

**PROPOSED:**

**PW 2013-17**

**4<sup>TH</sup> STREET AND WALNUT STREET PARKING GARAGE REPAIR**

***LETTING DATE: September 18, 2013 (2:00p.m. local time)***

**FOR:**

**THE CITY OF BLOOMINGTON**

**DEPARTMENT OF PUBLIC WORKS**

**POST OFFICE BOX 100**

**BLOOMINGTON, INDIANA**

SUBMITTED BY:

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Company or Firm Name

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Street and Number

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City or Town

State

Zip Code

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**SECTION I**  
**INVITATION TO QUOTERS**

## INVITATION TO QUOTERS

NOTICE IS HEREBY GIVEN THAT THE BOARD OF PUBLIC WORKS OF THE CITY OF BLOOMINGTON, INDIANA WILL RECEIVE SEALED QUOTES FOR THE BELOW-DESCRIBED WORK AT THE LOCATION INDICATED.

### ***4<sup>th</sup> Street and Walnut Street Parking Garage Repair***

This project shall include, but is not limited to repairs of the 4<sup>th</sup> Street and Walnut Street Parking Garage including but not limited to the removal and repair of failed joint sealants, spalled areas, clean seal and painting, as requested.

The proposal and other data submitted will form the basis of the negotiation of a lump agreement for the work. Proposals are to be submitted in proper form, as described in the "Instructions to Quoters". Sealed proposals shall be received by the Office of the City Engineer at City Hall, 401 North Morton Street, Bloomington, Indiana, at or before 2:00p.m. local time on September 18, 2013. Proposals will be publicly opened and read aloud by the Engineering and/or Public Works Staff at 2:00p.m. in the McCloskey Conference Room. Any proposals received after the designated time will be returned unopened. Proposals will be reviewed and the award may be made at the September 24, 2013 meeting of the Bloomington Board of Public Works.

Each Bidder shall file with his or her sealed proposal: (1) a properly executed Non-collusion Affidavit as required by the laws of the State of Indiana; (2) a Questionnaire Form 96 of the State Board of Accounts; (3) a cashier's check or certified check drawn on an acceptable bank or a Quote bond equal to five (5) percent of the total amount of Bid.

A MANDATORY pre-quote meeting will be held at the Garage Entrance located at 105 West 4<sup>th</sup> Street, Bloomington, Indiana, on September 6, 2013 at 2:00 p.m. local time.

Each Bidder must ensure that to the greatest extent feasible, opportunities for training and employment should be given to lower income residents of the project area and purchases and/or contract for work in connection with the project should be awarded to small business concerns which are located in, or owned in substantial part, by persons residing in the area of the project.

The City of Bloomington is an equal opportunity employer, and Bidder shall meet all requirements for equal employment under Title VII of the 1964 Civil Rights Act as amended and under the Bloomington Human Rights Ordinance, as amended.

Each Bidder for proposals over \$10,000.00 shall submit and have approved by the City of Bloomington Contract Compliance Officer, Barbara McKinney, and their written Affirmative Action Plan at least twenty-four (24) hours prior to the deadline for submission of proposals. Bids received that do not have an approved Affirmative Action Plan will be returned unopened. Each Bidder must insure that all employees and applicants for employment are not discriminated against because of race, religion, color, sex, national origin, ancestry or handicap. All the protected classes must be included in your Affirmative Action Plan for it to be acceptable. In addition to other requirements, your plan MUST include a workforce breakdown, an internal grievance procedure, a non-retaliation statement, designation of a person by name or position who is responsible for implementation of the Plan, applicability to both applicants and employees, recruitment of minorities, equal access to training programs, and an explanation of your method of communicating the operations of your affirmative action plan to employees and prospective applicants. Barbara McKinney, Contract Compliance Officer, may be contacted at (812) 349-3429, 8:00 a.m. to 5:00 p.m. Monday through Friday.

The Board of Public Works reserves the right to waive any informality and to accept or reject any or all proposals submitted.

Wage rates shall not be less than the prevailing wage rates as determined in accordance with IC 5-16-7.

The successful Bidder shall furnish performance and payment bonds for one-hundred (100) percent of the contract amount prior to the execution of the contract, and said bonds shall remain in effect for a period of one (1) year after final acceptance of the work.

Quotes may be held by the Board of Public Works for a period not-to-exceed sixty (60) days from the date of the opening of Quotes for the purpose of reviewing the Quotes and investigating the qualifications of the Quoter prior to awarding the contract.

**Board of Public Works, City of Bloomington, Indiana**

Charlotte Zietlow, President

**SECTION II**

**INSTRUCTIONS TO QUOTERS**

# INSTRUCTIONS TO BIDDERS

- 1.00 CONTRACT DOCUMENTS:** The "Invitation to Bidders", "Instructions to Bidders" "Bidder's Proposal", "Agreement", "General Conditions", "Special Conditions", "Specifications", and the "Contract Drawings" are the Contract Documents that will form the Contract.
- 1.01 INSPECTION OF THE SITE:** Bidders shall examine each of the Contract Documents, visit the site of the work and thoroughly and fully inform themselves of the construction hazards procedures, labor, conditions and factors, which could affect the prosecution and completion of the work. Such considerations shall include; the conditions of existing structures and facilities which may be affected by the proposed work, the procedure necessary for maintenance of uninterrupted operation of existing facilities, the availability and cost of labor and methods for transporting, handling, and storage of materials and equipment. All such factors shall be properly investigated and considered in the preparation of the Bidder's proposal. There will be no subsequent financial adjustment to any contract for lack of such prior information or its effects on the cost of the work.
- 1.02 OMISSIONS AND DISCREPANCIES:** Should Bidders find discrepancies in, or omissions from, the Contract Documents, or should they be in doubt as to their meaning, written notification should be made to the City Engineer. Interpretation of the proposed contract documents will be made only by written addendum. A copy of each addendum will be emailed or delivered to each person obtaining a set of contract documents from the City Engineer. The Owner will not be responsible for any other explanations or interpretations of the proposed contract documents.
- 2.00 PROPOSALS:** Pursuant to the "Invitation to Bidders" sealed proposals for performing the work shall be received by the Office of the City Engineer at City Hall, 401 North Morton Street, Bloomington, Indiana, at or before 2:00p.m. local time on September 18, 2013. Proposals will be publicly opened and read by the Engineering and/or Public Works Staff at 2:00 p.m. local time in the McCloskey Conference Room. Any proposals received after the designated time will be returned unopened. Proposals will be reviewed and the award may be made at the September 24, 2013 meeting of the Bloomington Board of Public Works.
- 2.01 PROPOSAL FORM:** Each proposal shall be legibly written or printed in ink on the Proposal Form with Unit Prices provided. All addenda to the Contract Documents on which a Proposal is based, properly signed by the Bidder, shall accompany the Proposal when submitted. No alteration in any Proposal, or in the Proposal Form on which it is submitted, shall be made by any person after the Proposal has been submitted by the Bidder.
- 2.02 PROPOSAL SIGNATURES:** Each Bidder shall sign their proposal using their usual signature and giving their full business address. Bids by partnerships shall be signed with the partnership name followed by the signature and designation of one of the partners or other authorized representative. Bids by corporations shall be signed with the name of the corporation followed by the signature and designation of the president, secretary, or other person authorized to bind the corporation. The names of all persons signing should also be typed or printed below the signature. A Bid by a person who affixes to their signature the word "president" or "secretary", "agent", or other designation without disclosing their principal may be held to be the Bid of the individual signing. When requested by the Owner, satisfactory evidence of the authority of the person signing shall be furnished. No Bidder may submit more than one Proposal. Two Proposals under different names will not be accepted from one firm or association.

- 2.03 PROPOSAL SUBMISSION:** Each Proposal submitted shall be enclosed in a sealed envelope or wrapping, addressed to the Board of Public Works, Post Office Box 100, Bloomington, Indiana 47402, identified on the outside with the words "SEALED BID", and the name of the project and the project number, and filed with the City Engineer at their office in City Hall at 401 North Morton, Bloomington, Indiana.
- 2.04 INDIANA LEGAL REQUIREMENTS:** Each Bidder shall submit under oath with their Bid a statement of their experience, proposed plan for performing the Work, equipment available to perform the work, and a financial statement. The statements shall be submitted on Questionnaire Form No. 96 of the Indiana State Board of Accounts. Each Proposal shall be accompanied by a properly executed Non-Collusion Affidavit as required by the laws of the State of Indiana.
- 2.05 PROPOSAL GUARANTEE:** Each Proposal shall be accompanied by a cashier's check or a certified check drawn on an acceptable bank, or an acceptable Bidder's bond in an amount of not less than five percent (5%) of the total Bid. No personal and/or company checks will be accepted and the bid shall be deemed unresponsive. The proposal guarantee shall be made payable without condition to the City of Bloomington, Indiana, hereinafter referred to as "Owner", and the amount of said Proposal Guarantee may be retained by and forfeited to the Owner as liquidated damages if the Proposal covered thereby is accepted and a contract based thereon is awarded and the Bidder should fail to enter into a contract in the form prescribed, with legally responsible sureties, within fifteen (15) days after such award is made and confirmed by the Owner.
- 2.06 RETURN OF PROPOSAL GUARANTEE:** The Proposal Guarantee deposit of each unsuccessful Bidder will be returned when their proposal is rejected. The Proposal Guarantee deposit of the Bidder to whom the Contract is awarded will be returned when the successful Bidder executes a contract and files a satisfactory performance bond. The Proposal Guarantee deposit of the second and third lowest responsible Bidders may be retained for a period not to exceed ninety (90) days pending the execution of the Contract and bond by the successful Bidder.
- 2.07 WITHDRAWAL OF PROPOSAL:** No Contractor may withdraw their Proposal for a period of sixty (60) days after the date and hour set for the opening, and the Bidders submitting the three lowest Bids may not withdraw their proposals for a period of one-hundred eighty (180) days after the opening date. A Bidder may withdraw their Proposal at any time prior to the expiration of the Bid period during which Proposals may be submitted by a written request signed in the same manner and by the same person who signed the Proposal.
- 2.08 ACCEPTANCE AND REJECTION OF PROPOSALS:** The Owner reserves the right to accept the proposal submitted by the lowest responsible and responsive Bidder; to reject any or all proposals; and to waive irregularities or informalities in any proposal. Proposals received after the specified time of closing will be returned unopened. The acceptance of a proposal will be a notice in writing signed by a duly authorized representative of the Board of Public Works, and no other act shall constitute acceptance of a proposal. The acceptance of a proposal shall bind the successful Bidder to execute the Contract and to be responsible for liquidated damages as provided in Section 8.00.
- 3.00 QUALIFICATION OF BIDDERS:** Bidders shall submit satisfactory evidence that they have a practical knowledge of the particular work bid upon, and that they have the necessary financial resources to complete the proposed work. Each Bidder shall execute completely and accurately Questionnaire Form No. 96 of the Indiana State Board of Accounts and shall file the same with their Proposal. The information contained therein shall be used by the Owner to determine the ability, experience, and capital resources of the Bidder. In determining the Bidder's qualifications, the following factors will be considered: whether the Bidder (a) maintains a permanent place of business; (b) has adequate plant and

equipment to do the work properly and expeditiously; (c) has the necessary financial resources to meet all obligations incident to the work; and (d) has appropriate technical experience. Each Bidder may be required to show that previous work performed has been handled in such a manner that there are no just and proper claims pending against such work. No Bid will be accepted which is submitted by a Bidder who is engaged in any work which would impair their ability to finance the work covered by such Bid or to provide suitable equipment for its proper prosecution and completion.

**4.00 EXECUTION OF CONTRACT:** Any Bidder whose proposal shall be accepted will be required to appear at the office of the City Engineer in person, or, if a firm or corporation, a duly authorized representative shall so appear, to execute the Contract within 15 days after notice that the Contract has been awarded to them. Failure or neglect to do so shall constitute a breach of the agreement effected by the acceptance of the Proposal. The amount of the Proposal Guarantee accompanying the Proposal of such Bidder shall be retained by the City as liquidated damages for such breach. In the event that any Bidder whose Proposal shall be accepted shall fail or refuse to execute the Contract as hereinbefore provided, the Board of Public Works may at their option, determine that such Bidder has abandoned the Contract and thereupon their Proposal and the acceptance thereof shall be null and void and the Owner shall be entitled to liquidated damages as above provided.

**4.01 INSURANCE:** The Contractor will be required to carry insurance throughout the lifetime of the Contract, as provided in the General Conditions, the amount of insurance of the various types being not less than the amounts specified therein.

**4.02 PAYMENTS:** Payment for all work performed under the proposed contract will be made in cash, or its equivalent, by the Owner within thirty (30) days after completion and final acceptance of the work covered by the contract. Partial estimates will be issued and paid as provided in the General Conditions.

**4.03 TIME FOR BEGINNING AND COMPLETING THE WORK:** The Contractor shall start active and continuous work on the contract within 15 calendar days after the date of the notice to proceed and shall complete the work within 30 calendar days. Calendar and work days shall be as defined in the General Conditions of these documents.

**4.04 TAXES AND PERMITS:** Attention is directed to the requirements of the General Conditions regarding payments of taxes and obtaining permits. The Contractor shall be responsible for obtaining all necessary permits.

**4.05 WORKER'S COMPENSATION:** Before any work is started, the Contractor shall obtain from the Indiana State Industrial Board and file with the Owner, a certificate as evidence of compliance with the provisions of the Indiana Worker's Compensation Act and the Indiana Worker's Occupational Diseases Act..

**4.06 PERFORMANCE BOND:** The Bidder to whom a contract is awarded will be required to furnish a Performance Bond to the Owner in an amount equal to one-hundred (100) percent of the contract price. The bond shall be executed on the form included in the Contract Documents by a surety company authorized to do business in the State of Indiana and acceptable as surety to the Owner. Accompanying the bond shall be a "Power of Attorney" authorizing the attorney-in-fact to bind the surety company and certified to include the date of the bond. The surety on the Performance Bond cannot be released for one year, and the bond must require that the surety will not be discharged for:

- A. modifications, omissions, or additions;
- B. defects in the contract; or
- C. defects in the bidding or awarding process.

- 4.07 PAYMENT BOND:** For all contracts a Payment Bond is required to insure payment of subcontractors, laborers, material suppliers, and persons furnishing services. The bond is executed by the Contractor to the state, approved by and for the benefit of the Owner, in an amount equal to the contract price. It is deposited with the board, and its surety cannot be released until one year after the board's final settlement with the Contractor. The bond must provide the same assurances as does the Performance Bond against conditions discharging the surety.
- 4.08 LOCAL MATERIALS:** Preference will be given to materials, products, supplies, and all other articles produced, manufactured, made, or grown in the State of Indiana.
- 4.09 NON-DISCRIMINATION IN EMPLOYMENT:** Each Bidder for proposals over \$10,000.00 shall submit and have approved by the City of Bloomington Contract Compliance Officer, Barbara McKinney, their written Affirmative Action Plan at least twenty-four (24) hours prior to the deadline for submission of proposals. Bids received that do not have an approved Affirmative Action Plan will be returned unopened. Each Bidder must insure that all employees and applicants for employment are not discriminated against because of race, religion, color, sex, national origin, ancestry or handicap. All the protected classes must be included in your Affirmative Action Plan for it to be acceptable. In addition to other requirements, your plan MUST include a workforce breakdown, an internal grievance procedure, a non-retaliation statement, designation of a person by name or position who is responsible for implementation of the Plan, applicability to both applicants and employees, recruitment of minorities, equal access to training programs, and an explanation of your method of communicating the operations of your affirmative action plan to employees and prospective applicants. Barbara McKinney, Contract Compliance Officer, may be contacted at (812) 349-3429, 8:00 a.m. to 5:00 p.m. Monday through Friday. The successful Bidder must comply with each section of its affirmative action plan and be prepared to comply in all respects with the contract provisions regarding non-discrimination which are included in the Employment Requirement and Wage Rate section. For contracts paid in whole or in part with federal funds, the Bidder must submit a signed statement as to whether he or she has previously performed work subject to Executive Order 11246. For contracts paid in whole or in part with federal funds, the successful Bidder must, if requested, submit a list of all subcontractors who will perform work on the project, and written and signed statements from authorized agents of the labor pools with which they will or may deal for employees on the work, together with supporting information to the effect that said labor pools' practices and policies are in conformity with Executive Order 11246, and that said labor pools will affirmatively cooperate in, or offer no hindrance to, recruitment, employment, and equal treatment of employees seeking employment, and performing work under the Contract, or a certification as to what efforts have been made to secure such statements when such agents or labor pools have failed or refused to furnish same, prior to the award of the Contract.

**SECTION III**

**BID FORM  
UNIT PRICES  
BIDDER AFFIDAVIT  
SAMPLE BID BOND**

**BID FORM**

This Quote Summary Sheet shall be completed and submitted with all other Quote Documents.

The Lump Sum cost to complete the repairs to the 4<sup>th</sup> Street and Walnut Street Parking Garage per the scope of work is;

\_\_\_\_\_, \$\_\_\_\_\_

All work shall be completed within 30 calendar days from date of the Notice to Proceed. Any and all Subcontractors performing work valued over \$10,000 shall be listed below: Any subcontractor not listed below at the time of bid, must be approved by the City of Bloomington prior to performing any work on this contract. Subcontractors not listed or approved will not be paid for work under this contract.

<b>SUBCONTRACTORS</b>	<b>ADDRESS</b>	<b>TYPE OF WORK</b>

Attachment "A"

"Scope of Work"

Garage Art Building Restoration

4th and Walnut Street, Bloomington In.

The contractor shall inspect the site and thoroughly inform themselves of all conditions, measurements, dimensions, safety procedures (road closings, sidewalk closings, proper caution signage, etc) to properly complete the work as described in this Scope of Work.

Should the contractor find any discrepancies or omissions from the Scope of Work the contractor shall notify the Operations and Facility Director immediately in writing. Contractor shall take all steps necessary to protect property, pedestrians and vehicular traffic during the construction process; this includes construction and advanced warning signage, street/sidewalk closings (if needed and approved by City Engineering). Contractor shall also secure any permits as required, at his expense, by local, county or state agencies prior to the start of the project.

Garage Art consists of the following:

Basement Level: 76 Permitted parking spaces, 1 bicycle enclosure and 1 sweeper enclosure.

Level #1: 34 metered parking spaces, 6 metered handicapped parking spaces, 2 permitted motorcycle parking spaces and 19 permitted parking spaces, 1 controlled access/exit point.

Level #2: 2 permitted handicapped parking spaces and 75 permitted parking spaces

Level #3: 2 permitted handicapped parking spaces and 75 permitted parking spaces

Level #4: 43 permitted parking spaces

There are 2 stairwells, one located on the northwest corner and one on the southeast corner of the structure.

There is one elevator located on the northwest corner as well.

There is a Skywalk that connects Garage Art to Fountain Square located on the northwest corner of the structure.

Garage Art is a 5 level structure constructed of precast concrete double tees supported by precast girders, spandrel beams and columns. The double tees are topped with a site poured concrete slab. The last time the structure was repaired was approximately 10 years ago, at that time repairs were completed to the precast structural components, connectors, topping sealants, joint sealants, expansion joints repairs, drains, and other miscellaneous items.

Under this Scope of Work we will be addressing mainly the structural components of the garage to include but not limited to; precast double tees, connectors, any spalling issues, drain receptacles, drain piping, door repair/replacement, skywalk sidewall replacement, and painting of all stairwells. All other areas such as sealing, coating, stripping, sign repairs, stairwell pans and risers, ceilings and lighting will be addressed and completed at a latter date.

- Remove all failed joint sealants in all decks, stairwell walls, elevator tower, decking, drains and exterior walls
- Remove spalled areas around all structural connector/ mending plates through-out the entire structure
- Remove all scaling and deterioration of the concrete on all wall panels, interior and exterior
- Remove concrete from all exposed rebar, replace rebar if necessary, seal all rebar to prevent rusting, coat all surfaces with a binder material and replace concrete to proper thickness to cover and protect rebar. This shall be completed on all surfaces through-out the garage (decks, walls, columns, double tee's, stairways, spandrel beams (on all sides)
- Remove and replace all defective/deteriorated drains, grates and piping. All piping shall be replaced with PVC schedule 40 in proper diameters.
- Replace all deteriorated doors, jambs, panic hardware, closers and properly seal all thresholds
- Properly clean, seal and paint the interior of all stairwells. All concrete surfaces shall be cleaned, primed with a high quality primer and 2 coats of high quality concrete paint with graffiti repelling qualities or coat all painted surfaces with anti-graffiti after paint has cured. All primers and paints must be approved prior to application
- Remove all suspended ceilings in all stairwells and properly dispose
- Advise Operations and Facilities Director of any issues (electrical, plumbing and/or additional deterioration found after ceilings have been removed)
- Remove and properly dispose of all carpeted wall materials in the skywalk
- Frame and insulate as needed the wall areas in the skywalk, place 1/2" A/C plywood over the newly framed walls to accept an FRP wall finish materials
- Properly install FRP panels over the 1/2" A/C plywood using approved adhesives, moldings and trims to provide a finished product (color TBD by owner)
- Contractor shall remove all debris and broom clean all areas of construction on a daily basis, all trash and debris must be taken to a code legal dump each day or stored in a locked container on site.
- Contractor shall coordinate all construction with the Operations and Facility Director and REI personnel prior to starting work on any level, stairwell or skywalk prior to the start of any work
- Contractor shall properly place caution, construction area closed signage and any other signage prior to the start of any construction in any area of the garage this signage shall be maintained through-out the entire construction process
- Contractor shall maintain a safe means for traffic, both vehicular and pedestrian during the entire length of the project, contractor is responsible for securing all permits and permissions prior to the start of any work
-

**SAMPLE BID BOND**

KNOW ALL MEN THESE PRESENTS, that we, the undersigned, \_\_\_\_\_  
\_\_\_\_\_ as Principal, and \_\_\_\_\_  
\_\_\_\_\_ as Surety, are hereby held and  
firmly bound unto \_\_\_\_\_ as OWNER in  
the penal sum of \_\_\_\_\_ for the payment of which, well and  
truly to be made, we hereby jointly and severally bind ourselves, successors and assigns.

Signed, this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

The condition of the above obligation is such that whereas the Principal has submitted to  
\_\_\_\_\_ a certain Project Manual for Indiana  
University Press Building Roof Replacement, attached hereto and hereby made a part hereof to enter into  
a contract in writing, for the  
\_\_\_\_\_  
\_\_\_\_\_

NOW, THEREFORE,

1. If said BID shall be rejected, or
2. If said BID shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attachment hereto (properly completed in accordance with said BID) and shall furnish a BOND for faithful performance of said contract, and for the payment of all persons performing labor furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any

and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its BOND shall be in no way impaired or affected by any extension of the time within which the OWNER may accept such BID; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

\_\_\_\_\_(L.S.)  
Principal

\_\_\_\_\_  
Surety

By: \_\_\_\_\_

**SECTION IV**  
**AFFIRMATIVE ACTION PLAN REQUIREMENTS**

2013

RE: Affirmative Action and Living Wage Ordinance

To Prospective Bidder:

Affirmative Action: All bidders with the City of Bloomington for projects in excess of \$10,000.00 must submit an affirmative action plan to my office. This plan must ensure that applications are employed and that employees are treated in a manner that provides equal employment opportunity and tends to eliminate inequality based upon race, religion, color, sex, national origin, ancestry or disability.

In addition, pursuant to the **Responsible Bidders Ordinance**, all bidders with the City of Bloomington for public work bids of \$150,000.00 or more must include two additional protected categories in their affirmative action plan: sexual orientation and gender identity.

Even if your company already has a plan on file with the City, you must check with me to make sure that it complies with our current requirements. If you already have a plan, but it does not cover all of the City's current requirements, you may submit a separate supplement with your plan to fill any gaps.

You must submit your written affirmative action plan (or supplement) to me at least twenty-four hours before the bid deadline. You must submit your plan to me separately from your bid. The twenty-four hours will give me sufficient time to review your and the other bidders' plans. I recommend that you submit your affirmative action plan to me earlier, if possible, so that you and I will have time to work out any problems that may be in your plan. Bidders who fail to submit acceptable plans by the deadline are subject to disqualification.

I strongly advise you to confirm with me that I have received your plan and that it meets our requirements well before the bid deadline. We will make every effort to work with you to clear up problems, but it remains your responsibility to confirm that I received your plan and that it complies with our requirements. If you fail to confirm that I received and approved your plan, you risk losing your eligibility to bid. We will be glad to provide a receipt upon request. Please let us know if you want a receipt when you submit your plan.

You must ensure that all the protected classes listed above are included in your plan. In addition to other requirements, your plan **MUST** include a workforce breakdown, and internal grievance procedure, a non-retaliation statement, designation of a person by name or position who is responsible for implementing the plan, applicability to both applicants and employees, recruitment of minorities, equal access to training programs, and an explanation of your methods of communicating the operations of your affirmative action plan to your employees and prospective applicants.

Accompanying this letter you will find the following materials:

- 1) A workforce breakdown form. You **MUST** submit a workforce breakdown (sometimes called a "utilization report") with your Affirmative Action Plan. This form is provided for your convenience. If you already have a current form you have completed for another jurisdiction that includes the same type of information, you may substitute for instead of using our form. Your workforce breakdown figures must be updated every six months. Even if you already have an acceptable affirmative action plan on file with my office, you should submit a new workforce breakdown each time you bid for a City Contract, to be sure we have up to date figures.
- 2) An affirmative Action Plan checklist. I will use this checklist to review your Affirmative Action Plan. If you compare your plan with this list, you should be able to tell whether your plan fulfills the City's requirements. If you omit any of the elements on the checklist, your plan will not be approved.

- 3) Two sample Affirmative Action Plan: one for bidders covered by the Responsible Bidders Ordinance and one for all other bidders. These may be useful if your company has never designed an Affirmative Action Plan before. Feel free to adopt one of these plans as your own or to amend them to meet your needs.

Additional materials, such as the City of Bloomington's Contract Compliance Regulations, are available from my office upon request.

**Living Wage:** Also, please be aware that you may be required to comply with the Bloomington Living Wage Ordinance. Whether the LWO applies to your project depends upon the size and type of your project and the number of people you employ. If you have questions about the applicability of the LWO, click on the LWO flow chart at [www.bloomington.in.gov/livingwage](http://www.bloomington.in.gov/livingwage) or call me. For 2013, the living wage for covered employees is \$11.85 an hour.

If you have any questions, contact me at 812.349.3429 or email me at [mckinneb@bloomington.in.gov](mailto:mckinneb@bloomington.in.gov). My office hours are Monday through Friday, 8:00a.m.-5:00p.m.

Thank you,

Barbara E. McKinney  
Human Rights Director/Contract Compliance Officer

**BLOOMINGTON HUMAN RIGHTS COMMISSION  
MODEL AFFIRMATIVE ACTION PLAN**

**POLICY STATEMENT**

\_\_\_\_\_, Inc., declares its policy to provide equal opportunity in employment, training and advancement, and to administer its employment practices without regard to race, color, religion, sex, national origin, ancestry or disability. Our policy of non-discrimination will prevail throughout every aspect of our employment practices, including recruitment, hiring, training and all other terms and conditions of employment. We shall implement an affirmative action plan to make it widely known that equal employment opportunities are available on the basis of individual merit. We shall survey and analyze our employment workforce annually to determine what steps, if any, are needed to conform effectively with this equal employment policy.

**RESPONSIBLE OFFICER**

Mr. \_\_\_\_\_ or Ms. \_\_\_\_\_ (or the \_\_\_\_\_ officer) is the equal employment opportunity officer for our company and is responsible for implementing this affirmative action policy.

**PUBLICATION OF POLICY**

Our employees will be made aware of our commitment to affirmative action through the following procedures:

- Posting notices on employee bulletin boards
- Including our policy statement and plan in our personnel manual
- Regularly sending out notice of our policy in paycheck envelopes
- Training supervisors to recognize discriminatory practices

We will make potential employees aware of our policy through the following procedures:

- Including the words "Equal Opportunity Employer" in all of our advertisements and notices for job openings
- Notifying employment agencies about our commitment
- Sending notice of our policy to unions

**IMPLEMENTING OUR POLICY**

Our Affirmative Action Plan will be implemented by widening our recruitment sources. We shall advertise in newspapers and other media that reach people in protected classes. We shall send job notices to schools with large percentages of students in the protected classes and to local groups that serve these classes.

We shall examine our hiring practices periodically to insure that we consider only job-related qualifications in filling our positions. We shall discard irrelevant educational requirements and unnecessary physical requirements. We shall retain only job-related questions on our employment application.

We shall keep affirmative action information on each applicant, but separate from his or her application.

