that much of the E-99 movement came as a result of creep due to the length of time the loading was actually on the wall (52 days). It was stated that this type of loading would not be experienced by a hurricane protection floodwall and therefore the movements would be less. The point was made that the constant impact by waves during a hurricane, however, could be an even more severe loading case. It was generally felt that wall movements as a result of a hurricane would still be high, but probably less than the E-99 loading condition. The best way to determine this would be to perform another test and find out what would happen.

Permanent set of the soil due to wall movement was also addressed. It was stated that in most instances this would not be visible to the general public and that aesthetics should not be of concern for this situation. Uniform movement of an I-wall would be taken up at each monolith joint and would also not be of concern. The maximum permanent set would be achieved only for the design storms (hurricane or flood). All lesser loading conditions would result in very small permanent set.

Mr. Marsalone stated that as a rule I-walls should not exceed 8 feet of stickup, and that we were asking for trouble if we built them higher than this in soft soil foundation conditions. There was unanimous concurrence in this. We should also consider using "kicker" pile walls which could reduce deflections and provide greater stability. In many instances the use of "kicker"

piles would provide a more economical wall design since the length of the sheet piling and maybe the section modulus of the sheet piling could be reduced. The design of the "kicker pile wall" would be similar to an anchor bulkhead design; the concrete cap would act as the structural wale between piles, and the sheet pile would have to provide enough tension capacity in the ground to counterbalance the vertical component of the "Kicker piles". This type of wall should be considered when appropriate.

10. The maximum allowable movement for an I-wall was then discussed. It was decided then that a flexible connection could be designed for those monolith joints that would experience the most relative movement with regards to adjacent monoliths (joints at P.I.'s and between I-wall and T-wall). In addition, slope and underseepage protection should be provided behind these joints.

It was agreed that deflection should not control the selection of the size of steel piling in the future for soft clays. Stress and stability should govern the design. Similarly, deflection should not be a basis for going from I-wall to T-wall.

Mr. Dubuisson stated that more testing may be needed to answer some questions still remaining. He stated NOD should formulate a design for such tests and have them performed. Also, flood fight personnel should be made aware of these critical joint connections and they should be closely monitored. However, seepage was not as big of a concern on hurricane protection projects as it should be for flood control projects.

11. Recommendations:

For soft clays, the findings of the WES report should be used to estimate deflection by utilizing the CANWALL Program. The procedure described in the WES report and discussed at the meeting should be followed.

Moments and penetrations used in the design of hurricane protection I-walls would be calculated using the conventional limit equilibrium approach as used in the past and would be based on the most critical loading case as set forth in guidance contained in paragraph 3 of the CEMRC-ED-DG Memorandum dated 23 Dec 87 and paragraph 2a of the CEMRC-ED-TS 1st Endorsement to the CELMN-ED-DD Memorandum dated 26 Jan 88, both referenced earlier in these minutes.

Consideration should be given to using kicker piles where appropriate.

CELMN-ED-DD
SUBJECT: I-Wall Deflections

Slope and underseepage protection and flexible joint connections will be designed for those joints where the relative movement between joints is considered critical.

Consideration should be given by NOD to perform additional tests for cyclic loading, stiffer soils, etc. How and when the test would be done will also be for NOD to decide. The load to be applied for the test would either be a water load or a direct pull type of loading. A scope of work should be prepared and WES would provide any assistance needed.

It should be documented in future DM's that heavier sheet pile does not significantly reduce deflections in soft soils.

It was stated that all considerations at this meeting are for new designs. Also, NOD should evaluate existing walls and make a recommendation in the future concerning the problem areas discussed at the meeting.

CELMV-ED-TS (CELMN-ED-DD/18 Nov 88) (1105-2-10c) 3d End Mr. Johnson/jm/5935
SUBJECT: I-Wall Deflection

DA, Lower Mississippi Valley Division, CE, Vicksburg, MS 39181-0080

07 MAR '89
FOR Commander, New Orleans District, ATTN: CELMN-ED-DD

The 2d Endorsement is satisfactory subject to the following comments:

Para 1c.

a. We have no objection to the proposed elimination of the 3 to 1 penetration to head ratio criteria, which was never meant to be a "hard and fast" rule. Also, we concur that if increased penetration is needed, it should be done on a case by case basis.

b. After receipt and review of the final report "WES Study of Finite-Element Based Design Procedures for Sheet Pile Walls," appropriate revisions to the criteria presented in the CEMRC-ED-GS memorandum, subject: Sheet Pile Wall Design Criteria, 23 Dec 87, will be summarized and furnished by letter. In this regard, we would like to reserve final judgement concerning minimum penetration to head ratios, and utilization of the "Q-case" exclusively for certain loading conditions, until review of this report is complete. WES has indicated that its report will be complete in a few weeks.

FOR THE COMMANDER:

2 Encls
nc

FRED H. BAYLEY III
Chief, Engineering Division