We shall keep records on our hiring decisions to evaluate the success of our affirmative action measures.

We shall decide placement, duties, benefits, wages, training prospects, promotions, layoffs and terminations without regard to race, sex, religion, color, national origin, ancestry, or disability.

**GRIEVANCE PROCEEDURE**

If an employee feels he or she has been discriminated against on the basis of race, sex, religion, color, national origin, ancestry or disability he or she may bring the complaint to his or her immediate supervisor.

If the complaint is not resolved readily at that level, he or she may submit it to \_\_\_\_\_ (personnel officer, corporate president, other) who will make a final decision on its validity. This grievance process does not preclude his or her complaining to local, state, or federal civil rights agencies. We will not retaliate against an employee or applicant for voicing a grievance or for filing a complaint with the appropriate agency.

Our current workforce breakdown is shown on the attached form.

\_\_\_\_\_  
Corporate President

\_\_\_\_\_  
Date



## AFFIRMATIVE ACTION PLAN CHECKLIST

NOTE: This is **not** an Affirmative Action Plan

Effective Date: \_\_\_\_\_

<b>Contractor: Plan MUST Include:</b>	<b>Yes</b>	<b>No</b>	<b>Comments:</b>
Policy statement of equal employment opportunity	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Covers:</b> Applicants for employment	<input type="checkbox"/>	<input type="checkbox"/>	
Employees	<input type="checkbox"/>	<input type="checkbox"/>	
<b>On basis of:</b> Race	<input type="checkbox"/>	<input type="checkbox"/>	
Religion	<input type="checkbox"/>	<input type="checkbox"/>	
Color	<input type="checkbox"/>	<input type="checkbox"/>	
Sex	<input type="checkbox"/>	<input type="checkbox"/>	
National Origin	<input type="checkbox"/>	<input type="checkbox"/>	
Ancestry	<input type="checkbox"/>	<input type="checkbox"/>	
Disability	<input type="checkbox"/>	<input type="checkbox"/>	
Sexual Orientation*	<input type="checkbox"/>	<input type="checkbox"/>	
Gender Identity*	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Designates a person responsible for implementation of the Plan</b>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Provides for communication of the policy:</b>			
Within the Organization	<input type="checkbox"/>	<input type="checkbox"/>	
Outside the Organization	<input type="checkbox"/>	<input type="checkbox"/>	
(e.g., recruitment sources, unions)			
<b>Applies to all terms and conditions of employment (e.g., hiring, placement, promotion, duties, wages, benefits, use of facilities, layoff, discipline, termination)</b>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Provision for: Recruitment from minority groups</b>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Provision for: Equal access to training programs</b>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Grievance Procedure</b>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Prohibits retaliation for filing grievances</b>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Workforce Breakdown</b>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>(figures up to date within 6 months)</b>			

**SECTION V**  
**WAGE RATES**

WAGE RATES ARE NOT APPLICABLE FOR THIS PROJECT

**SECTION VI**  
**STATE FORM NO. 96**  
**QUESTIONNAIRE/NON-COLLUSION AFFIDAVIT**

# CONTRACTORS BID FOR PUBLIC WORK

## PART I

(To be completed for all bids)

(Please type or print)

\_\_\_\_\_

Date: \_\_\_\_\_

1. Governmental Unit (Owner): \_\_\_\_\_

2. County : \_\_\_\_\_

3. Bidder (Firm): \_\_\_\_\_

Address: \_\_\_\_\_

City/State: \_\_\_\_\_

4. Telephone Number: \_\_\_\_\_

5. Agent of Bidder (if applicable): \_\_\_\_\_

Pursuant to notices given, the undersigned offers to furnish labor and/or material necessary to complete the public works project of \_\_\_\_\_

(Governmental Unit) in accordance with plans and specifications prepared by \_\_\_\_\_

\_\_\_\_\_ and dated \_\_\_\_\_ for the sum of \_\_\_\_\_ \$ \_\_\_\_\_

The undersigned further agrees to furnish a bond or certified check with this bid for an amount specified in the notice of the letting. If alternative bids apply, the undersigned submits a proposal for each in accordance with the notice. Any addendums attached will be specifically referenced at the applicable page.

If additional units of material included in the contract are needed, the cost of units must be the same as that shown in the original contract if accepted by the Governmental Unit. If the bid is to be awarded on a unit basis, the itemization of the units shall be shown on a separate attachment.

The Contractor and his subcontractors, if any, shall not discriminate against or intimidate any employee, or applicant for employment, to be employed in the performance of this contract, with respect to any matter directly or indirectly related to employment because of race, religion, color, sex, national origin or ancestry. Breach of this covenant may be regarded as a material breach of the contract.

### CERTIFICATION OF USE OF UNITED STATES STEEL PRODUCTS (If applicable)

I, the undersigned bidder or agent as a contractor on a public works project, understand my statutory obligation to use steel products made in the United States. I.C. 5-16-8-2. I hereby certify that I and all subcontractors employed by me for this project will use U.S. steel products on this project if awarded. I understand that violations hereunder may result in forfeiture of contractual payments.

## ACCEPTANCE

The above bid is accepted this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, subject to the following conditions: \_\_\_\_\_

Contracting Authority Members:


### PART II

(Complete sections I, II, III, and IV for all state and local public works projects as required by statutes if project is one hundred thousand dollars (\$100,000) or more. (IC 36-1-12-4)

Governmental Unit: \_\_\_\_\_

Bidder (Firm) \_\_\_\_\_

Date: \_\_\_\_\_

These statements to be submitted under oath by each bidder with and as a part of his bid. Attach additional pages for each section as needed.

### SECTION I EXPERIENCE QUESTIONNAIRE

1. What public works projects has your organization completed for the period of one (1) year prior to the date of the current bid?

Contract Amount	Class of Work	When Completed	Name and Address of Owner

2. What public works projects are now in process of construction by your organization?

Contract Amount	Class of Work	When to be Completed	Name and Address of Owner

3. Have you ever failed to complete any work awarded to you? \_\_\_\_\_ If so, where and why?

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4. List referenced from private firms for which you have performed work.

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SECTION II PLAN AND EQUIPMENT QUESTIONNAIRE

1. Explain your plan or layout for performing proposed work. (Examples could include a narrative of when you could begin work, completed the project, number of workers, etc. and any other information which you believe would enable the governmental unit to consider your bid.)

2. If you intend to sublet any portion of the work, state the name and address of each subcontractor, equipment to be used by the subcontractor, and whether you expect to require a bond. However, if you are unable to currently provide a listing, please understand a listing must be provided prior to contract approval.

3. What equipment do you have available to use for the proposed project? Any equipment to be used by subcontractors may also be required to be listed by the governmental unit.

4. Have you entered into contracts or received offers for all materials which substantiate the prices used in preparing your proposal? Otherwise, please explain the rationale used which would corroborate the prices listed.





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BID OF

\_\_\_\_\_ (Contractor)

\_\_\_\_\_ (Address)

\_\_\_\_\_

FOR  
PUBLIC WORKS PROJECTS  
OF

---

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Filed \_\_\_\_\_, \_\_\_\_\_

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Action taken \_\_\_\_\_

\_\_\_\_\_

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**SECTION VII**  
**GENERAL CONDITIONS**

## GENERAL CONDITIONS

### FOR

## CONSTRUCTION

### INDEX TO THE ARTICLES OF THE GENERAL CONDITIONS

- |   |   |
|---|---|
| 1. DEFINITIONS  | 12. CHANGE OF CONTRACT TIME   |
| 2. EXECUTION OF DOCUMENTS                                       | 13. LIQUIDATED DAMAGES  |
| 3. CORRELATION, INTERPRETATION AND INTENT OF DOCUMENTS          | 14. WARRANTY AND GUARANTEE: TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK. |
| 4. AVAILABILITY OF LANDS; PHYSICAL CONDITIONS; REFERENCE POINTS | 15. PAYMENTS AND COMPLETION.  |
| 5. BONDS AND INSURANCE  | 16. SUSPENSION OF WORK AND TERMINATION.   |
| 6. CONTRACTOR'S RESPONSIBILITIES                                | 17. ARBITRATION.  |
| 7. WORK BY OTHERS   | 18. ENVIRONMENTAL REQUIREMENTS.   |
| 8. OWNER'S RESPONSIBILITIES                                     | 19. MISCELLANEOUS.  |
| 9. ENGINEER'S RESPONSIBILITIES DURING CONSTRUCTION              |   |
| 10. CHANGES IN THE WORK   |   |
| 11. CHANGES IN CONTRACT PRICE                                   |   |

#### **1.00. DEFINITIONS.**

The Owner, the Contractor and the Engineer, are those mentioned as such in the Agreement. They are treated throughout the Contract Documents as if each were of the singular number and masculine gender. Wherever used in these General Conditions or in the other Contract Documents, the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

- 1.01. ADDENDA.** Written or graphic instruments issued prior to the execution of the Agreement which modify or interpret the Contract Documents, by additions, deletions, clarifications, or corrections. Addenda will become part of the Contract Documents when the Agreement is executed.
- 1.02. AGREEMENT.** The contractual agreement between the Contractor and the Owner.
- 1.03. APPLICATION FOR PAYMENT.** The form used by Contractor in requesting payments, including accompanying documentation required by the Contract Documents.
- 1.04. BID.** The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
- 1.05. BIDDER.** Any person, firm, or corporation submitting a Bid for the Work.
- 1.06. BOARD.** The City of Bloomington Board of Public Works.
- 1.07. BONDS.** Quote, performance, and payment bonds and other instruments of security, furnished by the Contractor and his surety in accordance with the Contract Documents.

- 1.08. CHANGE ORDER.** A written order to the Contractor signed by the Owner authorizing an addition, deletion, or revision in the Work, or an adjustment in the Contract Price or the Contract Time issued after execution of the Agreement.
- 1.09. CONTRACT.** The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Engineer and the Contractor, (2) between the Owner and a Subcontractor or Sub subcontractor, or (3) between any persons or entities other than the Owner and Contractor.
- 1.10. CONTRACT DOCUMENTS.** The Agreement, Addenda (whether issued prior to the opening of Quotes or the execution of the Agreement), Change Orders issued by the Owner or Engineer, Invitation to Quote, Instructions to Quoters, Proposal, Non-Collusion Affidavit, Questionnaire, Contractor's Quote, the Bonds, Employment Requirements and Wage Rates, Notification Procedures, General Equipment Stipulations, the Notice of Award, the Notice to Proceed, these General Conditions, the Special Conditions, the Specifications, Drawings, and Modifications.
- 1.11. CONTRACT PRICE.** The total amount payable to the Contractor under the Contract Documents.
- 1.12. CONTRACT TIME.** The number of days stated in the Agreement for the completion of the Work, computed as provided in these General Conditions; or by the date set forth in the Agreement. Contract days are NOT to be determined from the usage of the Indiana Department of Transportation (I.N.D.O.T.) Standard Specifications Manual.
- 1.13. CONTRACTOR.** The person, firm, or corporation with whom the Owner has executed the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Contractor" means the Contractor or the Contractor's authorized representative. The relationship of the Contractor to the Owner shall be that of an independent contractor.
- 1.14. DAY.** A calendar day of twenty-four hours measured from midnight to the next midnight.
- 1.15. DATE OF CONTRACT.** The date written in the first paragraph of the Contract Agreement.
- 1.16. DRAWINGS OR PLANS.** The graphic and pictorial portions of the Contract Documents, wherever located or whenever issued, showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.
- 1.17. ENGINEER.** The City Engineer, person, firm, or corporation named by the Owner "the City of Bloomington", or the duly authorized agents of the Engineer, acting within the scope of the duties entrusted to them.
- 1.18. FIELD ORDER.** A written order issued by the Engineer which clarifies or interprets the Contract Documents or orders minor changes in the Work.
- 1.19. MODIFICATION.** (a) A written amendment of the Contract Documents signed by both parties. (b) A Change Order. (c) A written clarification or interpretation issued by the Engineer. (d) A written order for a minor change or alteration in the Work issued by the Engineer. A Modification may be issued only after execution of the Agreement.
- 1.20. NOTICE OF AWARD.** The Written notice by the Owner to the apparent successful Quoter stating that upon compliance with the conditions precedent to be fulfilled by him within the time specified, the Owner will execute and deliver the Agreement to him.

- 1.21. NOTICE TO PROCEED.** A written notice given to the Contractor by the Owner (with a copy to the Engineer) fixing the date on which the Contract Time will commence to run and on which the Contractor shall start to perform his obligations under the Contract Documents.
- 1.22. OWNER.** The City of Bloomington named and designated in the Agreement as "Owner" acting through its Board of Public Works and its authorized agents. All notices, letters, and other communication directed to the Owner shall be addressed and delivered to the Office of the City Engineer, 401 North Morton, Bloomington, Indiana, 47401.
- 1.23. PROJECT.** The total construction of which the Work performed under the Contract Documents may be the whole or a part, and which may include construction by the Owner or by separate contractors.
- 1.24. QUOTE.** The offer or proposal of the Quoter submitted on the prescribed form setting forth the prices for the Work to be performed.
- 1.25. QUOTER** Any person, firm, or corporation submitting a Quote for the Work.
- 1.26. RESPONSIBLE QUOTER.** One who is fully capable of performing the contract requirements and who has the integrity and reliability to insure faithful performance.
- 1.27. RESPONSIVE QUOTER.** One who has submitted a Quote conforming in all material respects to the Contract Documents.
- 1.28. SHOP DRAWINGS.** All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the Contractor, a Subcontractor, manufacturer, supplier or distributor and which illustrate the equipment, material or some portion of the Work.
- 1.29. SPECIFICATIONS.** Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work, and performance of related services.
- 1.30. SUBCONTRACTOR.** An individual, firm, or corporation having a direct contact with the Contractor or with any other Subcontractor for the performance of a part of the Work to a special design at the site, but does not include a firm which merely furnishes material. All Subcontractor's performing work having a value over \$10,000.00 must be approved prior to performing any work under this contract agreement. Any work performed without prior approval will not be compensated for.
- 1.31. SUBSTANTIAL COMPLETION.** The date as determined by the Engineer when the construction of the Project or a specified part thereof is sufficiently completed, in accordance with the Contract Documents, so that the Project or specified part can be utilized for the purposes for which it was intended; or if there be no such determination, the date of final completion.
- 1.32. WORK.** Any and all obligations, duties, and responsibilities necessary to the successful completion of the Project assigned to, or undertaken by, the Contractor under the Contract Documents, including all labor, materials, equipment, and other incidentals, and the furnishing thereof.
- 1.33. MISCELLANEOUS DEFINITIONS**
- 1.33.1. AS ORDERED, AS DIRECTED, AS REQUIRED, AS PERMITTED, AS ALLOWED.** The order, directions, requirement, permission, or allowance of the Owner or Engineer is intended only to the extent of judging compliance with the Contract Documents. The terms do not imply that the Owner or Engineer has any authority or responsibility for supervision of the Contractor's forces or construction operations. Such supervision is the sole responsibility of the Contractor.

**1.33.2. REASONABLE, SUITABLE, ACCEPTABLE, PROPER, SATISFACTORY.** The terms reasonable, suitable, acceptable, proper, and satisfactory mean such to the Owner or Engineer and are intended only to the extent of judging compliance with the Contract Documents.

**1.33.3. UNDERSTOOD AND AGREED.** Whenever in these Contract Documents the expression “it is understood and agreed” or an expression of like import is used, such expression means the mutual understanding and agreement of the parties executing the Contract Agreement.

**2.00. EXECUTION OF AGREEMENT.**

**2.01. EXECUTION OF AGREEMENT.** The Agreement and other Contract Documents will be executed as set forth in the Special Conditions.

**2.02. DELIVERY OF BONDS.** When the executed Agreements are delivered to the Owner, the Contractor shall also deliver to the Owner such Bonds as he may be required to furnish in accordance with the Agreement.

**2.03. COPIES OF DOCUMENTS.** The Owner shall furnish to the Contractor the number of copies of the Contract Documents set forth in the Special Conditions or a minimum of 3 sets of complete documents.

**2.04. CONTRACTOR’S PRE-AWARD REPRESENTATIONS.** The Contractor represents that he has familiarized himself with, and assumes full responsibility for having familiarized himself with, the nature and extent of the Contract Documents, Work, locality, and with all local conditions and federal, state, and local laws, ordinances, rules and regulations that may in any manner affect performance of the Work, and represents that he has correlated his study, observations and site visits with the requirements of the Contract Documents. The Contractor also represents that he has studied all surveys and investigation reports of subsurface and latent physical conditions referred to in the Specifications and made such additional surveys and investigations as he deems necessary for the performance of the Work at the Contract Price in accordance with the requirements of the Contract Documents and that he has correlated the results of all such data with the requirements of the Contract Documents.

**2.05. COMMENCEMENT OF CONTRACT TIME; NOTICE TO PROCEED.** Unless otherwise provided in the SPECIAL CONDITIONS, the Contractor will be expected to start active and continuous work on the contract within 15 calendar days after the date of the Notice to Proceed. In **no case** shall work begin prior to the date of the ‘Notice to Proceed’ unless this time is waived and mutually agreed upon and indicated on the Notice to Proceed.

If a delayed starting date is indicated in the proposal, the 15 calendar day limitation shall be waived. Work day charges will then begin on a date mutually agreed upon, but not later than the delayed starting date specified. In the event that any contract is canceled after an award has been made but prior to the issuing of the Notice to Proceed, no reimbursement will be made for any expenses accrued relative to this contract during that period.

**2.06. STARTING THE PROJECT.** The Engineer shall be notified at least 3 days in advance of the date on which the work is expected to begin. Should the prosecution of the work for any reason be discontinued, the Engineer shall be notified at least 24 hours in advance of resuming operations.

**2.07. BEFORE STARTING CONSTRUCTION.** Before undertaking each part of the Work, the Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. He shall at once report in writing to the Engineer any conflict, error, or discrepancy which he

may discover. However, he shall not be liable to the Owner or Engineer for his failure to discover any conflict, error, or discrepancy in the Drawings or Specifications.

**2.08. SUBMISSION OF SCHEDULES.** Within ten days after delivery of the executed Agreement by the Owner to the Contractor, the Contractor shall submit to the Engineer for review, an estimated progress schedule that shall be in 'Critical Path' format and indicating the starting and completion dates of the various stages of the Work, and a preliminary schedule of Shop Drawing submissions and other specified schedules. The 'Critical Path' schedule must include all possible overlapping work that can be accomplished should one action or function not be available or accessible to the contractor in order to show that the Contractors interrelated activities that will control the work path to complete the project within the time limits set forth for the project.

Contracts with less than 60 calendar days completion time, less than 35 work days, or less than 60 days between the notice to proceed and the completion date do not need to submit a progress schedule.

The progress schedule may be used as a basis for establishing major construction operations and as a check on the progress of the work. The Engineer shall be notified at least 3 days in advance of the date on which the work is expected to begin.

Sufficient materials, equipment, labor shall be provided by the Contractor to meet the progress schedule (if required) and to guarantee the completion of the project in accordance with the plans and specifications.

**3.00. CORRELATION, INTERPRETATION, AND INTENT OF CONTRACT DOCUMENTS.**

It is the intent of the Specifications and Drawings to describe a complete Project to be constructed in accordance with the Contract Documents. The Contract Documents comprise the entire Agreement between the Owner and the Contractor. They may be altered only by a Modification.

The Contract Documents are complementary. What is called for by one is as binding as if called for by all. If the Contractor finds a conflict, error, or discrepancy in the Contract Documents, he shall call it to the Engineer's attention in writing at once. Before proceeding with the Work affected thereby, he shall not be liable to the Owner or Engineer for his failure to discover any conflict, error or discrepancy in the Specifications or Drawings. Any Work that may reasonably be inferred from the Specifications or Drawings as being required to produce the intended result shall be supplied whether or not it is specifically called for. Work, materials or equipment described in words which so applied have a well-known technical or trade meaning shall be deemed to refer to such recognized standards.

In case of discrepancy, calculated dimensions will govern over scaled dimensions; plans will govern over specifications; special conditions will govern over the plans and specifications. The instructions to Quoters and the description of the pay items listed in the itemized proposal will govern over plans, specifications, and special conditions. The precedence outlined herein shall not absolve the Contractor of his responsibility with regard to errors and omissions, or from his requirement to follow all IOSHA, OSHA, any local safety ordinances, and general good construction practices.

Advantage shall not be taken of any apparent error or omission in the plans or specifications. In the event such an error or omission is discovered, the Engineer shall be notified immediately in writing. Such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications will then be made.

**4.00. AVAILABILITY OF LANDS; PHYSICAL CONDITIONS; REFERENCE POINTS.**

- 4.01. AVAILABILITY OF LANDS.** The Owner shall furnish, as indicated in the Contract Documents and not later than the Notice to Proceed, the lands upon which the Work is to be done, rights-of-way for access thereto, and such other lands which are designated for use by the Contractor. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by Owner, unless otherwise specified in the Contract Documents. If the Contractor believes that any delay in the Owner's furnishing these lands or easements entitles him to an extension of the Contract Time, he may make a claim therefore as provided in these General Conditions
- 4.02. PHYSICAL CONDITIONS; SURVEYS AND REPORTS.** Refer to **Instructions to Quoters**. For identification of those surveys and investigation reports of subsurface and latent physical conditions at the Project site or otherwise affecting performance of the Work which have been relied upon by the Engineer in preparation of the Drawings and Specifications, refer to **SPECIAL CONDITIONS**.
- 4.03. UNFORESEEN PHYSICAL CONDITIONS.** The Contractor shall promptly notify the Owner and Engineer in writing of any subsurface or latent physical conditions at the site differing materially from those indicated in the Contract Documents. The Engineer will promptly investigate those conditions and advise the Owner in writing if further surveys or subsurface tests are necessary. Promptly thereafter, the Owner shall obtain the necessary additional surveys and tests and furnish copies to the Engineer and Contractor. If the Engineer finds that the results of such surveys or tests indicate that there are subsurface or latent physical conditions which differ materially from those intended in the Contract Documents, and which could not reasonably have been anticipated by the Contractor, a Change Order shall be issued incorporating the necessary revisions.
- 4.04. REFERENCE POINTS.** The Owner shall provide available engineering surveys for construction to establish reference points which in his judgment are necessary to enable the Contractor to proceed with the Work. The Contractor shall be responsible for surveying and laying out the Work (unless otherwise provided in the Special Conditions), and shall protect and preserve the established reference points and shall make no changes or reallocations without the prior written approval of the Owner. He shall report to the Engineer whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations. The Contractor shall replace and accurately relocate all reference points so lost, destroyed or moved at the Contractor's expense.
- 5.00. BONDS AND INSURANCE.**
- 5.01. PERFORMANCE, PAYMENT AND OTHER BONDS.** The Contractor shall furnish a Performance Bond, Payment Bond, and other Bonds specified in **AGREEMENT** as security for the faithful performance and payment of all his obligations under the Contract Documents. The Performance Bond shall be in an amount at least equal to *100%* of the Contract Price, unless otherwise listed in **SPECIAL CONDITIONS**. Bonds shall be executed on the forms (when provided) included in the Contract Documents and with such sureties as are licensed to conduct business in the state of Indiana and are named in the current list of "Surety Companies Acceptable on Federal Bonds" as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. The surety shall have an "A" minimum rating of performance and a financial rating strength of five times the Contract Price, all as stated in "Best's Key Rating Guide, Property-Liability". Each Bond shall be accompanied by a "Power of Attorney" authorizing the attorney-in-fact to bind the surety and certified to include the date of the Bond.
- 5.02. TERMINATION OF SURETY.** If the surety on any Bond furnished by the Contractor is declared a bankrupt or becomes insolvent or its right to do business is terminated

or revoked in any state where any part of the Project is located, the Contractor shall within five days thereafter substitute another Bond and surety, both of which shall be acceptable to the Owner.

**5.03. CONTRACTOR'S LIABILITY INSURANCE.** The Contractor shall purchase and maintain such insurance as will protect him from claims under worker's compensation laws, disability benefit laws, or similar employee benefit laws, from claims for damages because of bodily injury, occupational sickness or disease, or death of his employees, and claims insured by personal injury liability coverage; from claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees including claims insured by personal injury liability coverage; and from claims for injury to or destruction of tangible property, including loss of use resulting therefrom - any or all of which may arise out of or result from the Contractor's operations under the Contract Documents, whether such operations be by himself or by any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be legally liable. This insurance shall include the specific coverage's and be written for not less than any limits of liability and maximum deductibles specified in the Supplementary Conditions or required by law, whichever is greater, shall include contractual liability insurance and shall include the Owner and Engineer as additional insured parties. Before starting the Work, the Contractor shall file with the Owner and Engineer certificates of such insurance, acceptable to the Owner; these certificates shall contain a provision that the coverage afforded under the policies will not be canceled or materially changed until at least fifteen days prior written notice has been given to the Owner and Engineer.

**6.00. CONTRACTOR'S RESPONSIBILITIES.**

**6.01. SUPERVISION AND SUPERINTENDENCE.** The Contractor shall supervise and direct the Work efficiently and with his best skill and attention. He shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but he shall not be solely responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence or procedure of construction which is indicated in and required by the Contract Documents. The Contractor shall be responsible to see that the finished Work complies accurately with the Contract Documents.

**6.02. RESIDENT SUPERINTENDENT.** The Contractor shall keep on the Work site at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to the Owner and Engineer. The superintendent will be the Contractor's representative at the site and shall have authority to act on behalf of the Contractor. All communications given to the superintendent shall be as binding as if given to the Contractor.

**6.03. LABOR, MATERIALS AND EQUIPMENT.** The Contractor shall furnish all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water and sanitary facilities, and all other facilities and incidentals necessary for the execution, testing, initial operation, and completion of the Work.

All materials and equipment shall be new, except as otherwise provided in the Contract Documents. If required by the Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable

manufacturer, fabricator or processors, except as otherwise provided in the contract Documents.

The Contractor shall be fully responsible for all acts and omissions of his Subcontractors and of persons and organizations directly or indirectly employed by them, and of persons and organizations for whose acts any of them may be liable to the same extent that he is responsible for the acts and omissions of persons directly employed by him. Nothing in the Contract Documents shall create any contractual relationship between the Owner or Engineer and any Subcontractor or other person or organization having a direct contact with the Contractor, nor shall it create any obligation on the part of the Owner or Engineer to pay or to see to the payment of any monies due any Subcontractor or any other person or organization, except as may otherwise be required by law. The Owner or Engineer may furnish to any Subcontractor or other person or organization, to the extent practicable, evidence of amounts paid to the Contractor on account of specific Work done in accordance with the schedule of values.

The divisions and sections of the Specifications and the identification of any Drawings shall not control the Contractor in dividing the Work among Subcontractors or delineating the Work to be performed by any specific trade.

The Contractor agrees to bind specifically every Subcontractor to the specific terms and conditions of the Contract Documents for the benefit of the Owner.

All Work performed for the Contractor by a Subcontractor shall be pursuant to an appropriate agreement between the Contractor and the Subcontractor which shall contain provisions that waive all rights the contracting parties may have against one another for damages caused by fire or other perils covered by insurance, except such rights as they may have to the proceeds of such insurance. The Contractor shall pay each Subcontractor a just share of any insurance monies received by the Contractor.

- 6.04. PATENT FEES AND ROYALTIES.** The Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of the Owner or Engineer its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by the Owner in the Contract Documents. The Contractor shall indemnify and hold harmless the Owner and Engineer and anyone directly or indirectly employed by either of them from and against all claims, damages, losses and expenses (including attorneys' fees) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.
- 6.05. PERMITS.** The Contractor shall obtain and pay for all construction permits and licenses and shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of his/her Quote. The Owner shall assist the Contractor, when necessary, in obtaining such permits and licenses. The Contractor shall also pay all public utility charges necessary for the meter/service connections to place installed devices into working order and placing said service accounts in the name of the City of Bloomington, or their assigned designee.
- 6.06. LAWS AND REGULATIONS.** The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations applicable to the Work. If the Contractor observes that the Specifications or Drawings are in conflict therewith, he shall give the

Engineer prompt written notice thereof, and any necessary changes shall be adjusted by an appropriate Modification. If the Contractor performs any Work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Engineer, he shall bear all costs arising there from; however, it shall not be his primary responsibility to make certain that the Specifications and Drawings are in accordance with such laws, ordinances, rules and regulations.

**6.07. TAXES.** The Contractor shall pay all sales, consumer, use and other similar taxes required to be paid by him in accordance with the law of the place where the work is to be performed.

**6.08. USE OF PREMISES.** The Contractor shall confine his equipment, the storage of materials and equipment and the operations of his workmen to areas permitted by law, ordinances, permits, or the requirements of the Contract Documents, and shall not unreasonably encumber the premises with materials or equipment. No assumptions of allowable traffic closures shall be made by the Contractor unless specifically called for in a "Maintenance of Traffic" plan should one exist. All roadway and lane closures must be approved by the Engineer prior to implementing the closure and a 'Notice of Intent' to close a lane or roadway must be delivered in writing to the Engineer by the Wednesday preceding the week of the desired closure date or time so proper notification can be given to the required personnel.

The Contractor shall not load nor permit any part of any structure to be loaded with weights that will endanger the structure, nor shall he subject any part of the Work to stresses or pressures that will endanger it.

**6.09. RECORD DRAWINGS.** The Contractor shall keep one record copy of all Specifications, Drawings, Addenda, Modifications, and Shop Drawings at the site in good order and annotated to show all changes made during the construction process. These shall be available to the Engineer and shall be delivered to him for the Owner upon completion of the Project and prior to final payment.

**6.10. SAFETY AND PROTECTION.** The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. He shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

- 1) all employees on the Work and other persons who may be affected thereby. This includes ensuring the safety of pedestrians, bicyclist, and motorists who are allowed to access the site during the project.
- 2) all the Work and all materials or equipment to be incorporated therein, whether in storage on or off the site, and
- 3) other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation, or replacement in the course of construction.
- 4) The Contractor shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss. He shall notify owners of adjacent utilities when prosecution of the Work may affect them. All damage, injury or loss to any property caused directly or indirectly, in whole or in part, by the Contractor, any Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, shall be remedied by the Contractor: except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of the Owner or Engineer or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or

negligence of the Contractor. The Contractor's duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and the Engineer has issued a notice to the Owner and Contractor in accordance with Supplementary Conditions that the Work is acceptable.

**6.11. SUPERINTENDENT OF SAFETY.** The Contractor shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated in writing by the Contractor to the Owner. The Superintendent of Safety shall be responsible for the maintenance of traffic control devices and personnel in accordance with the Manual on Uniform Traffic Control Devices (M.U.T.C.D.) for work zone safety. Weekly "Sign and Barricade Reports" are to be submitted by the Superintendent of Safety.

**6.12. EMERGENCIES.** In emergencies affecting the safety of persons or the Work or property at the site or adjacent thereto, the Contractor, without special instruction or authorization from the Engineer or Owner, is obligated to act, at his discretion, to prevent threatened damage, injury or loss. He shall give the Engineer prompt written notice of any significant changes in the Work or deviations from the Contract Documents caused thereby, and a Change Order shall thereupon be issued covering the changes and deviations involved. If the Contractor believes that additional work done by him in an emergency which arose from causes beyond his control entitles him to an increase in the Contract Price or an extension of the Contract Time, he may make a claim therefore.

**6.13. INDEMNIFICATION.** The Contractor shall indemnify and hold harmless the Owner and Engineer and their agents and employees from and against all claims, damages, losses and expenses including attorneys' fees arising out of or resulting from the performance of the Work, provided that any such claim, damage, loss or expense:

- 1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting there from and
- 2) is caused in whole or in part by any negligent act or omission of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable regardless of whether or not it is caused in part by a party indemnified hereunder.

In any and all claims against the Owner or Engineer or any of their agents or employees by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under workmen's compensation acts, disability benefit acts or other employee benefit acts.

The indemnification obligations of the Contractor shall not extend to the liability of the Engineer, his agents or employees arising out of:

- 1) the preparation of maps, drawings, opinions, reports, surveys, Change Orders, designs, or specifications or
- 2) the giving of or the failure to give directions or instructions by the Engineer, his agents or employees, provided such giving or failure to give is the primary cause of injury or damage.

**7.00. WORK BY OTHERS.**

The Owner may perform additional work related to the Project by himself, or he may let other direct contracts therefore which shall contain General Conditions similar to these. The Contractor shall afford the other contractors who are parties to such direct contracts (or the Owner, if he is performing the additional work himself) reasonable opportunity for the introduction and storage of materials and equipment and the execution of work, and shall properly connect and coordinate his Work with theirs.

If any part of the Contractor's Work depends for proper execution or results upon the work of any such other contractor (or Owner), the Contractor shall inspect and promptly report to the Engineer in writing any defects or deficiencies in such work that render it unsuitable for such proper execution and results. His failure to so report shall constitute an acceptance of the other work as fit and proper for the relationship of his Work except as to defects and deficiencies which may appear in the other work after the execution of his Work.

The Contractor shall do all cutting, fitting, and patching of his Work that may be required to make its several parts come together properly and fit it to receive or be received by such other work. The Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of the Engineer and of the other contractors whose work will be affected.

If the performance of additional work by other contractors or the Owner is not noted in the Contract Documents prior to the execution of the contract, written notice thereof shall be given to the Contractor prior to starting any additional work. If the Contractor believes that the performance of any such additional work by the Owner or others involves him in additional expense or entitles him to an extension of the Contract Time, he may make a claim therefore.

**8.00. OWNER'S RESPONSIBILITIES.**

The Owner shall issue all communications to the Contractor through the Engineer.

In case of termination of the employment of the Engineer, the Owner shall appoint an engineer against whom the Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer. Any dispute in connection with such an appointment shall be subject to arbitration.

The Owner shall furnish the data required of him under the Contract Documents promptly and shall make payments to the Contractor promptly after they are due.

In addition to his rights to request changes in the Work, the Owner shall be obligated to execute Change Orders.

**9.00. ENGINEER'S STATUS DURING CONSTRUCTION.**

**9.01. OWNER'S REPRESENTATIVE.** The Engineer will be the Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of the Engineer as the Owner's representative during construction are set forth in these General Conditions and shall not be extended without the written consent of the Owner and the Engineer.

**9.02. CLARIFICATIONS AND INTERPRETATIONS.** The Engineer will issue with reasonable promptness such written clarifications or interpretations of the Contract Documents (in the form of Drawings or otherwise) as he may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. If the Contractor believes that a written clarification and interpretation entitles him to an increase in the Contract Price, he may make a claim therefore.

- 9.03. REJECTING DEFECTIVE WORK.** The Engineer will have authority to reject Work which is “defective” (which term is hereinafter used to describe Work that is unsatisfactory, faulty or defective, or does not conform to the requirements of the Contract Documents or does not meet the requirements of any inspection, test or approval referred to in the Specifications, or has been damaged prior to the Engineer’s recommendation of final payment). He will also have authority to require special inspection or special testing of the Work whether or not the Work is fabricated, installed or completed.
- 9.04. DECISIONS ON DISAGREEMENTS.** The Engineer will be the interpreter of the requirements of the Contract Documents and the judge of the performance hereunder. In his capacity as interpreter and judge he/she will exercise his/her best efforts to insure faithful performance by both Owner and Contractor. He will not show partiality to either and will not be liable for the result of any interpretation or decision rendered in good faith. Claims, disputes, and other matters relating to the execution and progress of the Work or the interpretation of or performance under the Contract Documents shall be referred to the Engineer for decision, which he will render in writing within a reasonable time.
- 9.05. ARBITRATION.** Either the Owner or the Contractor may demand arbitration with respect to any such claim, dispute, or other matter that has been referred to the Engineer, except any which have been waived by the making or acceptance of final payment, such arbitration to be in accordance with these General Conditions. However, no demand for arbitration of any such claim, dispute, or other matter shall be made until the earlier of (a) the date on which the Engineer has rendered his decision or (b) the tenth day after the parties have presented their evidence to the Engineer if he has not rendered his written decision before that date. No demand for arbitration shall be made later than thirty days after the date on which the Engineer rendered his written decision in respect to the claim, dispute or other matter as to which arbitration is sought; and the failure to demand arbitration within said thirty days’ period shall result in the Engineer’s decision being final and binding upon the Owner and the Contractor. If the Engineer renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence but shall not supersede the arbitration proceedings, except where the decision is acceptable to the parties concerned.
- 9.06. LIMITATIONS ON THE ENGINEER’S RESPONSIBILITIES.** Neither the Engineer’s authority to act under this article or elsewhere in the Contract Documents nor any decision made by him in good faith either to exercise or not exercise such authority shall give rise to any duty or responsibility of the Engineer to the Contractor, any Subcontractor, any material, man, fabricator, supplier or any of their agents or employees or any other person performing any of the Work.

The Engineer will not be responsible for the Contractor’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, and he will not be responsible for the Contractor’s failure to perform the Work in accordance with the Contract Documents.

The Engineer will not be responsible for the acts or omissions of the Contractor, or any Subcontractors, or any of his or their agents or employees or any other persons at the site or otherwise performing any of the Work.

**10.00. CHANGES IN THE WORK.**

Without invalidating the Agreement, the Owner may, at any time or from time to time, order additions, deletions or revisions in the Work; these will be authorized by Change Orders and initiated through a Field Order from the Engineer or Owner. Upon receipt of a Change Order, the Contractor shall proceed with the Work involved. All such Work

shall be executed under the applicable conditions of the Contract Documents. If any Change Order causes an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, an equitable adjustment will be made as provided in these General Conditions on the basis of a claim made by either party.

The Engineer may authorize minor changes or alterations in the Work not involving extra cost and not inconsistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order. If the Contractor believes that any minor change or alteration authorized by the Engineer entitles him to an increase in the Contract Price, he may make a claim therefore.

Additional work performed by the Contractor without authorization of a Change Order will not entitle him to an increase in the Contract Price or an extension of the Contract Time, except as otherwise provided herein.

The Owner shall execute appropriate Change Orders prepared by the Engineer covering changes in the Work to be performed as provided herein and any other claim of the Contractor for a change in the Contract Time or the Contract Price which is confirmed by the Engineer.

It is the Contractor's responsibility to notify his Surety of any changes affecting the general scope of the Work or change in the Contract Price and the amount of the applicable Bonds shall be adjusted accordingly.

**11.00. CHANGE OF CONTRACT PRICE.**

The Contract Price constitutes the total compensation payable to the Contractor for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by the Contractor shall be at his expense without change in the Contract Price.

The Contract Price may only be changed by a Change Order. Any claim for an increase in the Contract Price shall be based on written notice delivered to the Owner and Engineer within fifteen days of the occurrence of the event giving rise to the claim. Notice of the amount of the claim with supporting data shall be delivered within forty-five days of such occurrence unless the Engineer allows an additional period of time to ascertain accurate cost data. All claims for adjustments in the Contract Price shall be determined by the Engineer if the Owner and the Contractor cannot otherwise agree on the amount involved. Any change in the Contract Price resulting from any such claim shall be incorporated in a Change Order. All changes requested by the Engineer or Owner must be submitted to the Contractor in the form of a Field Order, at which time, the contractor shall provide in return a request for a change order with the prices for said requested work detailed by item and quantity for the Engineer and Owner to review for acceptance and so they can issue a Change Order for the approved work.

The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:

- 1) Where the Work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved.
- 2) By mutual acceptance of a lump sum.
- 3) On the basis of the Cost of the Work plus a Contractor's Fee for overhead and profit (determined in accordance with the following paragraphs).

**11.01. COST OF THE WORK.** The term "Cost of the Work" means the sum of all costs necessarily incurred and paid by the Contractor in the proper performance of the Work. Except as otherwise may be agreed to in writing by the Owner, such costs shall be in

amounts no higher than those prevailing in the locality of the Project, and shall include only the following items:

- 1) Payroll costs for employees in the direct employ of the Contractor in the performance of the Work under schedules of job classifications set forth in the Wage Scale Determination. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, worker's compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. Such employees shall include superintendents and foremen at the site. The expenses of performing Work after regular working hours, on Sunday or legal holidays shall be included in the above to the extent authorized by the Owner.
- 2) The cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and manufacturers' field services required in connection therewith. All cash discounts shall accrue to the Contractor unless the Owner deposits funds with the Contractor with which to make payments, in which case the cash discounts shall accrue to the Owner. All trade discounts, rebates and refunds, and all returns from sale of surplus materials and equipment shall accrue to the Owner, and the Contractor shall make provisions so that they may be obtained.
- 3) Payments made by the Contractor to the Subcontractors for Work performed by the Subcontractors. If required by the Owner, the Contractor shall obtain competitive bids from Subcontractors acceptable to him and shall deliver such bids to the Owner, who will then determine with the advice of the Engineer which bids will be accepted. If a subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a Fee, the Subcontractor's Cost of the Work shall be determined in the same manner as the Contractor's Cost of the Work. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.
- 4) Costs of special consultants (including, but not limited to, engineers, architects, testing laboratories, surveyors, lawyers and accountants) employed for services specifically related to the Work.

**11.02. SUPPLEMENTAL COSTS** include the following:

- 1) The proportion of necessary transportation, traveling and subsistence expenses of the Contractor's employees incurred in discharge of duties connected with the Work.
- 2) The cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workmen, which are consumed in the performance of the Work, and cost less market value of such items used but not consumed which remain the property of the Contractor.
- 3) Rentals of all construction equipment and machinery and the parts thereof whether rented from the Contractor or others in accordance with the rental agreements approved by the Owner with the advice of the Engineer, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof - all in accordance with the terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

- 4) Sales, use or similar taxes related to the Work, and for which the Contractor is liable, imposed by any governmental authority.
- 5) Deposits lost for causes other than the Contractor's negligence, royalty payments and fees for permits and licenses.
- 6) Losses, damages and expenses, not compensated by insurance or otherwise, sustained by the Contractor in connection with the execution of, and to, the Work, provided they have resulted from causes other than the negligence of the Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of the Owner. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining the Contractor's fee. If, however, any such loss or damage requires reconstruction and the Contractor is placed in charge thereof, he shall be paid for his services a fee proportionate to that stated under Contractor's Fee.
- 7) The cost of utilities, fuel and sanitary facilities at the site.
- 8) Minor expenses such as telegrams, long distance phone calls, telephone service at the site, expressage and similar petty cash items in connection with the Work.
- 9) The cost of premiums for additional bonds and insurance required because of changes in the Work.

**11.03** The term "**COST OF THE WORK**" shall *not* include any of the following:

- 1) Payroll costs and other compensation of the Contractor's officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, lawyers, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by the Contractor, whether at the site or in his principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications - all of which are to be considered administrative costs covered by the Contractor's Fee.
- 2) Expenses of the Contractor's principal and branch offices other than his office at the site.
- 3) Any part of the Contractor's capital expenses, including interest on the Contractor's capital employed for the Work and charges against the Contractor for delinquent payments.
- 4) Cost of premiums for all bonds and for all insurance policies whether or not the Contractor is required by the Contract Documents to purchase and maintain the same (except as otherwise provided above).
- 5) Costs due to the negligence of the Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to the correction of defective Work, disposal of materials or equipment wrongly supplied and making good any damage to property.
- 6) Other overhead or general expense costs of any kind not specifically and expressly included in the Cost of the Work.

**11.04. CONTRACTOR'S FEE.** The Contractor's Fee which includes his overhead and profit shall be determined as follows:

- 1) A mutually acceptable fee; or , if none can be agreed upon,
- 2) A fee based on the following percentages of the various portions of the Cost of the Work:

- for payroll costs and the cost of all materials and equipment included in the Work, the Contractor's Profit shall be ten percent.
- for payments to Subcontractors, the Contractor's Profit shall be five percent; and if a subcontract is on the basis of Cost of the Work Plus a Fee, the maximum allowable to the Subcontractor as a fee for overhead and profit shall be ten percent, and
- no fee shall be payable on the basis of costs of special consultants or supplemental costs.

**11.05. CREDIT.** The amount of credit to be allowed by the Contractor to the Owner for any such change which results in a net decrease in cost, will be the amount of the actual net decrease. When both additions and credits are involved in any one change, the combined overhead and profit shall be figured on the basis of the net increase, if any.

Whenever the cost of any Work is to be determined pursuant to preceding paragraphs, the Contractor will submit in form prescribed by the Engineer an itemized cost breakdown together with supporting data.

**12.00. CHANGE OF CONTRACT TIME.**

The Contract Time may only be changed by a Change Order. Any claim for an extension in the Contract Time shall be based on written notice delivered to the Owner and Engineer within fifteen days of the occurrence of the event giving rise to the claim. Notice of the extent of the claim with supporting data shall be delivered within forty-five days of such occurrence unless the Engineer allows an additional period of time to ascertain more accurate data. All claims for adjustment in the Contract Time shall be determined by the Engineer if the Owner and the Contractor cannot otherwise agree. Any change in the Contract Time resulting from any such claim shall be incorporated in a Change Order. Computation of Contract time shall be in accordance with the contract agreement and not that of the Indiana Department of Transportation (INDOT)

The Contract Time will be extended in an amount equal to time lost due to delays beyond the control of the Contractor if he makes a claim therefore as provided in the preceding paragraph. Such delays shall include, but not be restricted to, acts or neglect by any separate contractor employed by the Owner, fires, floods, labor disputes, epidemics, abnormal weather conditions, or acts of God.

All time limits stated in the Contract Documents are of the essence of the Agreement. The provisions made herein shall not exclude recovery for damages (including compensation for additional professional services) for delay by either party.

**13.00. LIQUIDATED DAMAGES.**

Liquidated damages shall be paid to the Owner in accordance with the Special Conditions if specified therein. If no provision is made in the Special Conditions, liquidated damages shall be paid as follows:

In the event the Contractor fails to satisfactorily complete the entire Work contemplated and provided for under this contract on or before the date of completion as determined and described elsewhere herein, the Owner shall deduct from the amount due the Contractor the sum as indicated on the table below for each calendar day (Sundays and legal holidays excluded) of delay, which sum is agreed upon not as a penalty, but as a fixed and liquidated damage for each day of such delay, to be paid in full and subject to no deduction, it being understood and agreed that timely completion is of the essence. If the monies due the Contractor

are less than the amount of such liquidated damages, then the Contractor or his surety shall pay the balance to the Owner.

**SCHEDULE FOR LIQUIDATED DAMAGES FOR EACH DAY OF OVERRUN IN CONTRACT TIME**

Original Contract Amount		Daily Charge	
From More Than	To and Including	Calendar Day or Fixed Date	Work Day
\$0	\$100,000.00	\$200.00	\$200.00
\$100,000.00	\$500,000.00	\$300.00	\$400.00
\$500,000.00	\$2,000,000.00	\$400.00	\$800.00
\$2,000,000.00	\$7,000,000.00	\$500.00	\$1,500.00
\$7,000,000.00	-----	\$700.00	\$2,000.00

**14.00. WARRANTY AND GUARANTEE: TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK.**

**14.01. WARRANTY AND GUARANTEE.** The Contractor warrants and guarantees to the Owner and Engineer that all materials and equipment will be new unless otherwise specified and that all Work will be of good quality and free from faults or defects and in accordance with the requirements of the Contract Documents and of any inspections, tests or approvals referred to in the Tests and Inspection paragraph. All unsatisfactory Work, all faulty or defective Work, and all Work not conforming to the requirements of the Contract Documents at the time of acceptance thereof or of such inspections, tests or approvals, shall be considered defective. Prompt notice of all defects shall be given to the Contractor. All defective Work, whether or not in place, may be rejected, corrected, or accepted as provided herein.

**14.02. TESTS AND INSPECTIONS.** If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to specifically be inspected, tested, or approved by some public body, the Contractor shall assume full responsibility therefore, pay all costs in connection therewith and furnish the Engineer the required certificates of inspection, testing, or approval. All other inspections, tests, or approvals required by the Contract Documents shall be performed by organizations acceptable to the Owner and the Contractor and the costs thereof shall be borne by the Owner unless otherwise specified.

The Contractor shall give the Engineer timely notice of readiness of the Work for all inspections, tests or approvals. If any such Work required so to be inspected, tested or approved is covered without written concurrence of the Engineer, it must, if requested by the Engineer, be uncovered for observation, and such uncovering shall be at the Contractor's expense unless the Contractor has given the Engineer timely notice of his intention to cover such Work and the Engineer has not acted with reasonable promptness in response to such notice. This timeframe of notification shall be no less than 2 hours, and occur during normal working hours of the City of Bloomington (Monday through Friday – 8:00a.m. to 5:00p.m.) Requests for inspection during all other hours shall receive 48 hours notice

Neither observations by the Engineer nor inspections, tests or approvals by persons other than the Contractor shall relieve the Contractor from his obligations to perform the Work in accordance with the Contract Documents.

**14.03. ACCESS TO WORK.** The Engineer and his representatives and other representatives of the Owner will at reasonable times have access to the Work. The Contractor shall

provide proper and safe facilities for such access and observation of the Work and also for any inspection or testing thereof by others.

**14.04. UNCOVERING WORK.** If any Work is covered contrary to the written request of the Engineer, it must, if requested by the Engineer, be uncovered for his observation and replaced at the Contractor's expense.

If any Work has been covered which the Engineer has not specifically requested to observe prior to its being covered, or if the Engineer considers it necessary or advisable that covered Work be inspected or tested by others, the Contractor, at the Engineer's request, shall uncover, expose or otherwise make available for observation, inspection or testing as the Engineer may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is defective, the Contractor shall bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction, including compensation for additional professional services, and an appropriate deductive Change Order shall be issued. If, however, such Work is not found to be defective, the Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction if he makes a claim therefore.

**14.05. OWNER MAY STOP THE WORK.** If the Work is defective, or the Contractor fails to supply sufficient skilled workmen or suitable materials or equipment, or if the Contractor fails to make prompt payment to Subcontractors or for labor, materials or equipment, the Owner may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the Owner to stop the Work shall not give rise to any duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other party.

**14.06. CORRECTION OR REMOVAL OF DEFECTIVE WORK.** If required by the Engineer prior to his recommendation of final payment, the Contractor shall promptly, without cost to the Owner and as specified by the Engineer, either correct any defective Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by the Engineer, remove it from the site and replace it with nondefective Work. If the Contractor does not correct such defective Work within a reasonable time, all as specified in a written notice from the Engineer, the Owner may have the deficiency corrected or the rejected Work removed and replaced. All direct or indirect costs of such correction or removal and replacement, including compensation for additional professional services, shall be paid by the Contractor, and an appropriate deductive Change Order shall be issued. The Contractor shall also bear the expenses of making good all Work of others destroyed or damaged by his correction, removal or replacement of his defective Work.

**14.07. CORRECTION PERIOD.** If, after final payment and prior to the expiration of one year after the date of Substantial Completion (unless a longer period is set forth in the Supplementary Conditions) or such longer period as may be prescribed by law or by the terms of any applicable special guarantee required by the Contract Documents, any Work is found to be defective, the Contractor shall promptly, without cost to the Owner and in accordance with the Owner's written instructions, either correct such defective Work or, if it has been rejected by the Owner, remove it from the site and replace it with non-defective Work. If the Contractor does not promptly comply with the terms of such instructions, the Owner may have the defective Work removed and replaced, and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, shall be paid by the Contractor.

**14.08. ACCEPTANCE OF DEFECTIVE WORK.** If, instead of requiring correction or removal and replacement of defective Work, the Owner (and, prior to final payment, the Engineer)

prefers to accept it, he may do so. In such case, if acceptance occurs prior to final payment, a Change Order shall be issued incorporating the necessary revisions in the Contract Documents, including appropriate reduction in the Contract Price; or, if the acceptance occurs after final payment, an appropriate amount shall be paid by the Contractor to the Owner.

**14.09. NEGLECTED WORK BY THE CONTRACTOR.** If the Contractor should fail to prosecute the Work in accordance with the Contract Documents, including any requirements of the progress schedule, the Owner, after seven days written notice to the Contractor may, without prejudice to any other remedy he may have, make good such deficiencies and the cost thereof (including compensation for additional professional services) shall be charged against the Contractor if the Engineer agrees with such action, in which case a Change Order shall be issued incorporating the necessary revisions in the Contract Documents including an appropriate reduction in the Contract Price. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

**15.00. PAYMENTS AND COMPLETION.**

**15.01. APPLICATION FOR PROGRESS PAYMENT.** The Contractor may, no more frequently than every two weeks, make an estimate of the value of the Work completed, and submit an Application for Payment. The estimated cost of repairing, replacing, or rebuilding any part of the Work or replacing materials which do not conform to the Contract Documents will be deducted from the estimated value. The Application for Payment shall be submitted to the Engineer for review and approval.

**15.02. CONTRACTOR'S WARRANTY OF TITLE.** The Contractor warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to the Owner at the time of payment free and clear of all liens, claims, security interests and encumbrances (hereafter in these General Conditions referred to as "Liens").

**15.03. REVIEW OF APPLICATION FOR PAYMENT.** The Contractor shall furnish to the Engineer such detailed information as he may request to aid in the review and approval of such Estimates. The Engineer will, within five working days after receipt of each Application for Payment, either recommend payment and present the Application to the Owner, or return the Application to the Contractor indicating in writing his reasons for refusing to recommend payment. In the latter case, the Contractor may make the necessary corrections and resubmit the Application. The Owner will pay to the Contractor within forty-five days after receipt of Application. Retainage shall be withheld from each payment in the amount of 10% of each Application up to 50% completion. At 50% completion further payments shall be made in full to the contractor and no further amounts may be retained unless the Engineer certifies that the job is not proceeding satisfactorily, but amounts previously retained shall not be paid to the Contractor. At 50% completion or any time thereafter when the progress of the Work is not satisfactory, additional amounts may be retained, but in no event shall the total retainage be more than 10% of the value of the work completed. Upon substantial completion of the work, any amount retained may be paid to the Contractor. When the work has been substantially completed except for the work which cannot be completed due to weather conditions, lack of materials or other reasons which in the judgment of the Owner are valid reasons for non-completion, the Owner may make additional payments, retaining at all times an amount sufficient to cover the estimated cost of the work still to be completed. Such Applications for Payment are processed on a regular biweekly schedule, which will be provided to the Contractor.

- 15.04. FINAL INSPECTION.** When the Work has been substantially completed and at a time mutually agreeable to the Owner, Engineer, and Contractor, the Engineer and Contractor shall make a final walk-through inspection of the Work. The Engineer shall report to the Owner his findings as to the acceptability and completeness of the Work.
- 15.05. APPLICATION FOR FINAL PAYMENT.** Upon written notice from the Engineer that Work is completed and acceptable as provided in the Supplementary Conditions, the Contractor shall make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied by all other documentation called for in the Contract Documents and such other data and schedules as the Engineer may reasonably require.
- 15.06. FINAL PAYMENT.** If, on the basis of his observation and review of the Work during construction, his final inspection and his review of the final Application for Payment, all as required by the Contract Documents, the Engineer is satisfied that the Work has been completed and the Contractor has fulfilled all of his obligations under the Contract Documents, he will, within ten days after receipt of the final Application for Payment, present the Application to the Owner for Payment. Thereupon the Engineer will give written notice to the Contractor that the Work is acceptable subject to the provisions of the paragraph regarding waiver of claims. Otherwise, he will return the Application to the Contractor, indicating in writing his reasons for refusing to recommend final payment, in which case the Contractor shall make the necessary corrections and resubmit the Application. The Owner shall, within thirty days of presentation to him of the final Application for Payment, pay the Contractor the entire sum found to be due after deducting all amounts to be retained under any provision of the Contract Documents.
- 15.07. CONTRACTOR'S CONTINUING OBLIGATION.** The Contractor's obligation to perform the Work and complete the Project in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by the Engineer, nor the issuance of a certificate of Substantial Completion, nor any payment by the Owner to the Contractor under the Contract Documents, nor any use or occupancy of the Project or any part thereof by the Owner, nor any act of acceptance by the Owner nor any failure to do so, nor any correction of defective Work by the Owner shall constitute an acceptance of Work not in accordance with the Contract Documents.
- 15.08. WAIVER OF CLAIMS.** The making and acceptance of final payment shall constitute:
- 1) a waiver of all claims by the Owner against the Contractor other than those arising from unsettled Liens, from defective Work appearing after final inspection or from failure to comply with the requirements of the Contract Documents or the terms of any special guarantees specified therein, and
  - 2) a waiver of all claims by the Contractor against the Owner other than those previously made in writing and still unsettled.
- 16.00. SUSPENSION OF WORK AND TERMINATION.**
- 16.01. OWNER MAY SUSPEND WORK.** The Owner may, at any time and without cause, suspend the Work or any portion thereof for a period of ninety days by notice in writing to the Contractor, which shall fix the date on which Work shall be resumed. The Contractor shall resume the Work on the date so fixed. The Contractor will be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if he makes a claim therefore as provided in these General Conditions.

**16.02. OWNER MAY TERMINATE.** If the Contractor is adjudged a bankrupt or insolvent, or if he makes a general assignment for the benefit of his creditors, or if a trustee or receiver is appointed for the Contractor or for any of his property, or if he files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or similar laws, or if he repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment, or if he repeatedly fails to make prompt payments to Subcontractors or for labor, materials or equipment or if he disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction, or if he disregards the authority of the Engineer, or if he otherwise violates any provision of the Contract Documents, then the Owner may, without prejudice to any other right or remedy and after giving the Contractor and his Surety seven days written notice, terminate the services of the Contractor and take possession of the Project and of all materials, equipment, tools, construction equipment and machinery thereon owned by the Contractor, and finish the Work by whatever method he may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct and indirect costs of completing the Project, including compensation for additional professional services, such excesses shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the Owner. Such costs incurred by the Owner shall be incorporated in a Change Order.

- 1) Where the Contractor's services have been so terminated by the Owner, said termination shall not affect any rights of the Owner against the Contractor then existing or which may thereafter accrue. Any retention or payment of monies by the Owner due the Contractor will not release the Contractor from liability.
- 2) Upon seven days written notice to the Contractor, the Owner may, without cause and without prejudice to any other right or remedy, elect to abandon the Project and terminate the Agreement. In such case, the Contractor shall be paid for all Work executed and any expense sustained plus a reasonable profit.

**16.03. CONTRACTOR MAY STOP WORK OR TERMINATE.** If, through no act or fault of the Contractor, the Work is suspended for a period of more than ninety days by the Owner or under an order of court or other public authority, or the Engineer fails to act on any Application for Payment within thirty days after it is submitted, or the Owner fails to pay the Contractor any sum recommended by the Engineer or awarded by arbitrators within thirty days of its approval and presentation, then the Contractor may, upon seven days written notice to the Owner and Engineer, terminate the Agreement and recover from the Owner payment for all Work executed and any expense sustained plus a reasonable profit. In addition and in lieu of terminating the Agreement, if the Engineer has failed to act on an Application for Payment or the Owner has failed to make any payment as aforesaid, the Contractor may upon seven days notice to the Owner and Engineer stop the Work until he has been paid all amounts then due.

**17.00. ARBITRATION.**

Except as otherwise required by the Supplementary Conditions, all claims, disputes and other matters in question arising out of, or relating to, this Agreement or the breach thereof except for claims which have been waived by the making or acceptance of final payment, shall be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then obtaining. This agreement so to arbitrate shall be specifically enforceable under the prevailing arbitration law. The award rendered by the arbitrators shall be final, and judgment may be entered upon it in any court having jurisdiction thereof.

Notice of the demand for arbitration shall be filed in writing with the other party to the Agreement and with the American Arbitration Association, and a copy shall be filed with the Engineer. The demand for arbitration shall be made within thirty days after the Engineer has rendered his decision where applicable, and in all other cases within a reasonable time after the claim, dispute, or other matter in question has arisen, and in no event shall it be made after institution of legal or equitable proceedings based on such claim, dispute or other matter in question would be barred by the applicable statute of limitations.

The Contractor will carry on the Work and maintain the progress schedule during any arbitration proceedings, unless otherwise agreed by him and the Owner in writing.

**18.00. ENVIRONMENTAL REQUIREMENTS.**

The Contractor, when constructing a project involving trenching and/or other related earth excavation, shall comply with the following environmental constraints and be required to install appropriate erosion control devices as determined by the City of Bloomington, which may include, but not be limited to the placement of inlet protection, silt fencing, check dams, temporary seeding and/or mulching. All costs for this work shall be included in the cost of the base Quote with work performed by the contractor to ensure that all erosion is contained on site.

- **18.01. WETLANDS.** The Contractor, when disposing of excess, spoil, or other related earth construction materials on public or private property, shall not fill in or otherwise convert wetlands
- **18.02. FLOODPLAINS.** The Contractor, when disposing of excess, spoil, or other related earth construction materials on public or private property, shall not fill in or otherwise convert 100 year flood plain areas delineated on the latest FEMA Floodplain Maps.
- **18.03. HISTORIC PRESERVATION.** Any excavation by the Contractor that uncovers an historical or archaeological artifact shall be immediately reported to the City Engineer's Office. Construction shall be temporarily halted pending the notification process and further directions issued by the City after consultation with the State Historic Preservation Office (SHPO).
- **18.04. ENDANGERED SPECIES.** The Contractor shall comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species or their critical habitat be brought to the attention of the contractor, the contractor shall immediately report this evidence to the City Engineer. Construction shall be temporarily halted pending the notification process and further directions issued by the OWNER after consultation with the U.S. Fish and Wildlife Service.

**19.00. MISCELLANEOUS.**

**19.01. GIVING NOTICE.** Whenever any provision of the Contract Documents requires the giving of written notice it shall be deemed to be validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by first class, registered or certified mail, postage prepaid, to the business address provided on the Contractual Agreement.

**19.02. COMPUTATION OF TIME.** Computation of time shall be set forth by the number of calendar days allowed for in the contract agreement. Calendar days shall consist of Monday through Friday excluding Saturday, Sunday, and City of Bloomington observed holidays. The usage of Indiana Department of Transportation (I.N.D.O.T.) standard

specifications with regard to time usage or computation does not apply to this contract and therefore is not applicable.

**19.03. ADDITIONAL SPECIFICATION REQUIREMENTS.** Areas of work not covered under Special Conditions will be required to meet specifications covered in applicable sections of Indiana Department of Transportation Specifications 2014 Edition (or latest edition and supplement at time of Bid) for the installation and placement of materials to ensure quality workmanship. INDOT Specifications shall not be interpreted to contradict current Public Works, or Bloomington Utility Specifications which shall override and supersede INDOT Specifications.

**SECTION VIII**  
**SPECIAL CONDITIONS**

## **Special Conditions**

Contractor shall maintain access for all garage users within the limits of the project during construction.

Contractor shall maintain a safe means for traffic, both vehicular and pedestrian during the entire length of the project, contractor is responsible for securing all permits and permissions prior to the start of any work.

Contractor shall follow and use accepted practices and methods when performing repairs exhibiting professional workmanship and safety of employees and the general public.

Contractor shall coordinate all construction with the Operations and Facility Director, and REI personnel prior to starting work on any level, stairwell or skywalk.

Contractor shall properly place caution, construction area closed signage and any other signage prior to the start of any construction in any area of the garage this signage shall be maintained throughout the completion of each respective area of work. All signage shall be manufactured and compliant with Indiana Manual on Uniform Traffic Control Devices (IMUTCD) for work zones.

Contractor shall continue sidewalk scored through driveways, curb ramps per INDOT standards, and shall include the usage of cast iron plates per ADA and ADAAG requirements. Plates shall be trimmed to fit as necessary with all work and material included in the contract bid price.

All repairs shall use materials and practices accepted nationally for workmanship on and to parking garage facilities and adhere to all material manufacturer's specifications.

**SECTION IX**  
**SAMPLE AGREEMENT**

**AGREEMENT**  
**BETWEEN**  
**DEPARTMENT OF PUBLIC WORKS**  
**AND**

**Contractor Name**

**FOR**

**4th Street and Walnut Street Parking Garage Repairs – PW2013-17**

**THIS AGREEMENT**, executed by and between the City of Bloomington, Indiana, Department of Public Works (hereinafter CITY), and Contractor, (hereinafter CONTRACTOR);

**WITNESSETH THAT:**

WHEREAS, CITY desires to retain CONTRACTOR'S services for Repairs to 4th Street and Walnut Street Parking Garage, Project No. PW 2013-17 (more particularly described in Attachment A, "Scope of Work"; and

WHEREAS, CONTRACTOR is capable of performing specified repairs as per his/her quote on the Bid Summary sheet; and

WHEREAS, CONTRACTOR was determined to be the lowest responsible and responsive Bidder for said project.

NOW, THEREFORE, in consideration of the mutual promises hereinafter enumerated, the parties agree as follows:

**ARTICLE 1.      TERM**

**1.01**      This Agreement shall be in effect upon execution of this Agreement by all parties.

**ARTICLE 2.      SERVICES**

**2.01**      CONTRACTOR shall complete all work required under this Agreement within thirty (30) calendar days from the written Notice to Proceed. Substantial Completion shall mean completion of all work.

**2.02**      It is hereby understood by both parties that time is of the essence in this Agreement. Failure of CONTRACTOR to complete all work as herein provided will result in monetary damages to CITY. It is hereby agreed that CITY will be damaged for every day the work has not been performed in the manner herein provided and that the measure of those damages shall be determined by reference to the then current INDOT Schedule of Liquidated Damages for Each Day of Overrun in Contract Time. CONTRACTOR agrees to pay CITY said damages or, in the alternative, CITY, at its sole discretion, may withhold monies otherwise due CONTRACTOR. It is expressly understood by the parties hereto that these damages relate to the time of performance and do not limit CITY's other remedies under this Agreement, or as provided by applicable law, for other damages.

**2.03**      CONTRACTOR agrees that no charges or claims for damages shall be made by him for any delays or hindrances, from any cause whatsoever during the progress of any portion of the services specified in the Agreement. Such delays or hindrances, if any, may be compensated for by an extension of time for a reasonable period as may be mutually agreed upon between the parties, it being understood, however,

that permitting CONTRACTOR to proceed to complete any service, or any part of the services / project, after the date to which the time of completion may have been extended, shall in no way operate as a waiver on the part of CITY of any of its rights herein.

### **ARTICLE 3. COMPENSATION**

**3.01** CONTRACTOR shall provide services as specified in Attachment A, "Scope of Work", attached hereto and incorporated into this Agreement.

**3.02** Upon the submittal of approved claims, CITY shall compensate CONTRACTOR in a lump sum not to exceed xxxxx (\$xxx,xxx.xx). CITY may withhold payment, in whole or in part, to the extent necessary to protect itself from a loss on account of any of the following:

1. Defective work.
2. Evidence indicating the probable filing of claims by other parties against CONTRACTOR which may adversely affect CITY.
3. Failure of CONTRACTOR to make payments due to subcontractors, material suppliers or employees.
4. Damage to CITY or a third party.

**3.03** The submission of any request for payment shall be deemed a waiver and release by CONTRACTOR of all liens and claims with respect to the work and period to which such payment request pertains except as specifically reserved and noted on such request.

**3.04** CONTRACTOR shall maintain proper account records for the scope of all services of this Agreement and provide an accounting for all charges and expenditures as may be necessary for audit purposes. All such records shall be subject to inspection and examination by CITY's representatives at reasonable business hours.

**3.05** CONTRACTOR shall submit time sheets (WH-347) for his own and all subcontracted employees, to City Engineer or his representative for approval and review, including review for compliance with Prevailing Wage requirements.

### **ARTICLE 4. GENERAL PROVISIONS**

**4.01** CONTRACTOR agrees to indemnify and hold harmless CITY and its officers, agents, officials and employees for any and all claims, actions, causes of action, judgments and liens arising out of any negligent act or omission by CONTRACTOR or any of its officers, agents, officials, employees, or subcontractors or any defect in materials or workmanship of any supply, materials, mechanism or other product or service which it or any of its officers, agents, officials, employees, or subcontractors has supplied to CITY or has used in connection with this Agreement and regardless of whether or not it is caused in part by a party indemnified herein under. Such indemnity shall include attorney's fees and all costs and other expenses arising there from or incurred in connection therewith and shall not be limited by reason of the enumeration of any insurance coverage required herein.

#### **4.02 Abandonment, Default and Termination**

4.02.01 CITY shall have the right to abandon the work contracted for in this Agreement without penalty. If CITY abandons the work described herein, CONTRACTOR shall deliver to CITY all surveys, notes, drawings, specifications and estimates completed or partially completed and these shall become the property of CITY. The earned value of the work performed shall be based upon an estimate of the proportion between the work performed by CONTRACTOR under this Agreement and the work which CONTRACTOR was obligated to perform under this Agreement. This proportion shall

be mutually agreed upon by CITY and CONTRACTOR. The payment as made to CONTRACTOR shall be paid as a final payment in full settlement of his services hereunder.

- 4.02.02 If CONTRACTOR defaults or fails to fulfill in a timely and proper manner the obligations pursuant to this Agreement, CITY may, after seven (7) days' written notice has been delivered to CONTRACTOR, and without prejudice to any other remedy it may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due to CONTRACTOR. In the alternative, CITY, at its option, may terminate this Agreement and take possession of the site and of all materials, equipment, tools and construction equipment and machinery thereon owned by CONTRACTOR, and may finish the project by whatever method it may deem expedient, and if the such action exceeds the unpaid balance of the sum amount, CONTRACTOR or his surety, shall pay the difference to CITY.
- 4.02.03 Default: If CONTRACTOR breaches this Agreement or fails to perform the work in an acceptable manner, he shall be considered in default. Any one or more of the following will be considered a default:
1. Failure to begin the work under this Agreement within the time specified.
  2. Failure to perform the work with sufficient supervision, workmen, equipment and materials to insure prompt completion of said work within the time limits allowed.
  3. Unsuitable performance of the work as determined by CITY ENGINEER or his representative.
  4. Neglecting or refusing to remove defective materials or failure to perform anew such work as shall have been rejected.
  5. Discontinuing the prosecution of the work or any part of it.
  6. Inability to finance the work adequately.
  7. If, for any other reason, CONTRACTOR breaches this Agreement or fails to carry on the work in an acceptable manner.
- 4.02.04 CITY shall send CONTRACTOR a written notice of default. If CONTRACTOR, or his Surety, within a period of ten (10) days after such notice, fails to remedy the default, then CITY shall have full power and authority, without violation of the Contract, to take the prosecution of the work out of the hands of said CONTRACTOR, to appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable, and may, at its option, turn the work over to the Surety, or enter into an agreement with another Contractor for the completion of the Agreement according to the terms and provisions thereof, or CITY may use such other methods as, in its opinion, shall be required for the completion of said Contract in an acceptable manner.
- 4.02.05 All cost of completing the work under the Contract shall be deducted from the monies due or which may become due to said CONTRACTOR. In case the expenses so incurred by CITY shall be less than the sum which would have been payable under the Contract if it had been completed by said CONTRACTOR, CONTRACTOR shall be entitled to receive the difference. However, in case such expense shall exceed the sum which would have been payable under the Contract, CONTRACTOR and his Surety will be liable and shall pay to CITY the amount of said excess. By taking over the prosecution of the work, CITY does not forfeit the right to recover damages from CONTRACTOR or his Surety for his failure to complete the work in the time specified.
- 4.02.06 Notwithstanding any other provision of this Agreement, if funds for the continued fulfillment of the Agreement by CITY are at any time not forthcoming or are insufficient, through failure of any entity to appropriate the funds or otherwise, then CITY shall have the right to terminate this Agreement without penalty by giving prior written notice documenting the lack of funding in which instance, unless otherwise agreed to by the parties, this Agreement shall terminate and become null and void.

4.02.07 CITY agrees that it will make its best effort to obtain sufficient funds, including but not limited to, including in its budget for each fiscal period during the term hereof a request for sufficient funds to meet its obligations hereunder in full.

#### **4.03 Successors and Assigns**

4.03.01 Both parties agree that for the purpose of this Agreement, CONTRACTOR shall be an Independent Contractor and not an employee of CITY.

4.03.02 No portion of this Agreement shall be sublet, assigned, transferred or otherwise disposed of by CONTRACTOR except with the written consent of CITY being first obtained. Consent to sublet, assign, transfer, or otherwise dispose of any portion of this Agreement shall not be construed to relieve CONTRACTOR of any responsibility of the fulfillment of this Agreement.

#### **4.04 Extent of Agreement: Integration**

4.04.01 This Agreement consists of the following parts, each of which is as fully a part of this Agreement as if set out herein:

1. This Agreement.
2. Technical Specification (Attachment A, "Scope of Work").
3. E-Verify Affidavit (Attachment B).
4. Project Schedule (Attachment C).
5. No Investment In Iran (Attachment D)
6. Upfront Specifications (Definitions and Bidder's Responsibilities ).
7. Instructions to Bidders.
8. Advertisement.
9. CONTRACTOR'S submittals.
10. The current Indiana Department of Transportation Standard Specifications and the latest addenda.
11. All plans as provided for the work that is to be completed.

4.04.02 In resolving conflicts, errors, discrepancies and disputes concerning the Scope of Work to be performed by CONTRACTOR, and other rights and obligations of CITY and CONTRACTOR, the document expressing the greater quantity, quality or other scope of work in question, or imposing the greater obligation upon CONTRACTOR and affording the greater right or remedy to CITY shall govern; otherwise the documents shall be given precedence in the order as enumerated above.

#### **4.05 Insurance**

CONTRACTOR shall, as a prerequisite to this Agreement, purchase and thereafter maintain such insurance as will protect him from the claims set forth below which may arise out of or result from CONTRACTOR'S operations under this Agreement, whether such operations be by CONTRACTOR or by any SUBCONTRACTORS or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

<u>Coverage</u>	<u>Limits</u>
A. Worker's Compensation & Disability	Statutory Requirements
B. Employer's Liability Bodily Injury by Accident	\$100,000 each accident
Bodily Injury by Disease	\$500,000 policy limit
Bodily Injury by Disease	\$100,000 each employee
C. Commercial General Liability (Occurrence Basis)	\$1,000,000 per occurrence
Bodily Injury, personal injury, property damage, contractual liability, products-completed operations, General Aggregate Limit (other than Products/Completed Operations)	and \$2,000,000 in the aggregate
Products/Completed Operation	\$1,000,000
Personal & Advertising Injury Limit	\$1,000,000
Each Occurrence Limit	\$1,000,000
Fire Damage (any one fire)	\$50,000
D. Comprehensive Auto Liability (single limit, owned, hired and non-owned)	\$1,000,000 each accident
Bodily injury and property damage	
E. Umbrella Excess Liability	\$5,000,000 each occurrence and aggregate
The Deductible on the Umbrella Liability shall not be more than	\$10,000

4.05.02 CONTRACTOR'S comprehensive general liability insurance shall also provide coverage for the following:

1. Premises and operations;
2. Contractual liability insurance as applicable to any hold-harmless agreements;
3. Completed operations and products; which also must be maintained for a minimum period of two (2) years after final payment and CONTRACTOR shall continue to provide evidence of such coverage to CITY on an annual basis during the aforementioned period;
4. Broad form property damage - including completed operations;
5. Fellow employee claims under Personal Injury; and
6. Independent Contractors.

4.05.03 With the prior written approval of CITY, CONTRACTOR may substitute different types or amounts of coverage for those specified as long as the total amount of required protection is not reduced.

4.05.04 Certificates of Insurance showing such coverage then in force (but not less than the amount shown above) shall be on file with CITY prior to commencement of work. These Certificates shall contain a provision that coverage afforded under the policies will not be canceled or non renewed until at least sixty (60) days' prior written notice has been received by CITY. The CITY shall be named as an additional insured on the Commercial General Liability, Automobile Liability, and Umbrella Excess Liability policies. The CONTRACTOR shall agree to a waiver of subrogation on its Worker's Compensation policy.

**4.06 Necessary Documentation** CONTRACTOR certifies that it will furnish CITY any and all documentation, certification, authorization, license, permit or registration required by the laws or rules and regulations of the City of Bloomington, the State of Indiana and the United States. CONTRACTOR further certifies that it is now and will maintain in good standing with such governmental agencies and that it will keep its license, permit registration, authorization or certification in force during the term of this Agreement.

**4.07 Applicable Laws** CONTRACTOR agrees to comply with all federal, state, and local laws, rules and regulations applicable to CONTRACTOR in performing work pursuant to this Agreement, including, but not limited to, discrimination in employment, prevailing wage laws, conflicts of interest, public notice, accounting records and requirements. This Agreement shall be governed by the laws of the United States, and the State of Indiana, and by all Municipal Ordinances and Codes of the City of Bloomington. Venue of any disputes arising under this Agreement shall be in the Monroe Circuit Court, Monroe County, Indiana.

**4.08 Non-Discrimination**

4.08.01 CONTRACTOR and subcontractors shall not discriminate against any employee or applicant for employment, to be employed in the performance of this Agreement, with respect to hire, tenure, terms, training, conditions or privileges of employment, because of race, sex, color, religion, national origin, ancestry, age, handicap, or disabled veteran status. Breach of this covenant may be regarded as a material breach of the Agreement.

4.08.02 CONTRACTOR certifies for itself and all its subcontractors compliance with existing laws of the State of Indiana and the United States regarding:

1. Prohibition of discrimination in employment practices on the basis of race, sex, color, religion, national origin, ancestry, age, handicap, or any other legally protected classification;
2. The utilization of Minority and Women Business Enterprises. CONTRACTOR further certifies that it:
  - a. Has formulated its own Affirmation Action plan for the recruitment, training and employment of minorities and women, including goals and timetable; which has been approved by the City's Contract Compliance Officer.
  - b. Encourages the use of small business, minority-owned business and women-owned business in its operations.

4.08.03 FURTHER, PURSUANT TO INDIANA CODE 5-16-6-1, CONTRACTOR AGREES:

- A) That in the hiring of employees for the performance of work under this Agreement or any sub agreement hereunder, no contractor, or subcontractor, nor any person acting

on behalf of such CONTRACTOR or subcontractor, shall by reason of race, sex, color, religion, national origin, ancestry, or any other legally protected classification, discriminate against any citizen of the State of Indiana who is qualified and available to perform the work to which the employment relates.

- B) That no contractor, subcontractor, or any person on their behalf, shall, in any manner, discriminate against or intimidate any employee hired for performance of work under this Agreement on account of race, religion, color, sex, national origin, ancestry, handicap, or any other legally protected classification.
- C) That there may be deducted from the amount payable to CONTRACTOR, by CITY, under this Agreement, penalty of Five Dollars (\$5.00) for each person for each calendar day during which such person was discriminated against or intimidated in violation of the provisions of this Agreement. Any such person discriminated against retains the right to file a discrimination complaint with the appropriate civil rights agency or court.
- D) That this Agreement may be canceled or terminated by CITY and all money due or to become hereunder may be forfeited, for a second or any subsequent violations of the terms or conditions under this section of the Agreement.

#### **4.09 Workmanship and Quality of Materials**

4.09.01 CONTRACTOR shall guarantee the work for a period of one (1) year from the date of substantial completion. Failure of any portion of the work within one (1) year due to improper construction, materials of construction, or design may result in a refund to CITY of the purchase price of that portion which failed or may result in the forfeiture of CONTRACTOR's Performance Bond.

4.09.02 OR EQUAL: Wherever in any of the Agreement Documents an article, material or equipment is defined by describing a proprietary product, or by using the name of a manufacturer or vender, the term "Or Equal" or the term "The Equivalent" if not inserted, shall be implied, and it is done for the express purpose of establishing a basis of durability and efficiency and not for the purpose of limiting completion. Whenever material or equipment is submitted for approval as being equal to that specified, the submittal shall include sufficient information and data to demonstrate that the material or equipment conforms to the Contract requirements. The decision as to whether or not such material or equipment is equal to that specified shall be made by the ENGINEER. The approval by the ENGINEER of alternate material or equipment as being equivalent to that specified, shall not in any way relieve CONTRACTOR of responsibility for failure of the material or equipment due to faulty design, material, or workmanship, to perform the function required by the Contract Documents. Specifications as determined by other entities within the City of Bloomington such as City Utilities shall only be substituted or changed by their approval which shall be submitted in writing to the ENGINEER.

4.09.03 CITY shall be the sole judge of the sufficiency of workmanship and quality of materials. Disputes shall be resolved by the Director of Public Works and are not subject to arbitration.

**4.10 Safety.** CONTRACTOR shall be responsible for the safety of employees at all times and shall provide all equipment necessary to insure their safety. CONTRACTOR shall ensure the enforcement of all applicable safety rules, regulations, ordinances and laws, whether federal, state or local. Contractor's Superintendent of Safety shall make daily inspections upon the arrival and leaving of the site at the close of each workday.

**4.11 Amendments/Changes**

- 4.11.01 Except as provided in Paragraph 4.11.02, this Agreement may be amended only by written instrument signed by both CITY and CONTRACTOR.
- 4.11.02 Without invalidating the Agreement and without notice to any surety, CITY may, at any time or from time to time, order, in writing, additions, deletions, or revisions in the work. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the work involved, which will be performed under the applicable conditions of the Agreement Documents.
- 4.11.03 If CONTRACTOR believes that any direction of CITY under paragraph 4.11.02, or any other event or condition, will result in an increase in the Contract time or price, he shall file written notice with CITY no later than twenty (20) calendar days after the occurrence of the event giving rise to the claim and stating the general nature of the claim with supporting data. No claim for any adjustment of the Contract time or price will be valid if not submitted in accordance with this Paragraph.
- 4.11.04 CONTRACTOR shall carry on the work and adhere to the progress schedule during all disputes or disagreements with CITY. No work shall be delayed or postponed pending resolution of any dispute or disagreement except as CONTRACTOR and CITY may otherwise agree in writing.

**4.12 Performance Bond and Payment Bond**

- 4.12.01 CONTRACTOR shall provide CITY with a Performance Bond and Payment Bond in the amount of one hundred percent (100%) of the contract amount.
- 4.12.02 Failure by CONTRACTOR to perform the work in a timely or satisfactory fashion may result in forfeiture of CONTRACTOR’S Performance Bond.
- 4.12.03 If the surety on any bond furnished by CONTRACTOR becomes a party to supervision, liquidation, or rehabilitation action pursuant Indiana Code 27-9 et seq. or its right to do business in the State of Indiana is terminated, CONTRACTOR shall, within thirty (30) calendar days thereafter, substitute another bond and surety, both of which must be acceptable to CITY.

**4.13 Payment of Subcontractors** CONTRACTOR shall pay all subcontractors, laborers, material suppliers and those performing services to CONTRACTOR on the project under this Agreement. CITY may, as a condition precedent to any payment hereunder, require CONTRACTOR to submit satisfactory evidence of payments of any and all claims of subcontractors, laborers, material suppliers, and those furnishing services to CONTRACTOR. Upon receipt of a lawful claim, CITY shall withhold money due to CONTRACTOR in a sufficient amount to pay the subcontractors, laborers, material suppliers, and those furnishing services to CONTRACTOR.

**4.14 Written Notice** Written notice shall be considered as served when delivered in person or sent by mail to the individual, firm, or corporation, or to the last business address of such known to CONTRACTOR who serves the Notice. Notice shall be sent as follows:

TO CITY:

TO CONTRACTOR:

City of Bloomington		
Attn: Barry Collins, Facility Director		
P.O. Box 100 Suite 130		
Bloomington, Indiana 47402		

**4.15 Severability and Waiver** In the event that any clause or provision of this Agreement is held to be invalid by any court of competent jurisdiction, the invalidity of such clause or provision shall not affect any other provision of this Agreement. Failure of either party to insist on strict compliance with any provision of this Agreement shall not constitute waiver of that party's right to demand later compliance with the same or other provisions of this Agreement.

**4.16 Notice to Proceed** CONTRACTOR shall not begin the work pursuant to the "Scope of Work" of this Agreement until it receives an official written Notice to Proceed from the City Engineer. Contractor shall start active and continuous work on the Agreement within fifteen (15) calendar days after the date of the Notice to Proceed. In no case shall work begin prior to the date of the Notice to Proceed. If a delayed starting date is indicated in the proposal, the fifteen (15) calendar day limitation will be waived. Work day charges will then begin on a date mutually agreed upon, but not later than the delayed starting date specified. In the event that any Agreement is canceled after an award has been made but prior to the issuing of the Notice to Proceed, no reimbursement will be made for any expenses accrued relative to this contract during that period.

**4.17 Steel or Foundry Products**

4.17.01 To comply with Indiana Code 5-16-8, affecting all contracts for the construction, reconstruction, alteration, repair, improvement or maintenance of public works, the following provision shall be added: If steel or foundry products are to be utilized or supplied in the performance of any contract or subcontract, only domestic steel or foundry products shall be used. Should CITY feel that the cost of domestic steel or foundry products is unreasonable; CITY will notify CONTRACTOR in writing of this fact.

4.17.02 Domestic Steel products are defined as follows:

"Products rolled, formed, shaped, drawn, extruded, forged, cast, fabricated or otherwise similarly processed, or processed by a combination of two (2) or more of such operations, from steel made in the United States by open hearth, basic oxygen, electric furnace, Bessemer or other steel making process."

4.17.03 Domestic Foundry products are defined as follows:

"Products cast from ferrous and nonferrous metals by foundries in the United States."

4.17.04 The United States is defined to include all territory subject to the jurisdiction of the United States.

4.17.05 CITY may not authorize or make any payment to CONTRACTOR unless CITY is satisfied that CONTRACTOR has fully complied with this provision.

**4.18 Verification of Employees' Immigration Status**

Contractor is required to enroll in and verify the work eligibility status of all newly-hired employees through the E-Verify program. (This is not required if the E-Verify program no longer exists). Contractor shall sign an affidavit, attached as Exhibit B, affirming that Contractor does not knowingly employ an unauthorized alien. "Unauthorized alien" is defined at 8 U.S. Code 1324a(h)(3) as a person who is not a U.S. citizen or U.S. national and is not lawfully admitted for permanent residence or authorized to work in the U.S. under 8 U.S. Code Chapter 12 or by the U.S. Attorney General.

Contractor and any of its subcontractors may not knowingly employ or contract with an unauthorized alien, or retain an employee or contract with a person that the Contractor or any of its subcontractors learns is an unauthorized alien. If the City obtains information that the Contractor or any of its subcontractors employs or retains an employee who is an unauthorized alien, the City shall notify the Contractor or its subcontractors of the Agreement violation and require that the violation be remedied within thirty (30) calendar days of the date of notice. If the Contractor or any of its subcontractors verify the work eligibility status of the employee in question through the E-Verify program, there is a rebuttable presumption that the Contractor or its subcontractor did not knowingly employ an unauthorized alien. If the Contractor or its subcontractor fails to remedy the violation within the thirty (30) calendar day period, the City shall terminate the Agreement, unless the City determines that terminating the Agreement would be detrimental to the public interest or public property, in which case the City may allow the Agreement to remain in effect until the City procures a new contractor. If the City terminates the Agreement, the Contractor or its subcontractor is liable to the City for actual damages.

Contractor shall require any subcontractors performing work under this Agreement to certify to the Contractor that, at the time of certification, the subcontractor does not knowingly employ or contract with an unauthorized alien and the subcontractor has enrolled in and is participating in the E-Verify program. Contractor shall maintain on file all subcontractors' certifications throughout the term of this Agreement with the City.

**4.19 No Investment in Iran:** Contractor is required to certify that it does not engage in investment activities in Iran as more particularly described in Indiana Code 5-22-16.5. (This is not required if federal law ceases to authorize the adoption and enforcement of this statute.) Contractor shall sign an affidavit, attached as Attachment D, affirming that Contractor is not engaged in said investment activities.

Attachment D is attached hereto and incorporated herein by reference as though fully set forth.

IN WITNESS WHEREOF, the parties of this Agreement have hereunto set their hands.

DATE: \_\_\_\_\_

City of Bloomington  
Bloomington Board of Public Works

BY:

BY:

\_\_\_\_\_  
Charlotte Zietlow, President, Board of Public Works

\_\_\_\_\_  
Contractor Representative

\_\_\_\_\_  
James McNamara, Member, Board of Public Works

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Frank Hrisomalos, M.D., Member, Board of Public Works

\_\_\_\_\_  
Title of Contractor Representative

\_\_\_\_\_  
Mark Kruzan, Mayor of Bloomington

## **ATTACHMENT 'A'**

### **"SCOPE OF WORK"**

#### **4th Street and Walnut Street Parking Garage Repair**

The contractor shall inspect the site and thoroughly inform themselves of all conditions, measurements, dimensions, safety procedures (road closings, sidewalk closings, proper caution signage, etc) to properly complete the work as described in this Scope of Work.

Should the contractor find any discrepancies or omissions from the Scope of Work the contractor shall notify the Operations and Facility Director immediately in writing. Contractor shall take all steps necessary to protect property, pedestrians and vehicular traffic during the construction process; this includes construction and advanced warning signage, street/sidewalk closings (if needed and approved by City Engineering). Contractor shall also secure any permits as required, at his expense, by local, county or state agencies prior to the start of the project.

Garage Art consists of the following:

Basement Level: 76 Permitted parking spaces, 1 bicycle enclosure and 1 sweeper enclosure.

Level #1: 34 metered parking spaces, 6 metered handicapped parking spaces, 2 permitted motorcycle parking spaces and 19 permitted parking spaces, 1 controlled access/exit point.

Level #2: 2 permitted handicapped parking spaces and 75 permitted parking spaces

Level #3: 2 permitted handicapped parking spaces and 75 permitted parking spaces

Level #4: 43 permitted parking spaces

There are 2 stairwells, one located on the northwest corner and one on the southeast corner of the structure.

There is one elevator located on the northwest corner as well.

There is a Skywalk that connects Garage Art to Fountain Square located on the northwest corner of the structure.

Garage Art is a 5 level structure constructed of precast concrete double tees supported by precast girders, spandrel beams and columns. The double tees are topped with a site poured concrete slab. The last time the structure was repaired was approximately 10 years ago, at that time repairs were completed to the precast structural components, connectors, topping sealants, joint sealants, expansion joints repairs, drains, and other miscellaneous items.

Under this Scope of Work we will be addressing mainly the structural components of the garage to include but not limited to; precast double tees, connectors, any spalling issues, drain receptacles, drain piping, door repair/replacement, skywalk sidewall replacement, and painting of all stairwells. All other areas such as sealing, coating, stripping, sign repairs, stairwell pans and risers, ceilings and lighting will be addressed and completed at a latter date.

- Remove all failed joint sealants in all decks, stairwell walls, elevator tower, decking, drains and exterior walls
- Remove spalled areas around all structural connector/ mending plates through-out the entire structure
- Remove all scaling and deterioration of the concrete on all wall panels, interior and exterior
- Remove concrete from all exposed rebar, replace rebar if necessary, seal all rebar to prevent rusting, coat all surfaces with a binder material and replace concrete to proper thickness to cover and protect rebar. This shall be completed on all surfaces through-out the garage (decks, walls, columns, double tee's, stairways, spandrel beams (on all sides)
- Remove and replace all defective/deteriorated drains, grates and piping. All piping shall be replace with PVC schedule 40 in proper diameters.
- Replace all deteriorated doors, jambs, panic hardware, closers and properly seal all thresholds
- Properly clean, seal and paint the interior of all stairwells. All concrete surfaces shall be cleaned, primed with a high quality primer and 2 coats of high quality concrete paint with graffiti repelling qualities or coat all painted surfaces with anti-graffiti after paint has cured. All primers and paints must be approved prior to application
- Remove all suspended ceilings in all stairwells and properly dispose
- Advise Operations and Facilities Director of any issues (electrical, plumbing and/or additional deterioration found after ceilings have been removed)
- Remove and properly dispose of all carpeted wall materials in the skywalk
- Frame and insulate as needed the wall areas in the skywalk, place 1/2" A/C plywood over the newly framed walls to accept an FRP wall finish materials
- Properly install FRP panels over the 1/2" A/C plywood using approved adhesives, moldings and trims to provide a finished product (color TBD by owner)
- Contractor shall remove all debris and broom clean all areas of construction on a daily basis, all trash and debris must taken to a code legal dump each day or stored in a locked container on site.
- Contractor shall coordinate all construction with the Operations and Facility Director and REI personnel prior to starting work on any level, stairwell or skywalk prior to the start of any work
- Contractor shall properly place caution, construction area closed signage and any other signage prior to the start of any construction in any area of the garage this signage shall be maintained through-out the entire construction process
- Contractor maintain a safe means for traffic, both vehicular and pedestrian during the entire length of the project, contractor is responsible for securing all permits and permissions prior the start of any work



## **Attachment C**

### **“PROJECT SCHEDULE”**

A project schedule (critical path method) is to be completed for the work and included with the contract as Attachment 'C'. Schedule shall include all controlling operations, and any planned access or entrance closures anticipated during the project. All businesses shall be accommodated as needed to remain open during construction if any ingress/egress areas are affected.



**SECTION X**  
**SPECIFICATIONS**

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# Part Three

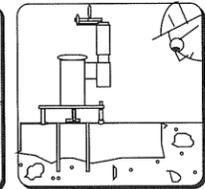
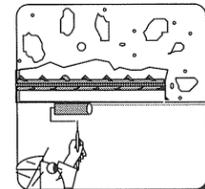
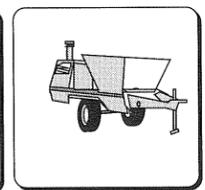
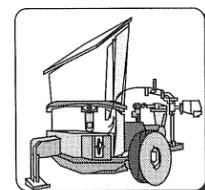
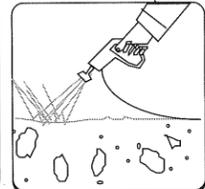
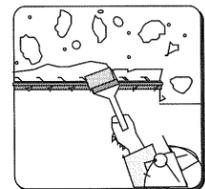
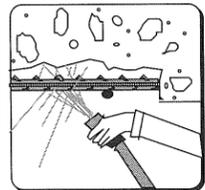
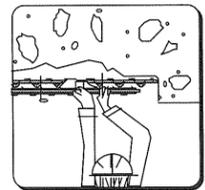
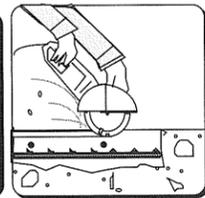
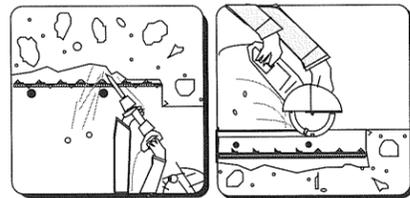
# Surface Repair

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# Introduction to Part Three



## Part Three

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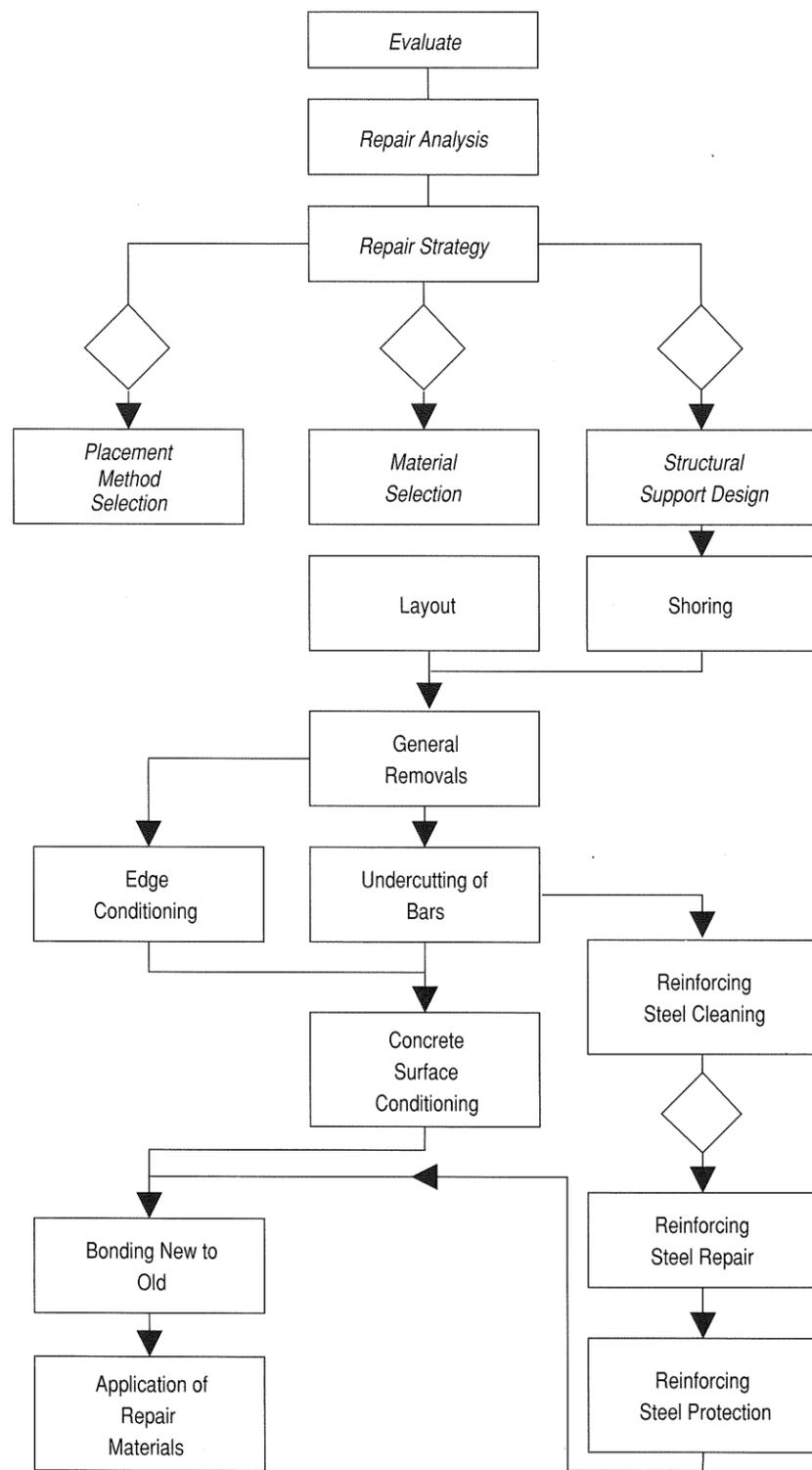
Surface repair of concrete has been practiced ever since the first concrete placement. Much has been learned and forgotten over this period. The process was once simple, with few choices for materials and placement techniques. The current practice of surface repair is far more complex than in the past for a number of reasons as indicated below.

- High performance concrete is used for new construction, (high strength, lightweight, containing different additives).
- Design practice is more precise.
- Concrete is used for many applications involving aggressive environments.
- Atmospheric pollution and the use of de-icing salts are more prevalent.
- Structures are more complex; including post-tensioned, precast, and composite.
- A wide variety of repair materials is available for special applications.
- More placement techniques are available for repair.

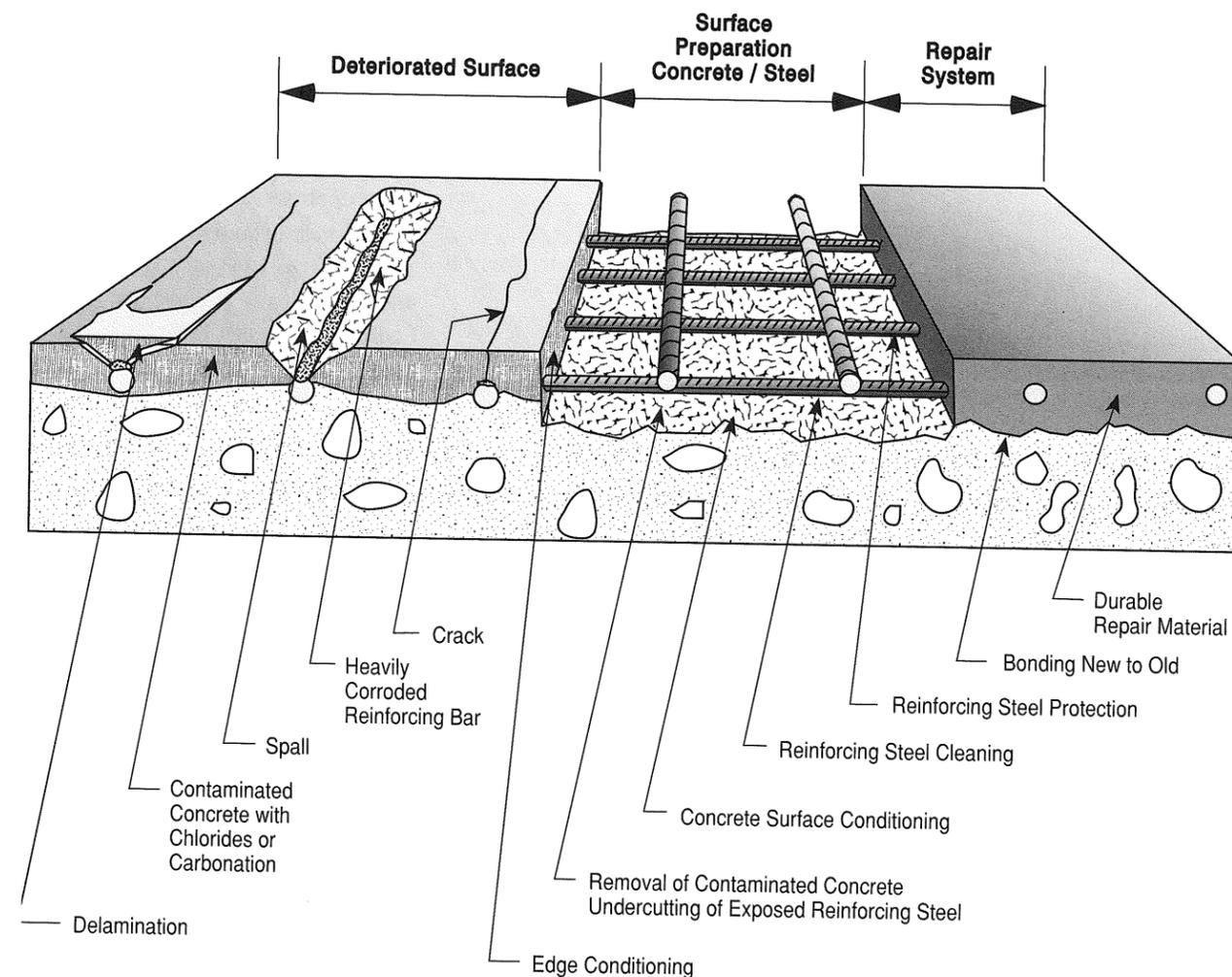
The current state of the art techniques for surface repair requires a working knowledge of material testing and evaluation, structural engineering, surface preparation tools and effects, material properties and behavior, environmental regulations and placement technology. Accomplishing durable, effective repairs is not a sure process. Much can go wrong, there are few redundancies, and many steps depend upon the success of others. Building durable and effective surface repairs is an ever-improving process. The following flow chart details these major steps involved in surface repair:

- Repair analysis, strategy and design
- Material selection
- Surface preparation
- Reinforcing steel cleaning, repair and protection
- Bonding surface repairs to existing substrate
- Placement techniques

# Flow Chart of General Procedures



# Anatomy of Surface Repairs



# Section 1: Analysis, Strategy & Design

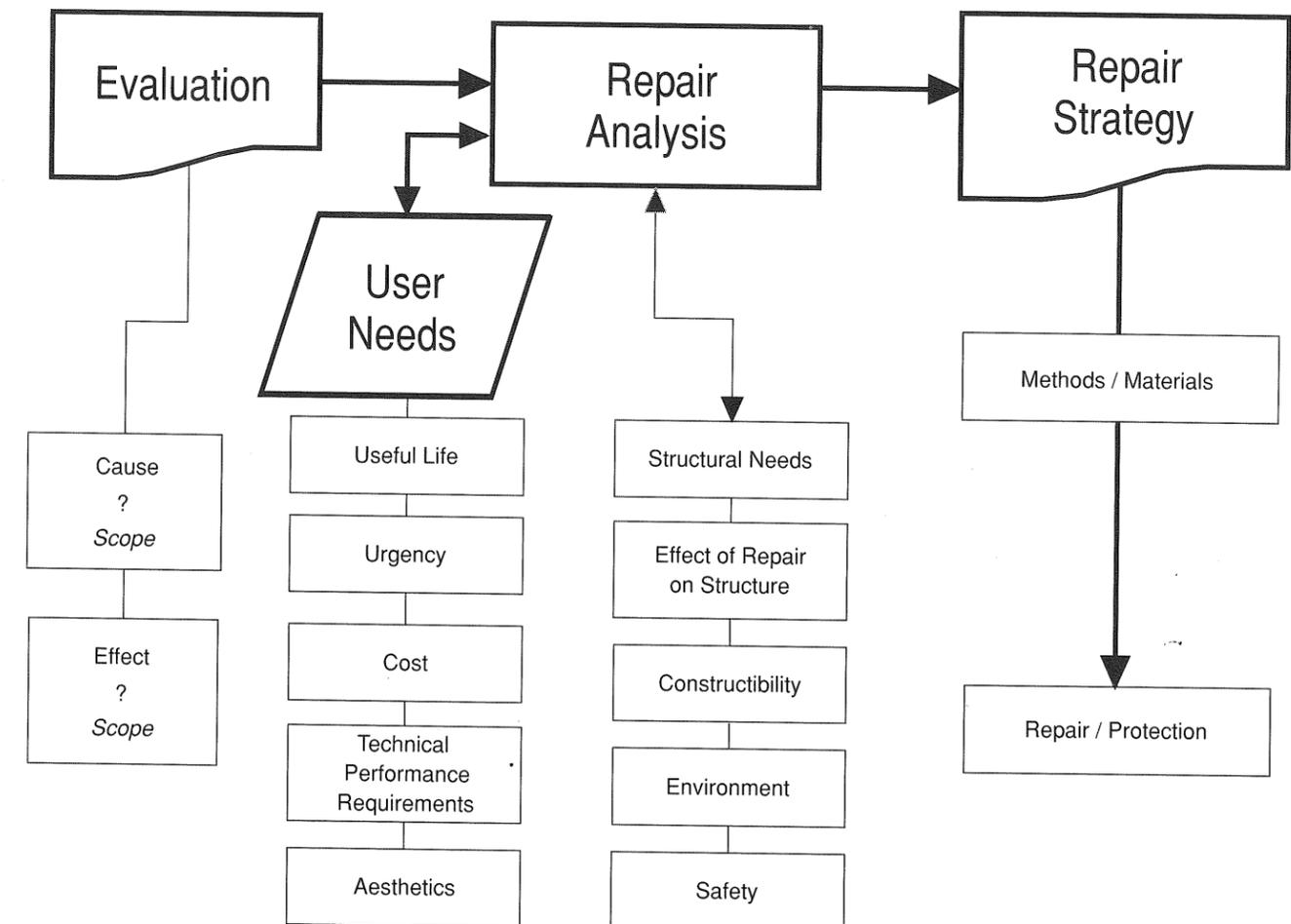
**The following topics are covered in this section:**

- Introduction to Analysis, Strategy & Design
- Structural Needs
- Types of Stress Acting on Repairs
- Performance Requirements, Examples
- The Challenge of Placing Loads into Repairs
- Cause/Effect Design Error
- Repair Problem—Analysis and Strategy

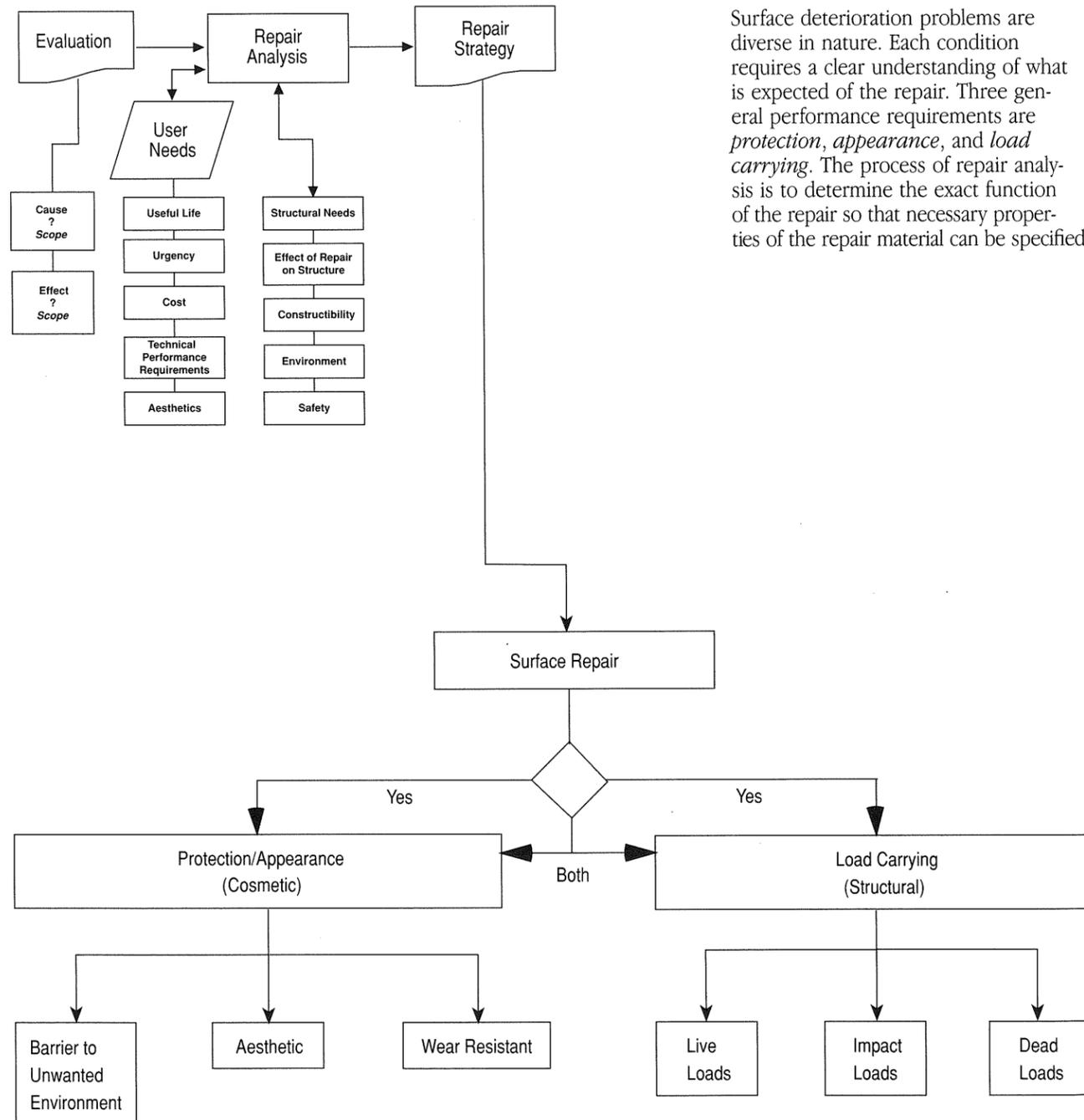
# Introduction to Analysis, Strategy & Design

The process of solving concrete repair problems includes repair analysis, strategy and design. A comprehensive evaluation must be conducted, including the scope of both the cause and effect of the deterioration. The results of the evaluation, together with the user's needs or requirements, form the necessary external information to begin the design process. The final design presents a solution based on considerations of durability, constructibility and compatibility with the existing structure.

The section, "Surface Repair Analysis, Strategy and Design," covers the cause/effect relationship in repair design, performance criteria for repair methods and material selection, the structure's impact on repair effectiveness, and some typical repair design errors. It is important to note that the scope of this book precludes a detailed examination of this enormous topic; the discussion offered here is intended to provide the reader with a broad framework to perform the design of a repair project.

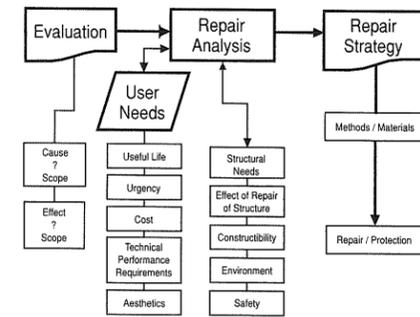


# Performance Requirements



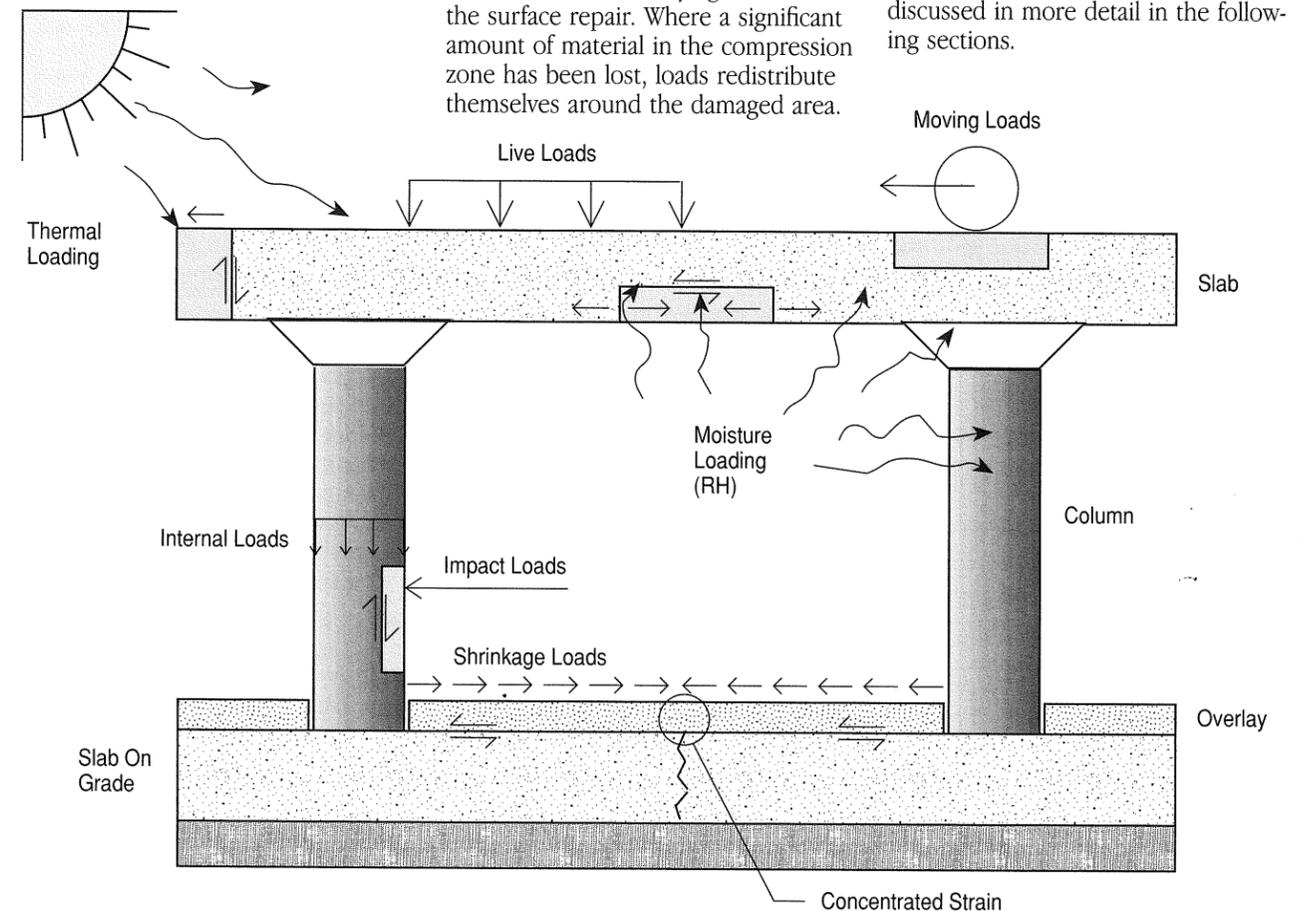
Surface deterioration problems are diverse in nature. Each condition requires a clear understanding of what is expected of the repair. Three general performance requirements are *protection, appearance, and load carrying*. The process of repair analysis is to determine the exact function of the repair so that necessary properties of the repair material can be specified.

# Structural Needs

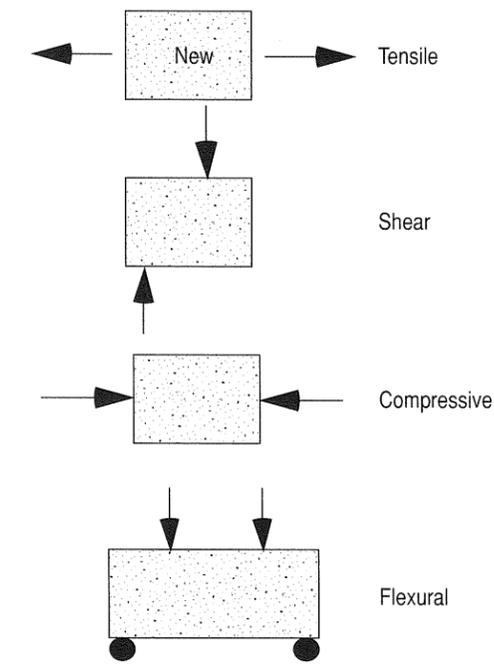
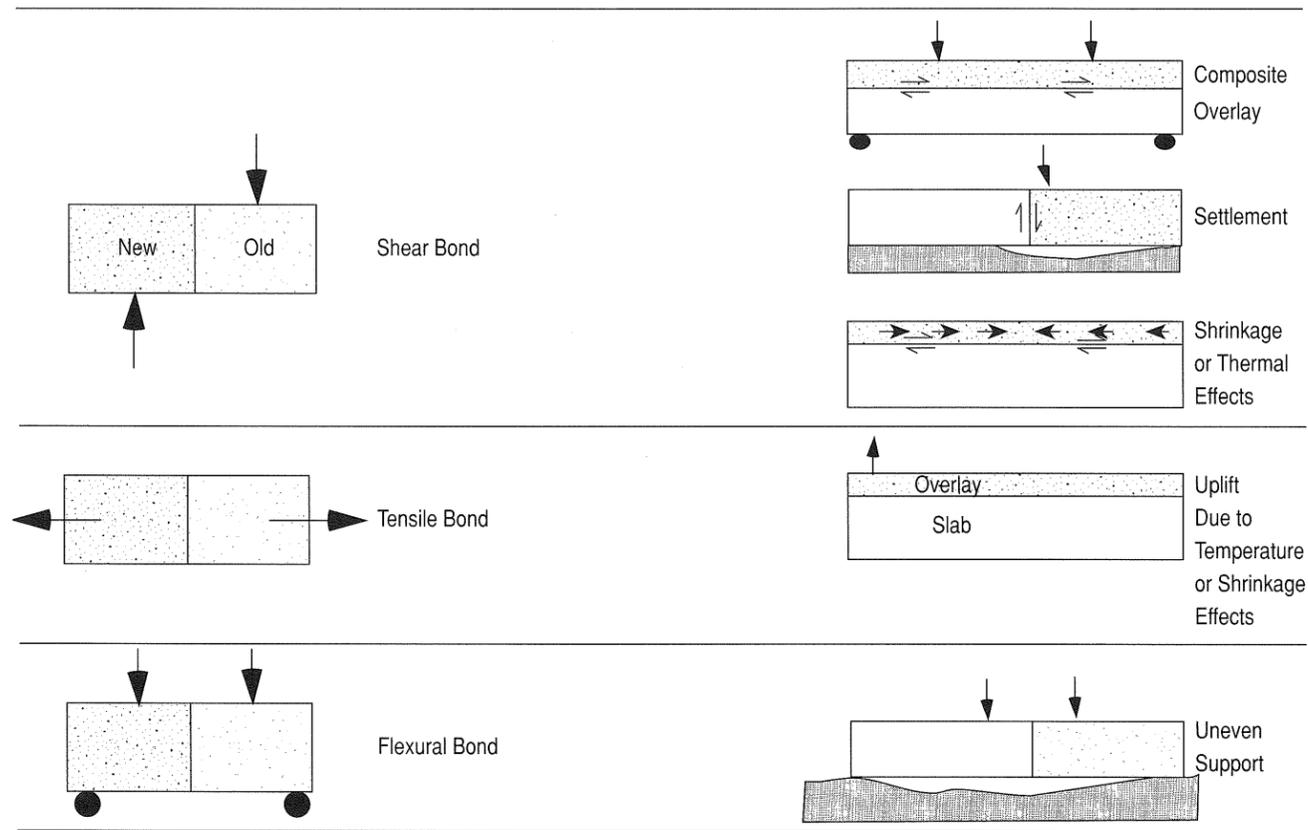


A concrete surface repair must replace damaged concrete, restore required structural function, protect itself and possibly underlying concrete from aggressive environments, and restore any lost user performance requirements. It is important to analyze all possible stresses in the repair material and at the interface between the repair and the existing substrate. Stresses in the repair are generated by relative volume changes between the repair and the existing concrete substrate, and by service loads carried by the repair. Stresses in the repair must be within the capacity of the new and existing materials. Otherwise, failure may occur. In many situations it is difficult to achieve the stress-carrying function of the surface repair. Where a significant amount of material in the compression zone has been lost, loads redistribute themselves around the damaged area.

To recreate the original load distribution, full load relief must be provided during the surface repair process. Repair material must be installed, cured, and after the material reaches the specified strength, loads would be allowed on the member. Load relief from members is typically provided with temporary shoring and jacking. Relative volume changes caused by drying shrinkage of the new material place the repair into tension (assuming the repair material is restrained from shrinkage by the bond between the repair material and the existing concrete). In most applications, the desirable condition is to have the repair in a compressive state so that compressive loads can be carried. This topic is discussed in more detail in the following sections.



# Types of Stress Acting on Repairs



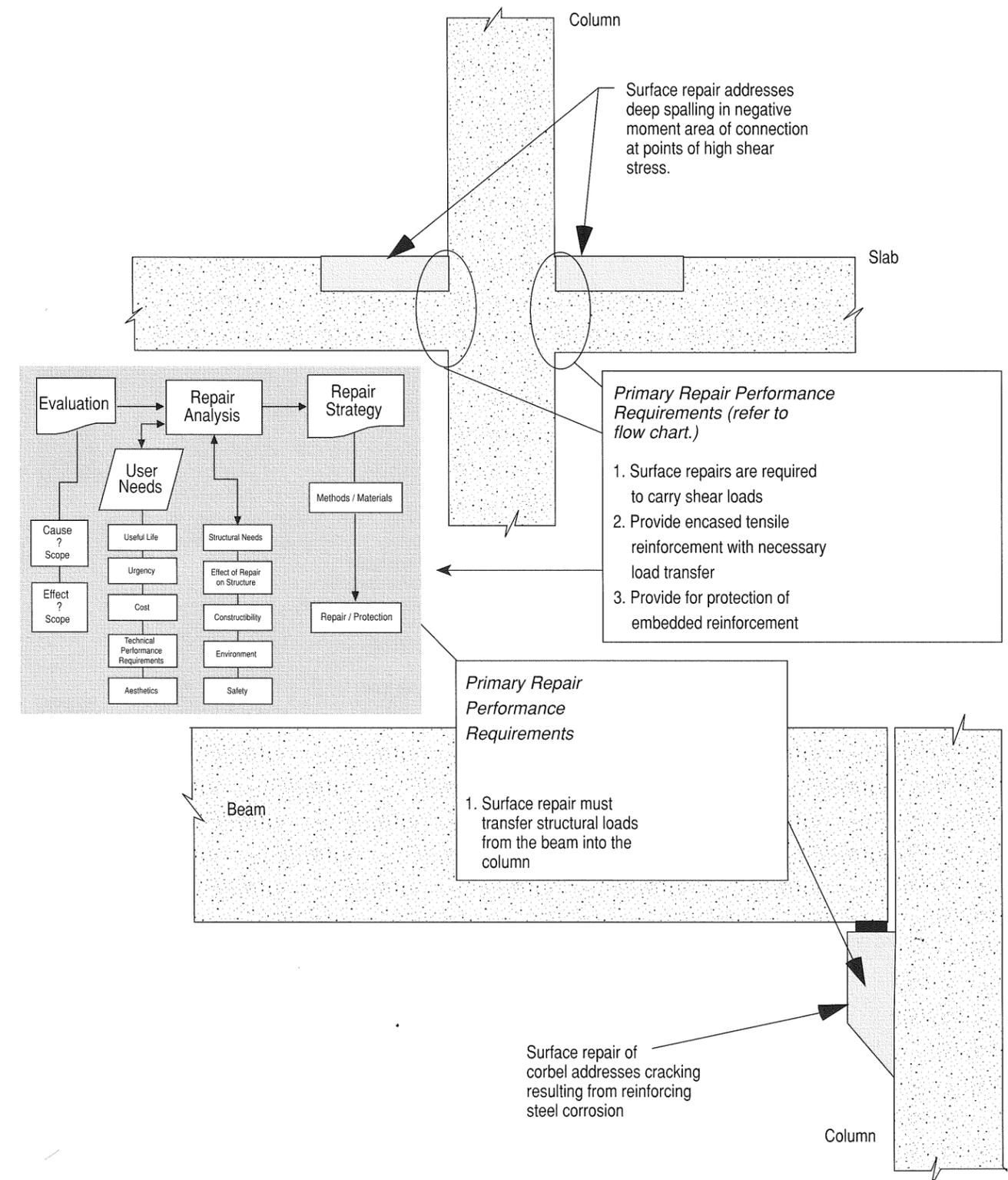
## Checklist of Possible Forces Acting on the Repair<sup>1</sup>

- Structural Forces (Internal)
- Static Concentrated Loads (External)
- Moving Loads (Horizontal and Vertical)
- Impact Loads
- Temperature Expansion
- Temperature Contraction
- Thermal Shock Expansion
- Thermal Shock Contraction
- Internal Moisture Expansion
- Internal Moisture Contraction
- Concentrated Strain (Reflective Cracking)

Each of the above forces can act as one or in combination. The orientation of the force and the configuration of the repair will dictate the type of stress acting on the repair. Some typical stress configurations are detailed in the following figures.

<sup>1</sup>Plum, D.R., Materials—How to Select, Construction Maintenance and Repair, November/December 1991, England, pp. 27-30.

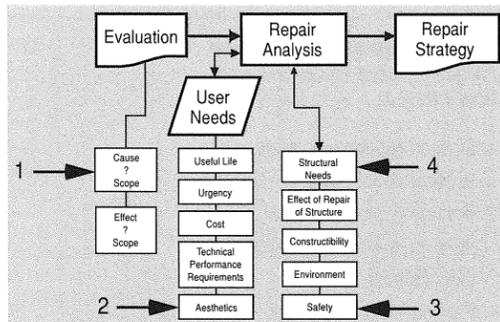
# Performance Requirements Examples



# Performance Requirements Examples, continued

### Repair Performance Requirements

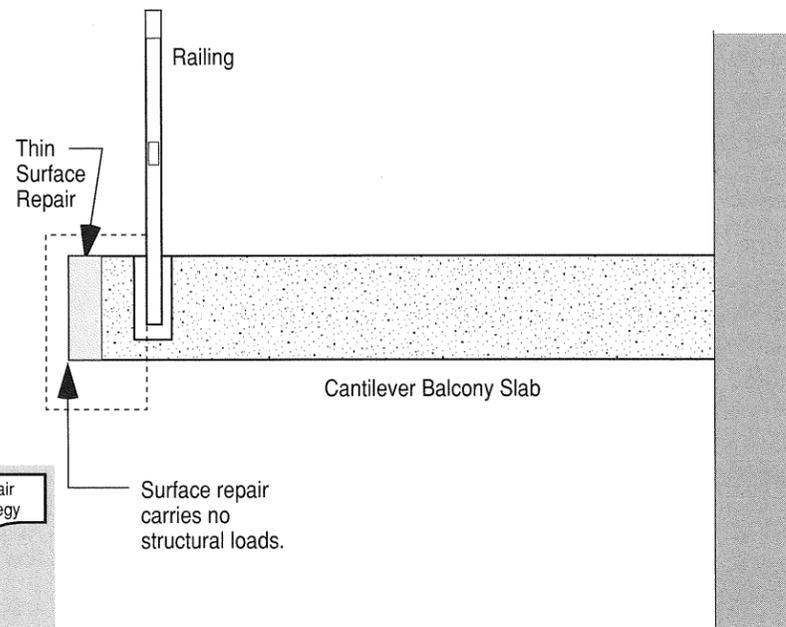
1. Provide for protection of embedded reinforcement.
2. Aesthetically pleasing.
3. Will not come loose from substrate.  
(See flow chart for number reference.)



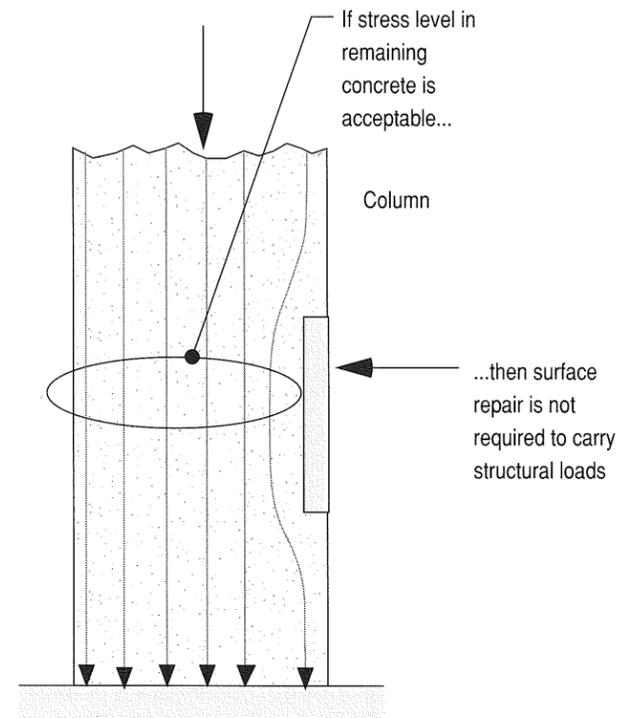
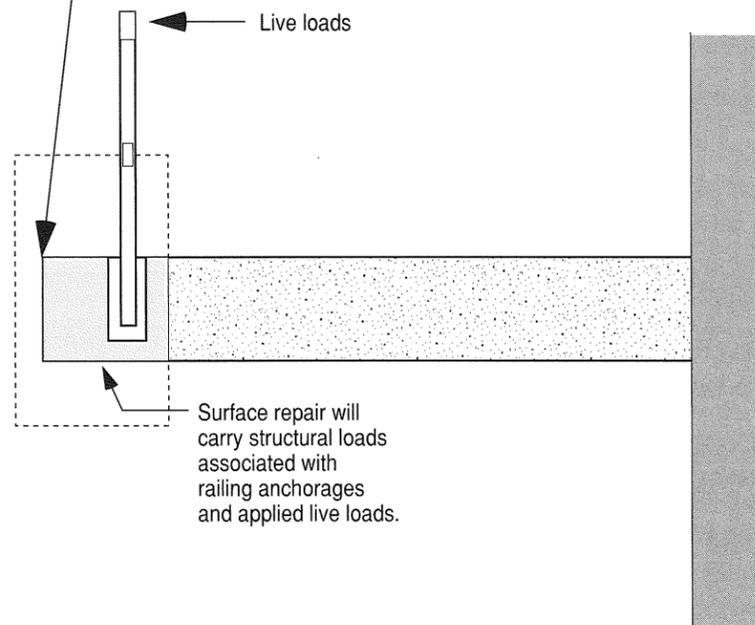
### Repair Performance Requirements

(See flow chart for number reference)

1. Provide for protection of embedded reinforcement.
2. Aesthetically pleasing.
3. Will not come loose from substrate.
4. Will carry structural loads from railing system.

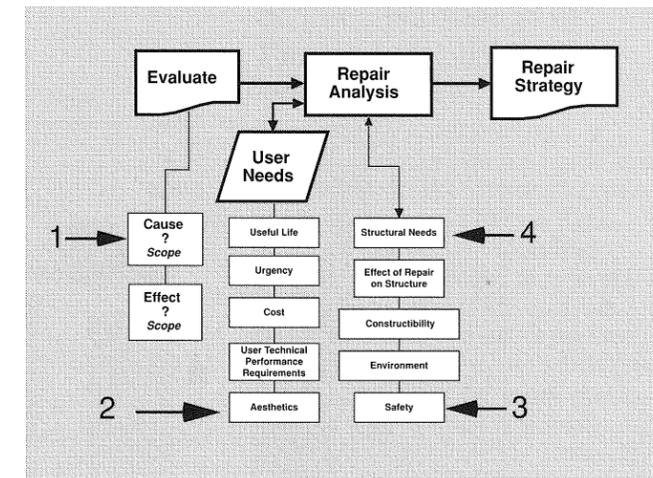


Surface repair address deep spalling and repair of balcony railing attachment.



### Primary Repair Performance Requirements

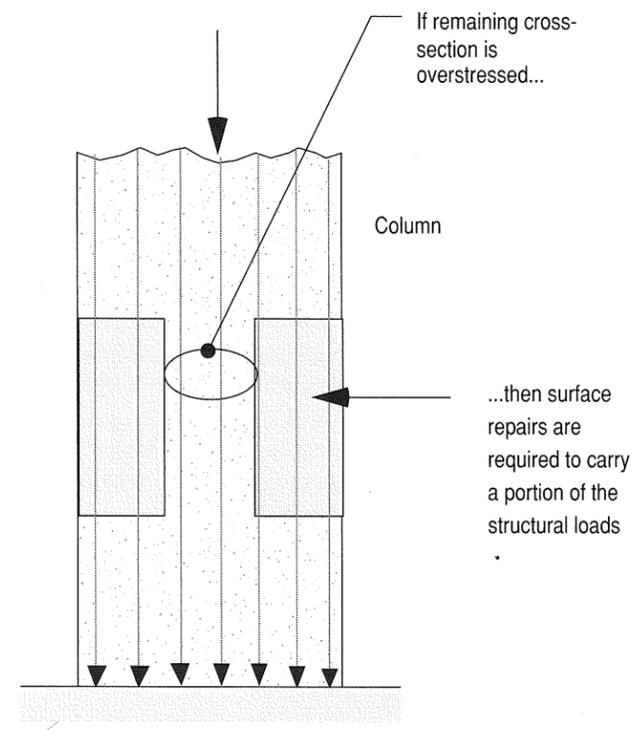
1. Provides for protection of embedded reinforcement.
2. Aesthetically pleasing.
3. Will not come loose from substrate.  
Refer to flow chart for number references.



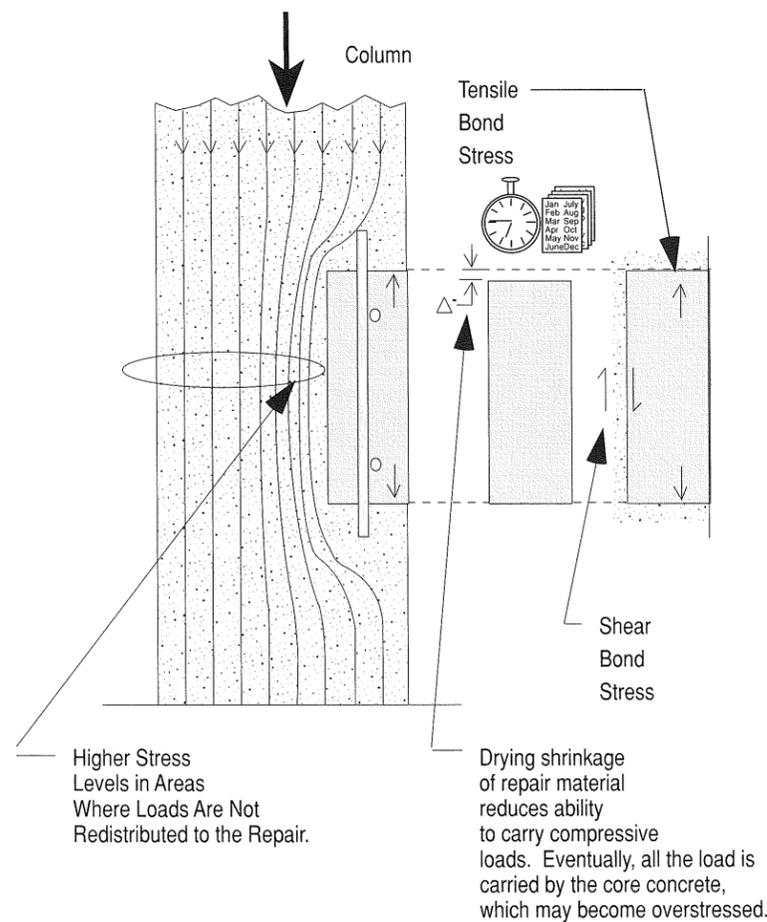
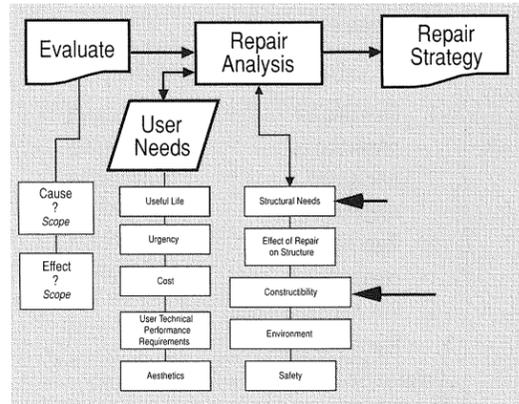
### Primary Repair Performance Requirements

1. Provides for protection of embedded reinforcement.
2. Aesthetically pleasing.
3. Will not come loose from substrate.
4. Will carry a portion of compressive loads.

Refer to flow chart for number references.



# The Challenge of Placing Loads into Repairs



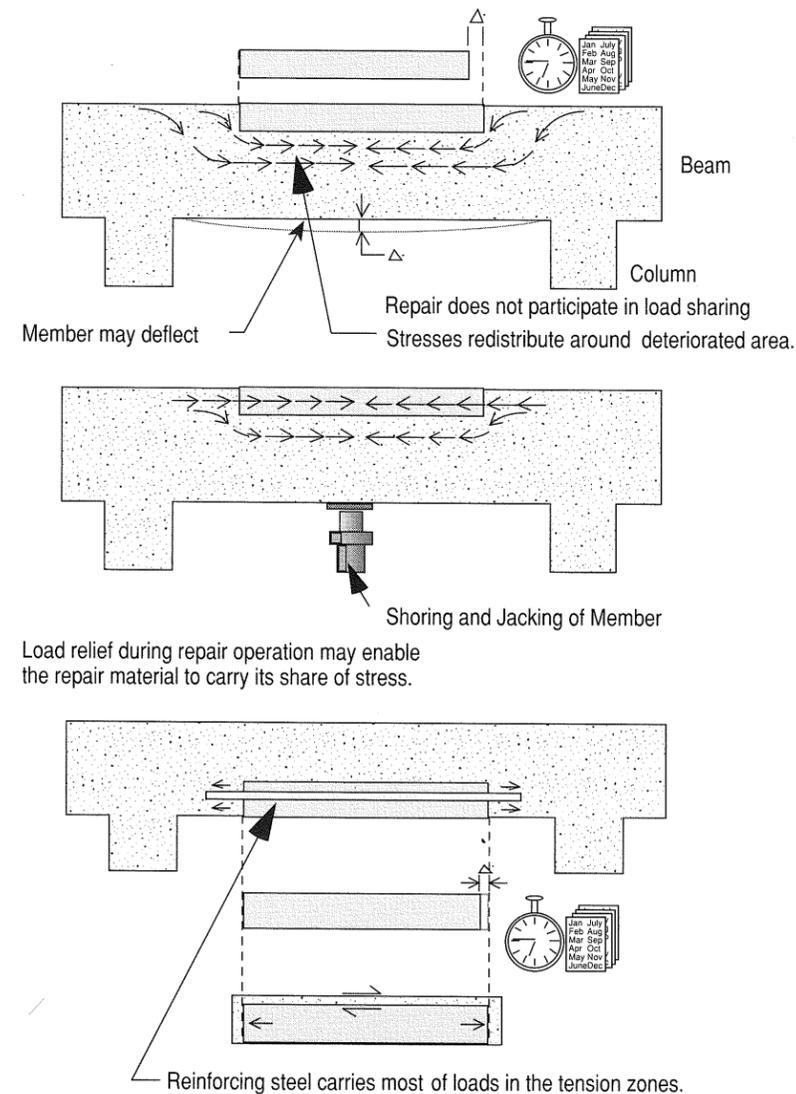
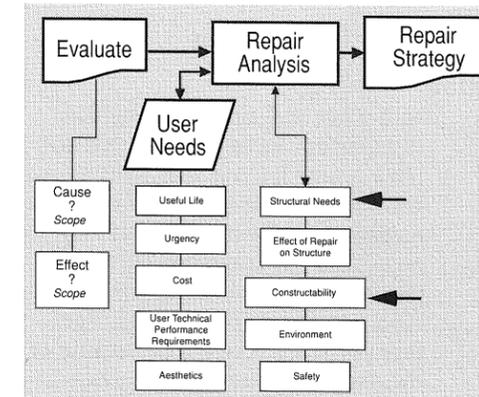
## Column Repair

Columns carry compressive loads. After surface deterioration, compressive loads within the column are redistributed around the affected area, increasing the stress level in the remaining cross-section. A surface repair will not carry its share of stress unless the compressive loads are removed from the column during repair operations. Another factor that affects the ability of the repair to carry the expected proportion of the load, is drying shrinkage of the repair material. Drying shrinkage reduces the volume of repair material relative to the existing concrete, and as a result, the surface repair is not filling the originally prepared space. Excessive drying shrinkage is evident when tension cracking appears on the surface of the repair. This topic is discussed in more detail in the section, "Surface Repair Material Requirements."

### Procedure for placing loads in repair materials

1. Remove loads from member by appropriate shoring and jacking during repair procedure and maturity of repair materials.
2. Select extremely low drying shrinkage repair materials (See note).
3. Select repair materials with low creep values over anticipated environmental conditions.
4. Select repair materials with a compatible stress-strain (E) relationship to the existing concrete.

*Note:* If the repair material has drying shrinkage of 500 microstrains, it will take an additional compressive strain of 500 microstrains in the member to begin the process of making the repair load carrying.



## Stress Distribution in Flexural Members Compression Zone

Deterioration in compression zones of flexural members results in redistribution of stress to the remaining sound concrete section. Significant section loss may result in overstress and excessive deflection. Removal of loads during repair operations allows the repair to carry the expected proportion of the load.

## Stress Distribution in Flexural Member's Tension Zone

Deterioration in tension zones of flexural members exposes tensile steel reinforcement. Most, if not all, tension is carried by the reinforcing steel. Loads do not usually redistribute around the deteriorated area unless the tension steel has lost cross-section in the corrosion process. If the steel has lost section, excessive deflections may result. During the repair process, relief of tension loads is desirable and is usually accomplished by temporary support of the affected member. Active shoring (shoring that carries the acting dead and live loads of the member) will allow for repair of damaged reinforcing bars at a low stress level. After completion of repairs and removal of shoring, the repaired bars will be able to carry the original loads.

# Cause/Effect Design Error

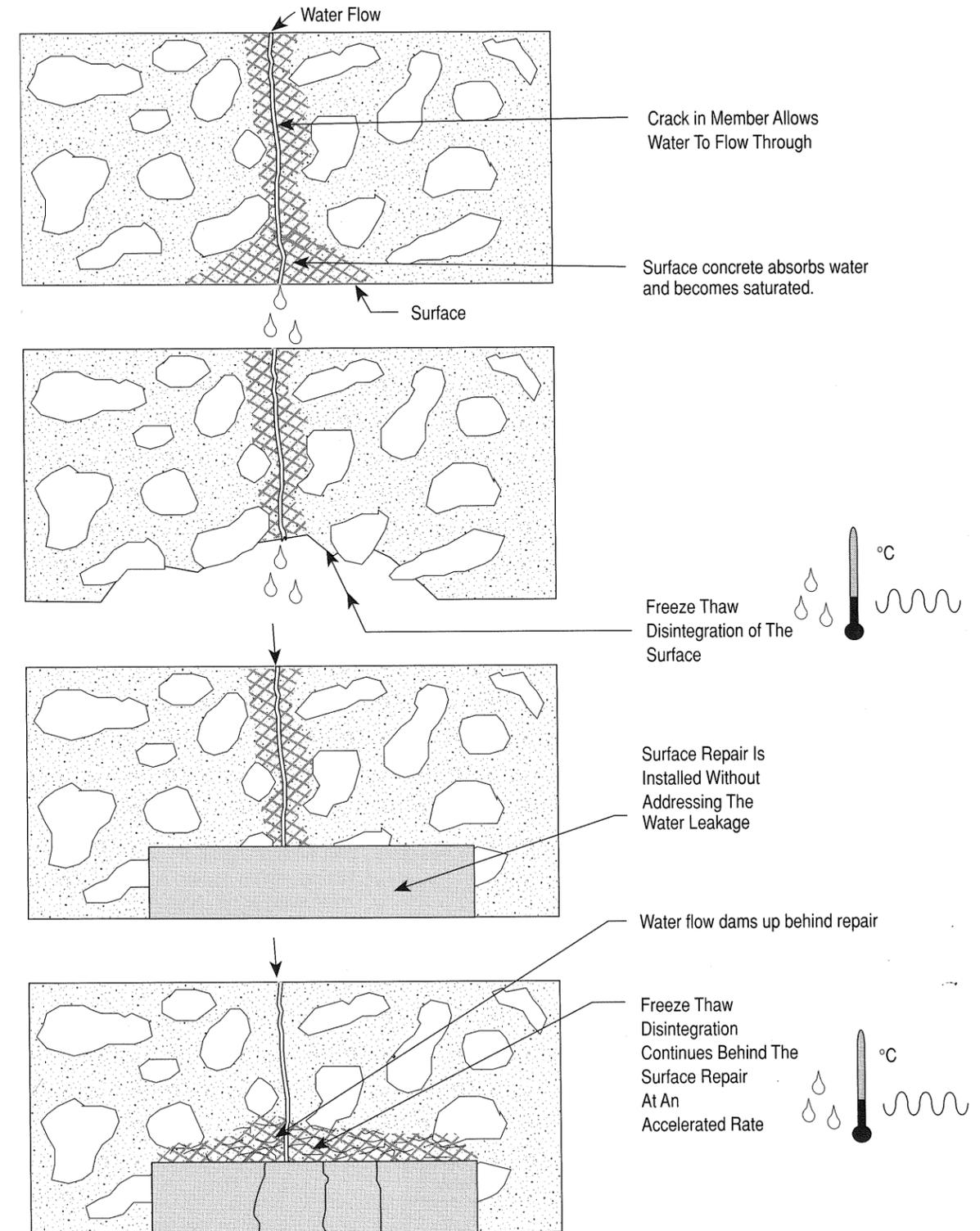
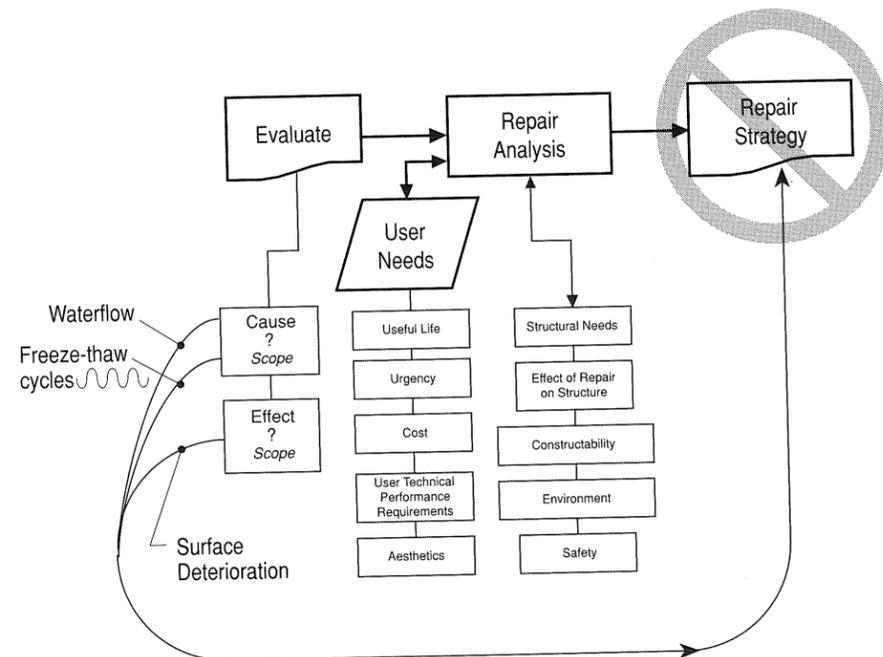
## Repair of Surface Freeze-Thaw Deterioration Without Removing the Cause

Freeze-thaw damage to concrete surfaces is common. The effect is surface disintegration; the cause is water saturation of the porous concrete matrix and freeze-thaw cycles.

A common problem found with repair of freeze-thaw damaged concrete where the source of moisture is from within the member, is continued disintegration behind the surface repair. Internal sources of moisture are typically found in structures such as retaining walls, downstream faces of dams, lock walls, and water retaining tanks. Water under a pressure head will attempt to follow a path to a lower pressure head. Paths are found through cracks, construction joints, expansion joints, and in some cases, porous concrete. Concrete adjacent to a water path may become saturated

with water and, upon freezing, may disintegrate. Surface repairs that do not stop the internal flow of water into concrete are susceptible to freeze-thaw damage and may have a short life because of the continued freeze-thaw disintegration behind the surface repair. In some cases the disintegration process is accelerated because of the damming effect of the surface repair on the free flow of water moving through the structure.

When this condition exists, internal water flow should be cut off via grouting, external waterproofing techniques or drainage systems that route the flow of water through the structure. Other techniques utilize deep surface repairs, that place the bond line below the frost line.





## Additional Sources of Information

Johnson, S.M., Deterioration, Maintenance and Repair of Structures, McGraw-Hill Book Co., New York, 1965.

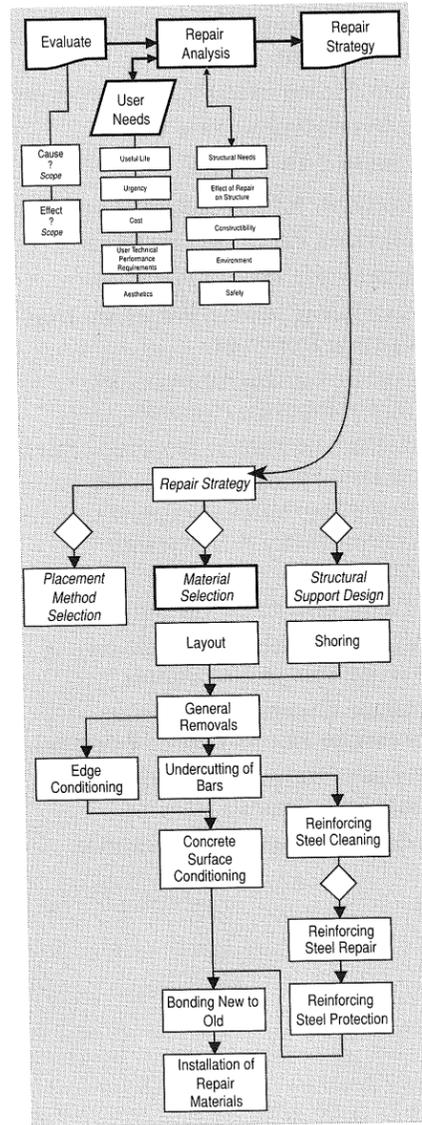
Evaluation and Repair of Concrete Structures, Engineer Manual EM 1110-2-2002, U.S. Army Corps of Engineers, 1986.

## Section 2: Material Requirements

### **The following topics are covered in this section:**

Introduction to Material Requirements  
Selection Process Flow Chart  
Checklist, User Needs  
Checklist, Service/Exposure Conditions  
Checklist, Placement Conditions  
Establishing Material Properties:  
Establishing Material Properties: Load Carrying Properties  
Establishing Material Properties: Service/Exposure Properties  
Establishing Material Properties: External Load Properties  
Establishing Material Properties: Constructibility & Appearance Properties  
Volume Change Effects: Introduction  
Volume Change Effects: Summary of Volume Change Mechanisms  
Volume Change Effects: Drying Shrinkage Process Desired Properties  
Volume Change Effects: Selecting Low Shrinkage Materials  
Additional Sources of Information

# Introduction to Materials Requirements



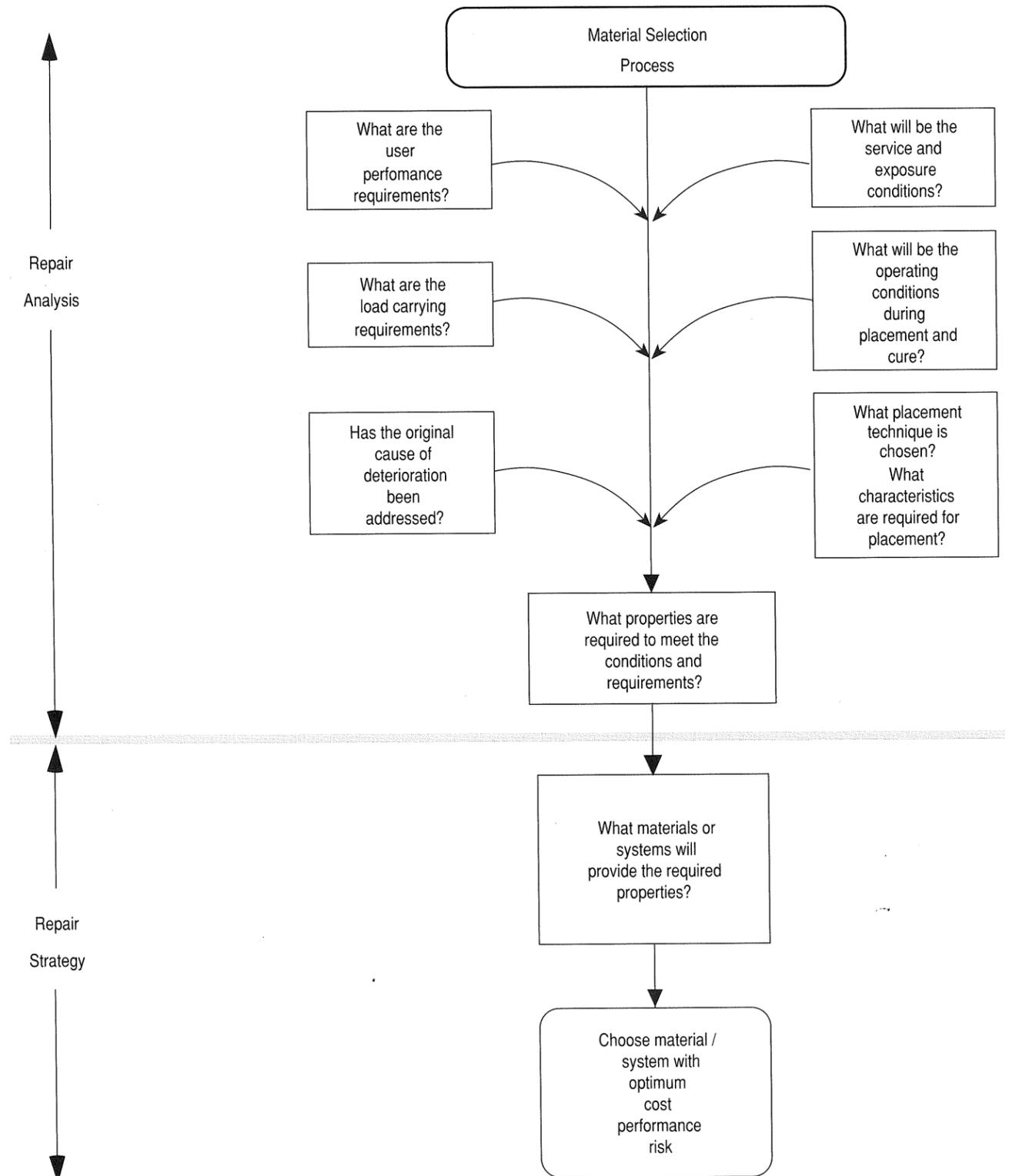
## Establishing Criteria for Surface Repair Materials

Selecting repair materials for surface repair is an important and complex process involving an understanding of what is required of the repair by the owner (user) and engineer, service and exposure conditions, and installation technique. After requirements are established and material properties are defined, the selection of specific materials can be made. In some instances, more than one material or system of materials will satisfy the established requirements. Final selection of materials is made based on the relationship between cost, performance and risk.

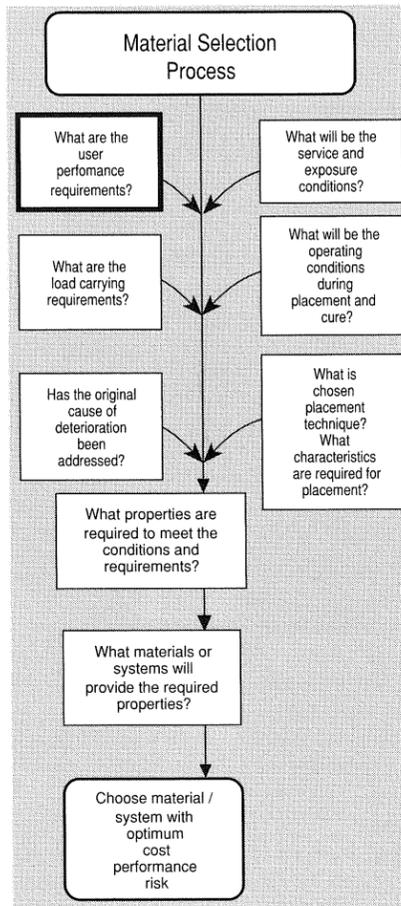
Selecting repair materials requires an understanding of material behavior in the uncured and cured states in the anticipated service and exposure conditions. One of the greatest challenges facing the successful performance of repair materials is their dimensional behavior relative to the substrate. Relative dimensional changes cause internal stresses within the repair material and within the substrate. High internal stresses may result in tension cracks, loss of load-carrying capability, delamination or deterioration. Particular attention is required to minimize these stresses and to select materials that properly address relative dimensional behavior.

Another difficult challenge is selecting surface repair materials for structural (load-carrying) applications. Many would like the new repair material to assume the stress level which existed originally. There are two obstacles to achieving 100% repair efficiency (repair efficiency = amount of stress carried by repair as compared to original concrete stress level). First, how is the repair material loaded initially? Are loads removed from the structure during repair? Second, how will the dimensional behavior relative to the substrate affect the repair's stress level? It is unlikely that one will find materials that fill the repair cavity completely, do not shrink during cure, and behave in the same way as the substrate when subjected to loads, temperature and moisture change. Selecting materials is a job of compromise!

# Selection Process Flow Chart



# Checklist, User Needs



## What is the required appearance?

	Yes	No	Comments
Repair hidden			
Repair visible			
Crack free			
Surface texture			

## How will the repair work interfere with the use of structure?

Turn around time

## What is *expected life* of repair?

How long

Maintenance interval

## What is tolerance for a repair failure?

Type of failure—

cracking  disintegration  delamination  separation

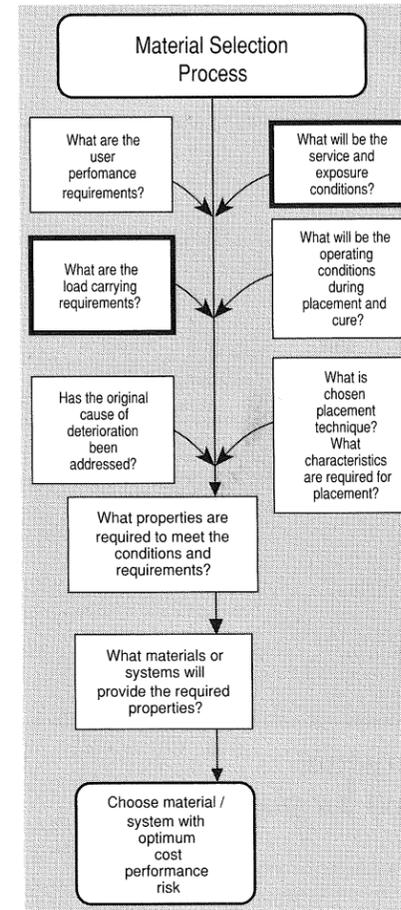
Effect of failure on personal injury

Effect of failure on process interruption

Effect of failure on structural performance

Effect of failure on environment

# Checklist, Service/Exposure Conditions



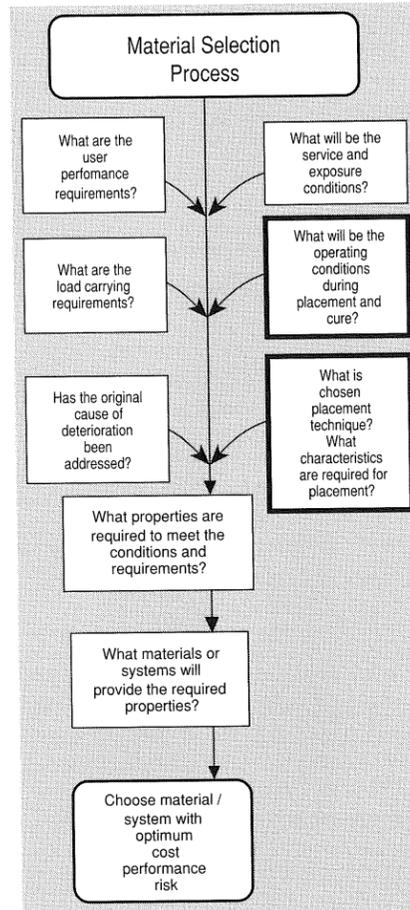
## What are the load carrying requirements?

Dead loads	<i>Refer to surface repair analysis, strategy and design section.</i>
Live loads	

## What will be the service/exposure conditions surrounding the material?

Atmospheric gases <input type="checkbox"/> Yes <input type="checkbox"/> No	Type			
	Concentration			
	Duration			
Chemicals in contact <input type="checkbox"/> Yes <input type="checkbox"/> No	Frequency			
	Type			
	Concentration			
UV exposure <input type="checkbox"/> Yes <input type="checkbox"/> No	Duration			
	Frequency			
	Moisture conditions <input type="checkbox"/> Yes <input type="checkbox"/> No	Duration		
Temperature <input type="checkbox"/> Yes <input type="checkbox"/> No	Frequency			
	Operating Range			
	Duration			
	Frequency			
	Freeze-Thaw Cycles			
External loading <input type="checkbox"/> Yes <input type="checkbox"/> No		<input type="checkbox"/> Yes	<input type="checkbox"/> No	Comment
	Wheel			
	Pedestrian			
	Static			
	Impact			
	Liquids—static			
	Liquids—moving			

# Checklist, Placement Conditions



## What will be the operating conditions during placement and curing?

Access	
Wind	Wind velocity
Temperature	Substrate
	Surrounding environment
Moisture	Substrate
	Environment
Turn-around time	
Loading	Vibrations
	Deflection

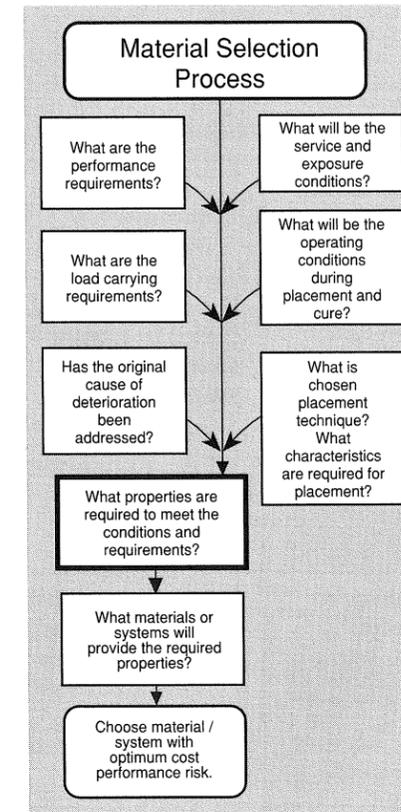
## What is chosen placement technique? What characteristics are required for placement?

Flowability	
Non-sag	
Set time	

## What is geometric configuration of repair?

Exposed surface area	
Thickness of repair	
Size of exposed reinforcing bars/wwf	
Spacing of reinforcing bars	
Clearance between reinforcing bars and substrate	
Clearance between reinforcing bars and exposed surface	

# Establishing Material Properties

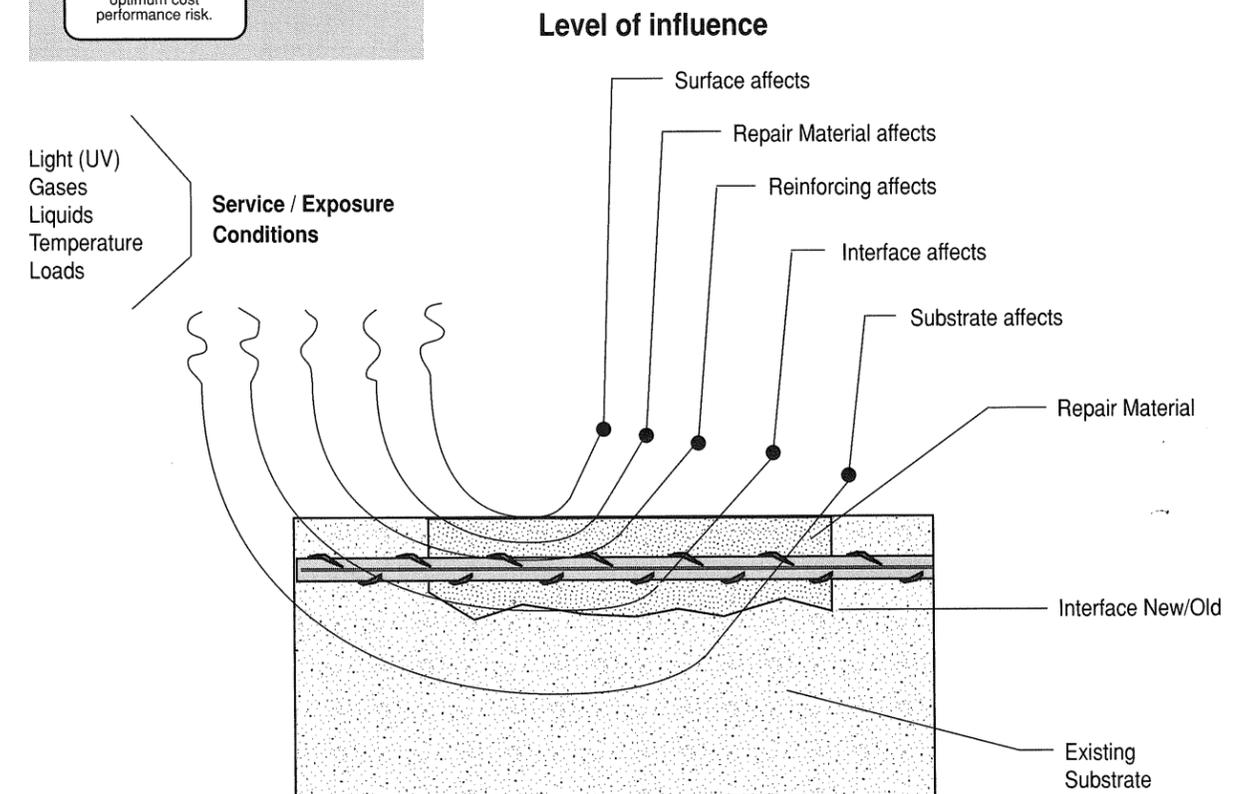


Selecting repair materials that will successfully perform under anticipated service and exposure conditions requires an understanding of how the service and exposure conditions affect the repaired member (new repair material, bond, substrate). For each service/exposure condition, a response (an effect) is generated. The response may occur at different levels (locations) within the repaired member, including the surface, repair material, reinforcing steel, bond interface and the substrate.

Example 1: Condition: Calcium chloride and moisture deposited on surface. Response: Surface of repair is subjected to chloride. Over time, the chloride will penetrate to the level of reinforcement; corrosion will result.

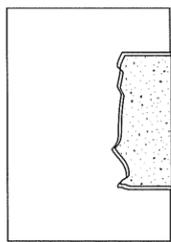
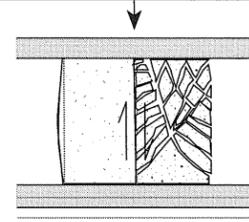
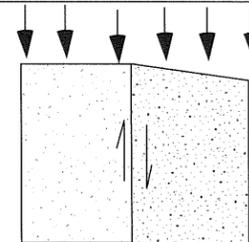
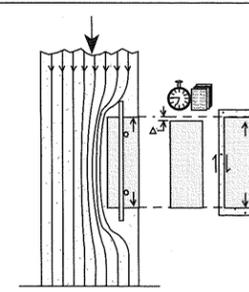
Example 2: Condition: Steel wheel load travels over repaired joint nosing. Response: Surface of repair is subjected to impact loading (local crushing at corner); repair material transfers load to bond line at substrate. (Bond is stressed; delamination may occur.)

Understanding the repair material's response to a given service/exposure condition helps in *determining required material properties* for a successful repair program. The following pages outline particular structural (load-carrying), service/exposure, constructibility, and appearance conditions typical to many repair situations. The following tables present positive and negative properties to be considered in the selection of a successful repair material.



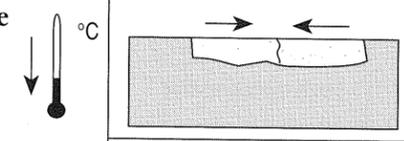
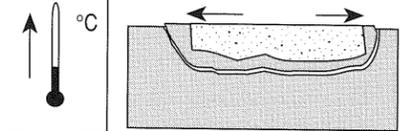
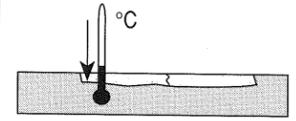
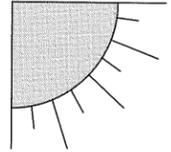
# Establishing Materials Properties

## Load-Carrying Properties

Goal (performance requirements)	Results if the wrong material is selected (undesirable response)	Look for these properties	Avoid these!
<b>Bond to substrate</b>	 <p>Loss of bond, delamination, detachment of repair from substrate</p>	Tensile bond, low internal stress	High internal stress caused by thermal incompatibility, drying shrinkage*
<b>Load carrying as intended by the engineer</b>	 <p>Does not carry loads as anticipated, overstressing either substrate or repair material</p>	Equal modulus of elasticity with substrate	Low or high modulus of elasticity compared to substrate
	 <p>Carries loads initially, but over time, the repair relaxes under creep deformation.</p>	Extremely low compression creep	High compression creep
	 <p>Drying shrinkage causes material to lose volume, reducing its ability to carry compressive loads.</p>	Extremely low drying shrinkage*	Shrinkage*

\*Refer to Volume Change Effects included at the end of this section.

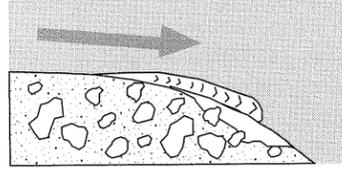
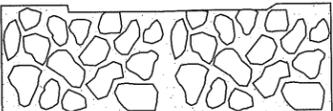
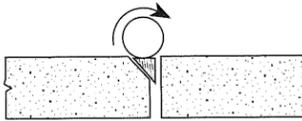
## Service/Exposure Properties

Goal (performance requirements)	Results if the wrong material is selected (undesirable response)	Look for these properties	Avoid these!
<b>Temperature changes</b>	 <p>Shrinkage stresses cause cracking in repair material.</p>	Equal thermal coefficient to substrate*	Unequal thermal coefficient to substrate
	 <p>Compressive stresses in substrate causing spalling.</p>	Equal thermal coefficient to substrate*	Unequal thermal coefficient to substrate
<b>Temperature changes in repair material during placement</b>	 <p>Shrinkage stresses in repair material causing cracking.</p>	Low exotherm during placement and cure	High exotherm during placement and cure
<b>Atmospheric gases</b>	 <p>Moisture conditions</p>	Corrode reinforcing steel, disintegrate cement matrix.	High permeability, cracking in repair material
<b>Chemical contact</b>	 <p>Moisture conditions</p>	Corrode reinforcing steel.	High permeability, cracking in repair material
	Disintegrate cement matrix.	Chemical resistance to substance at surface or internally	Lack of chemical resistance
<b>UV exposure</b>	 <p>Change in mechanical properties of repair material, changes to modulus of elasticity.</p>	High UV resistance at surface	Low UV resistance
<b>Moisture conditions, saturation</b>	 <p>Freeze thaw cycles</p>	Dissintegration of cement matrix.	High permeability
<b>Moisture conditions</b>	 <p>Changes in internal moisture</p>	Shrinkage stresses, causing cracking.	High permeability, high drying shrinkage*

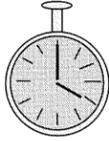
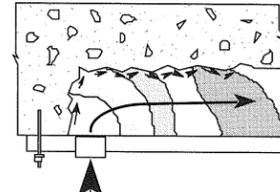
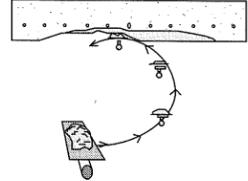
\*Refer to volume change affects included at the end of this section.

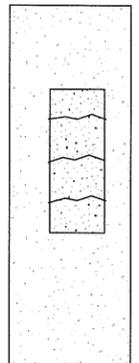
# Establishing Material Properties

## External Loads/Properties

Goal (performance requirements)	Results if the wrong material is selected (undesirable response)	Look for these properties	Avoid these!	
Moving liquids  Moving liquids and suspended solids	Erosion of surface  	High density	Low density	
		High compressive	Low compressive	
		High tensile	Low tensile	
		High density	Low density	
		High compressive	Low compressive	
		High tensile	Low tensile	
Vehicle wheels	Erosion and abrasion of surfaces  	Abrasion damage to surface	High density, high compressive strength	Low density, low compressive strength
		Edge spalling at joints	High compressive, tensile and bond strength, tensile anchorage into substrate	Low compressive, tensile and bond strength
		Spalling	High tensile strength, internal tensile reinforcement	Low tensile strength
Impact		High compressive strength	Low compressive strength	
		Low modulus of elasticity	High modulus of elasticity	
		Loss of bond	High bond strength, tensile anchorage into substrate	Low bond strength

## Constructibility & Appearance Properties

Goal (performance requirements)	Look for these properties	Avoid these!
Constructibility  Turn-around time  	Rapid strength gain	Slow strength gain
Flowability  	High slump	Low slump
Non sag  	High internal cohesion, high adhesive grip	Low internal cohesion, low adhesive grip
Forgiving  "Murphy's Law"	Simple formulation, redundant	Complex formulation, dependent reactions

Goal (performance requirements)	Results if the wrong material is selected (undesirable response)	Look for these properties	Avoid these!	
Appearance  		Cracking of surface from drying shrinkage*	Low drying shrinkage,* flexible surface membrane	High drying shrinkage*
		Cracking of surface in plastic stage	Low exotherm	High exotherm
		Low surface water loss during placement	High surface water loss during placement	

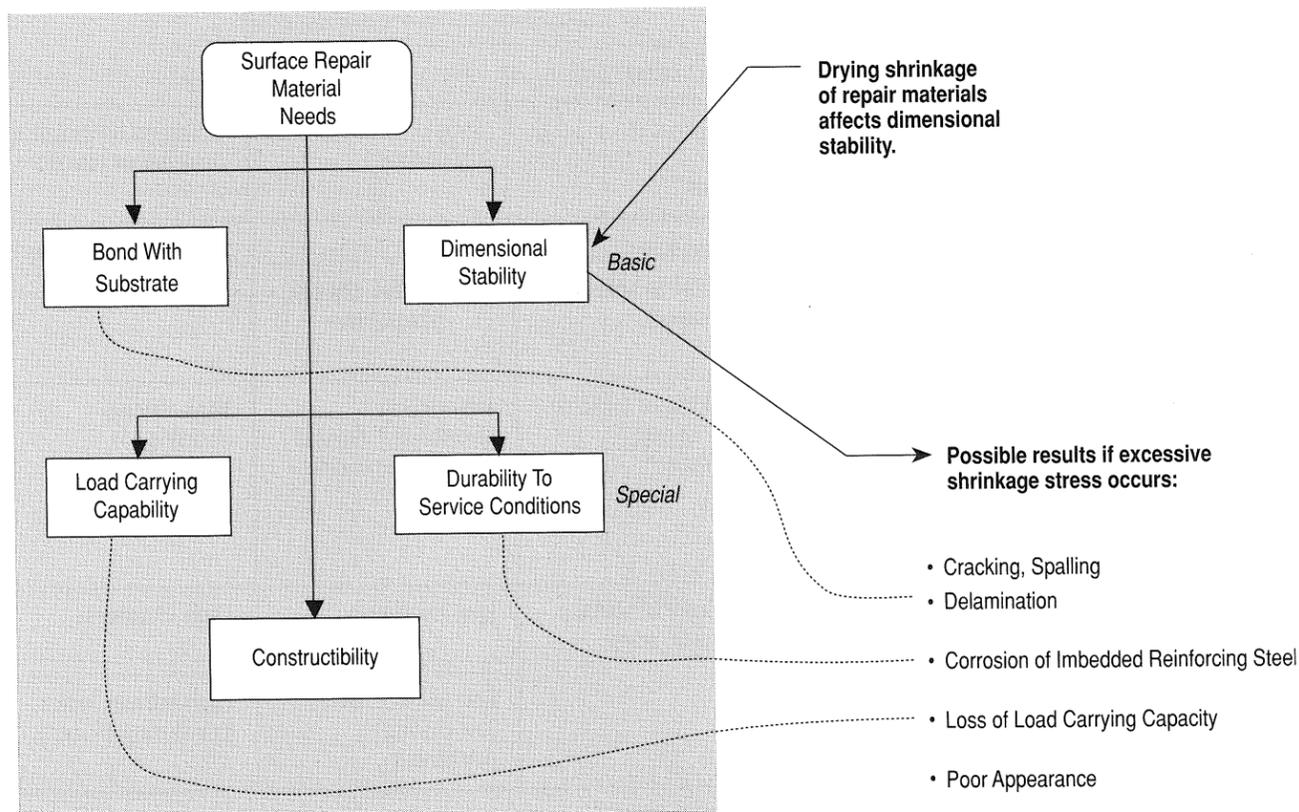
\*Refer to volume change affects included at the end of this section.

# Volume Change Effects

## Introduction

One of the greatest challenges in the selection of repair materials is maintaining their relative dimensional compatibility with the substrate. Moisture-related volume changes in repair materials (drying shrinkage) cause many repair failures: shrinkage cracking, delamination, loss of load carrying capacity, corrosion of imbedded reinforcing steel, and poor appearance. Selection of repair materials with minimal drying shrinkage is critical for durable repairs.

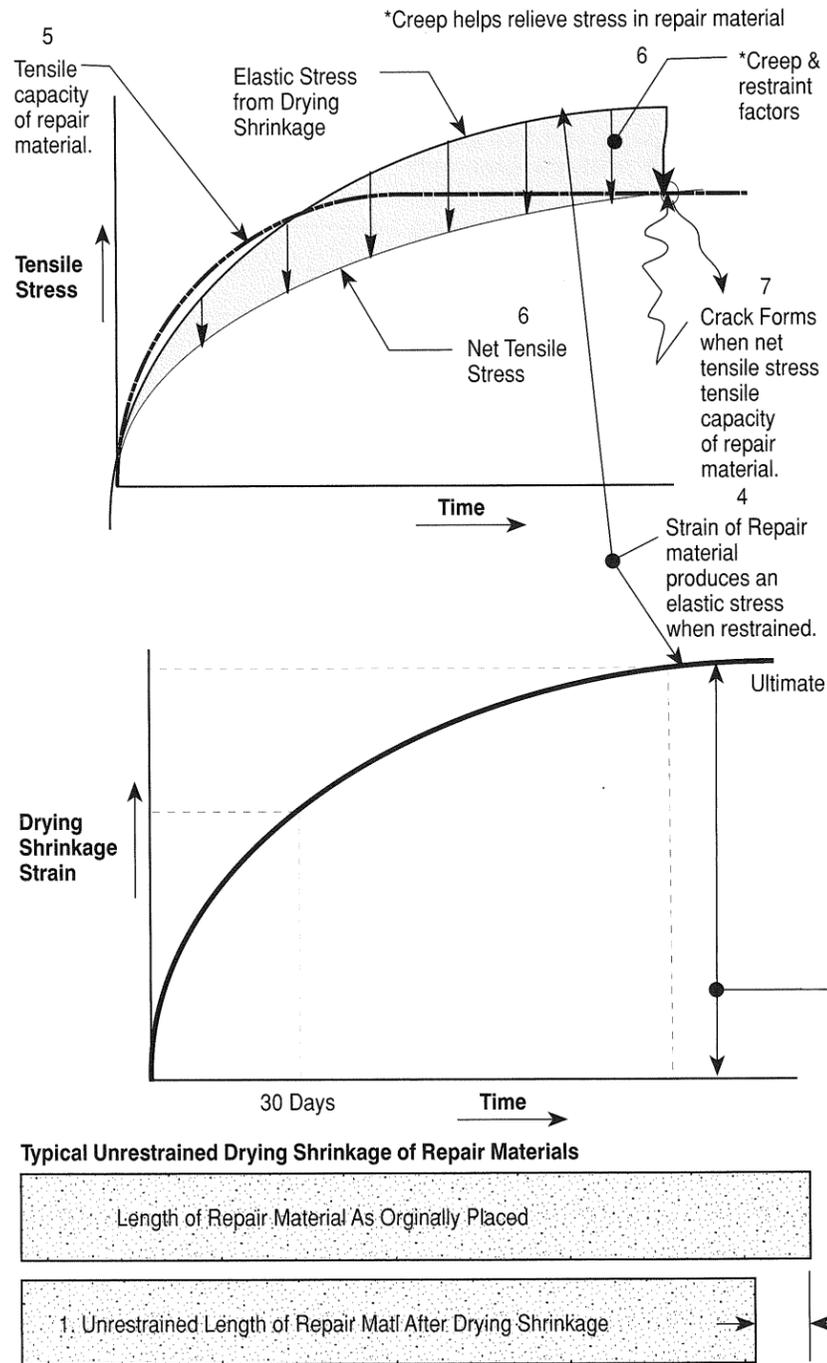
Selecting repair materials with minimal drying shrinkage requires an understanding of the drying shrinkage process. Most repair materials that are mixed and placed have an excessive amount of water above that which is required for hydration. As the repair is allowed to dry out and assume the humidity of the surrounding environment, the material shrinks in volume and tensile stress begins to accumulate in the repair material. Wet curing of cementitious materials will postpone the start of the drying process, and may cause slight expansion. The repair material resists cracking until the stress exceeds its tensile capacity (refer to accompanying illustration of the drying shrinkage process).



## Summary of Volume Change Mechanisms

	$a_n$ $a_o$ <b>Thermal Coefficient Of Expansion (a)</b>	$a_n = a_o$ No stress occurs.
<p>Given a temperature change evenly distributed through the materials, the following stresses will occur according to the relationship of the Thermal Coefficients of the new and old materials.</p>	<p>If <math>a_n &gt; a_o</math> or <math>a_n &lt; a_o</math></p>	<p>Shear bond is stressed.</p>
	<b>Modulus Of Elasticity (E)</b>	<p>If <math>E_n = E_o</math> No stress occurs.</p>
<p>Given an evenly distributed load, the following stresses will occur according to the relationship of the Modulus of Elasticity of the new and old materials.</p>	<p>If <math>E_n &gt; E_o</math> or <math>E_n &lt; E_o</math></p>	<p>Elastic Brittle</p> <p>Shear bond is stressed. Brittle material may become overstressed.</p>
	<b>Drying Shrinkage (S<sub>n</sub>)</b>	<p>If <math>S_n = 0</math> No stress occurs.</p>
<p>Assuming the old material has already developed a stable drying shrinkage volume, the following stresses will occur according to the amount of drying shrinkage of the new material.</p>	<p>If <math>S_n &gt; 0</math></p>	<p>Shear bond is stressed. Loads carried by repair are reduced; tension in repair material.</p>
	<b>Creep (C<sub>n</sub>)</b>	<p>If <math>C_n = 0</math> No stress occurs.</p>
<p>Assuming the old material has already developed a stable creep volume, then the following stresses will occur according to the amount of creep occurring in the new material.</p>	<p>If <math>C_n &gt; 0</math></p>	<p>Shear bond is stressed; loads carried by repair are reduced.</p>

# Volume Change Effects



## Dry Shrinkage Process

1. Repair materials with drying shrinkage will contract in volume if unrestrained.
2. Drying shrinkage takes time. Most of the shrinkage will take place in the first 30 days.
3. Repair materials are not free to shrink because they are bonded to an existing substrate.
4. Since the shrinkage (strain) is restrained from occurring by the substrate, the repair material will accumulate internal tensile stress.
5. The repair material has no tensile strength when first placed, but begins to increase tensile strength as the material matures.
6. As the repair material is stretched (tensile stress) it also relaxes from tensile creep factors reducing the tensile stress to a net tensile stress.
7. The process is a "horse race" between the tensile capacity of the repair material and the net tensile stress in the repair material. If the net tensile stress exceeds the tensile capacity, the repair material will lose the race and crack.

## Selecting Low Shrinkage Materials

Drying shrinkage is a critical factor in selecting repair materials for any application which requires a bonded (integral with substrate) condition. It is necessary to select materials with low to zero drying shrinkage.

### What is low shrinkage?

### How do you find repair materials with low shrinkage?

These are difficult questions to answer. First, let's look at defining shrinkage for repair materials.<sup>1</sup> In 1987, Alberta Transportation and Utilities conducted an evaluation program for concrete surface repair materials. In this study 46 different repair materials were evaluated for various properties. One of the properties investigated was drying shrinkage. The ASTM C 157 shrinkage test was performed by one independent testing laboratory. The following chart presents test results sorted from the lowest shrinkage on the left to the highest shrinkage on the right. *Surprising Results!* By sorting the test results from low to high shrinkage, a cross section of the industry's repair materials was available for comparison. The shrinkage properties of the majority of repair materials far exceed the shrinkage value of normal weight concrete (0.05% @ 30 days<sup>2</sup>). These percentages of shrinkage do not sound large, but their effects are dramatic. Restrained shrinkage induces tensile stresses in the repair material and compressive stresses in the sub-

strate. Most repair materials have a tensile capacity of 200-1000 psi (1.4-6.9 MPa), depending upon age and design. Shrinkage of 0.025% translates into 1,000 psi (6.9 MPa) tensile stress (assuming an Elastic Modulus of  $4 \times 10^6$  psi ( $28 \times 10^3$  MPa)).

For discussion purposes the author has taken the liberty of classifying shrinkage of materials in three basic categories: low, moderate and high. Any material with shrinkage of less than normal weight concrete (0.05%) is called *low shrinkage*. Materials with shrinkage between 0.05% and 0.10% are called *moderate shrinkage*. Materials with shrinkage greater than 0.10% are called *high shrinkage*. At the present time, the industry cannot require the manufacturers of repair materials to meet a certain maximum shrinkage value because the basis for acceptable shrinkage value has not been established.

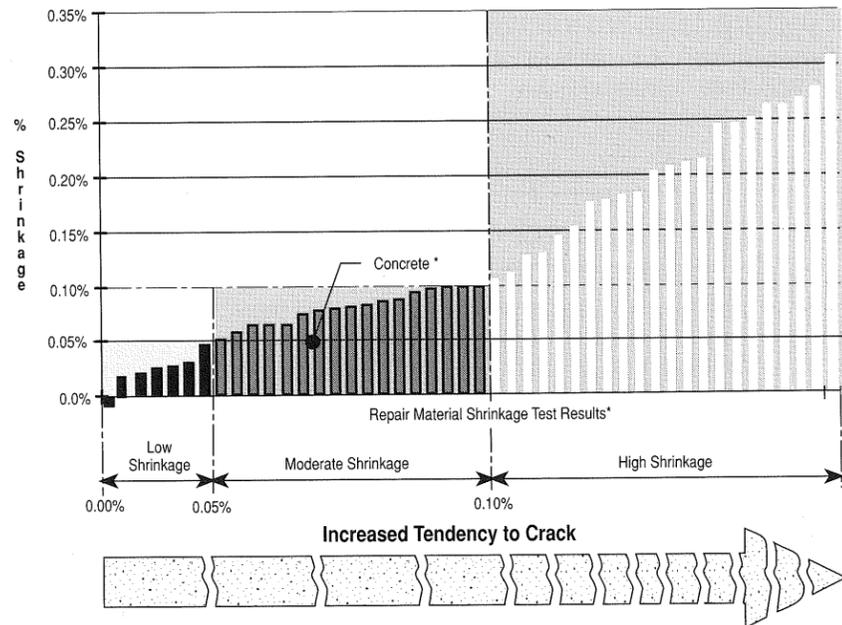
However, it is obvious that the goal for designing a surface repair material's drying shrinkage properties should be 0.00%.<sup>3</sup>

<sup>1</sup>Carter, P. Gurjar, S., Alberta Concrete Patch Evaluation Program, Alberta Transportation and Utilities, Edmonton, Canada, 1987.

<sup>2</sup>*Volume Changes of Concrete*, Concrete Information, Portland Cement Association, Revised Chapter 12, Design and Control of Concrete Mixtures, p. 2.

<sup>3</sup>Emmons, P.H., McDonald, J.E., Vaysburd, A.M., Some Compatibility Problems in Repair of Concrete Structures—A Fresh Look, Proceedings, 3rd International Colloquium on Material Science and Restoration, Germany, 1992.

# Volume Change Effects



Shrinkage test results, Alberta Concrete Patch Evaluation Program, Report No. ABTR/RD/RR-87/05

		Water/Cement Ratio				
		0.4	0.5	0.6	0.7	
Aggregate/ Cement Ratio	3	.08	.12			
	4	.055	.085	.105		High Shrinkage
	5	.04	.06	.075	.085	
	6	.03	.04	.055	.065	Moderate Shrinkage
	7	.02	.03	.04	.05	Low Shrinkage

Shrinkage after 180 days in RH50%, 21°C, 5" square cross-section.  
Source: Lea, P.M., *The Chemistry of Cement and Concrete*, third edition, Edward Arnold (publishers) Ltd., 1970

# Additional Sources of Information

## Selecting Low Shrinkage Materials

Process for Screening Repair Materials for Low Drying Shrinkage:

-Select materials which demonstrate drying shrinkage close to 0.00%. Materials in the low category, 0 to 0.05%, have less risk of cracking than materials in the moderate category, 0.05% to 0.10%. Avoid materials above 0.10%, unless special conditions exist.

Recommendations for Reducing Drying Shrinkage of Surface Repair Materials:

- Use mixes with maximum aggregate content.
- Use clean, sound aggregates.
- Use aggregate size as large as practical.
- Avoid conditions that increase water demand, such as high temperature mixes.
- Use minimum required cement contents to meet strength requirements.
- Use proper wet curing techniques that provide reduced early shrinkage.
- Use placement techniques that allow for optimum aggregate loadings (size and amount).

The table at left shows the effects of various water/cement/aggregate ratios on shrinkage.

ACI 209R-82, Prediction of Creep, Shrinkage and Temperature Effects in Concrete Structures.

Warner, J., Selecting Repair Materials, *Concrete Construction*, Vol. 29, No. 10, Oct. 1984, pp. 865-871.

Plum, D.R., The Behavior of Polymer Materials in Concrete Repair, and Factors Influencing Selection, *The Structural Engineer*, England, Sept. 1990, pp. 337-345

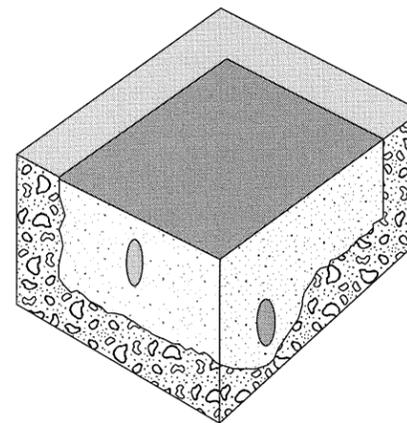
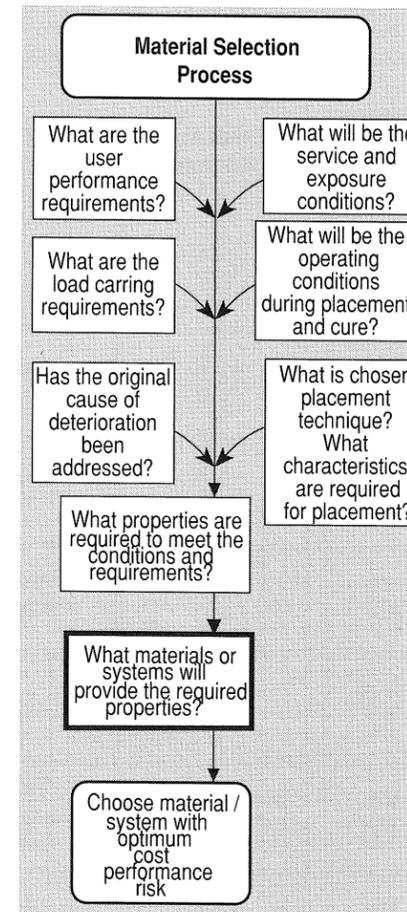
Mays, G. and Wilkenson, W., Polymer Repairs to Concrete: Their Influence on Structural Performance, Katherine and Bryant Mather International Conference on Concrete Durability, ACI SP-100, Vol. 1, 1987, pp. 351-376.

# Section 3: Material Selection

**The following topics are covered in this section:**

- Introduction to Material Selection
- Summary of Repair Materials
- Repair Material Ingredients

## Introduction to Material Selection



Selecting materials that meet all necessary properties established by conditions and requirements is difficult. Some require load-carrying capability along with durability, and other situations require only durability. Most materials used for deep repairs (greater than 1.5"/38 mm) utilize portland cement binders and well proportioned aggregates. Durability for these materials can be added using special pozzolans (microsilica), polymers (latex), or admixtures that reduce permeability. Most of the latex-modified, low w/c, and microsilica-modified concretes and mortars can be easily used once one has experience in how these materials behave during placement and cure. The use of portland cement-based repair materials (site-batched, ready mix or bagged) requires special attention to shrinkage and curing. All materials should have reliable shrinkage test data to screen and select for low shrinkage materials. (See "Material Requirements" section.)

Curing of portland cement-based materials is critical in reducing early shrinkage and for future long-term performance. In structural applications, it is important to understand the repair material's response to loads. Two important properties for load-sharing applications are elastic modulus and compressive creep. Elastic modulus property can be easily obtained. However, compressive creep values are much more difficult to obtain.

It is important to understand the exposure and service conditions to which the selected materials will be subjected. It has been demonstrated that the addition of latex (SBR) to modify cement-based repair materials causes the flexural creep value to soar under high humidity (90%) conditions.<sup>1</sup> Most of the

<sup>1</sup>Plum, D.R., Materials—Why They Fail, Construction Maintenance & Repair, Sept.-Oct. 1991, England, pp. 3-6.

reported materials creep properties evaluated under 50% relative humidity and therefore appear acceptable.

Avoid the use of materials that contain unknown ingredients or where new unproven technology is being used, except on experimental or pilot type projects. Use of materials containing gypsum results in uncontrolled expansion and extremely low durability when subject to moisture. Care should be exercised when using high exothermal materials such as magnesium phosphate-based materials. The high heat of hydration can cause thermal cooling stresses.

Other state of the art materials have been found to contain high amounts of alkali material which may result in early deterioration caused by alkali/silica reactions. Some materials are sensitive to the method of application. Latex modifiers have proven exceptional in overlays, but, when used in some applications involving dry mix shotcrete, have resulted in interbond failure. Failure was caused by latex films forming on unfinished surfaces. The shotcrete process uses high velocity air which accelerates the formation of bond-inhibiting latex film.

Polymer concretes and mortars are the other major class of materials used to repair concrete surfaces. Epoxies and acrylics blended with graded aggregates produce strong and chemically resistant materials. They can be used for thin application or thick applications where the service/exposure conditions do not cause dimensional incompatibility problems. Polymer materials have high thermal coefficients as compared to concrete. Except for thin surface coating systems, they should not be used in solar exposure situations.

The following pages outline the most common repair materials, along with their properties and limitations.

# Summary of Repair and Overlay Materials

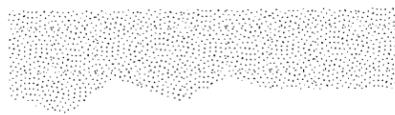
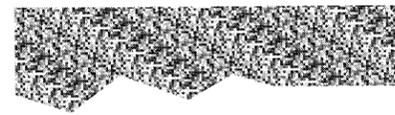
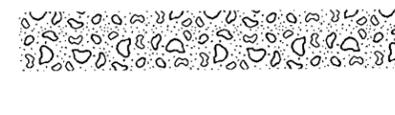
Materials	Ingredients			Application Requirements		
	Binder	Additive	Admixture	Thickness Limitation in/cm	Installation Temperature °F/°C	Curing
Portland Cement Mortar	Portland cement		Water reducer. Air-entr.	$\frac{1.5-4}{3.8-10}$	$\frac{40-90}{5-32}$	Wet 7 days
Portland Cement Concrete	Portland cement		Water reducer. Air-entr.	$> \frac{1.75}{4.4}$	$\frac{40-90}{5-32}$	Wet 7 days
Microsilica Modified Portland Cement Concrete	Portland cement	Micro-silica	HRWR Air-entr.	$> \frac{1.25}{3.0}$	$\frac{40-90}{5-32}$	Wet 7 days
Latex Modified Portland Cement Concrete	Portland cement		Latex SBR	$> \frac{1.25}{3.0}$	$\frac{45-95}{7-35}$	Wet 3 days
Polymer Modified Portland Cement Mortar with Non-sag Filler	Portland cement	Non-sag fillers	Acrylic latex	$\frac{0.25-1.5}{0.6-3.8}$		
Magnesium Phosphate Cement Concrete	Magnesium phosphate cement			$> \frac{0.75}{1.9}$	$\frac{50-100}{10-40}$	Sheet 45 min.- 2 days
Preplaced-Aggregate Concrete	Portland cement	Pozzolans	Fluidifier	$> \frac{3.0}{7.6}$	$\frac{40-90}{5-32}$	Wet 7 days
Epoxy Mortar	Epoxy resin			$\frac{0.13-0.38}{0.4-1.2}$	$\frac{50-90}{10-32}$	4 hrs.- 2 days
Methylmethacrylate (MMA) Concrete	Acrylic resin			$\frac{0.25-0.50}{0.6-1.3}$	$\frac{20-120}{-6-50}$	1 hr.- 6 hr.
Shotcrete	Portland cement	Pozzolans	Water reducer. acceler. latex	$> \frac{0.5}{1.3}$	$\frac{40-90}{5-32}$	Wet 7 days

* Drying Shrinkage	Coeff. of Thermal Expansion	Material Properties									Comments
		Compressive Strength				Elastic Modulus psi/MPa	Permeability (Concrete = 10)	Freeze-Thaw Resistance	Non-Sag Quality	Exo-therm	
		1 Hr.	1 Day	3 Days	28 Days						
Moderate	Equal to substrate	0	$\frac{650}{4.5}$	$\frac{2500}{17.2}$	$\frac{5000}{34.5}$	$\frac{3.4 \times 10^6}{2.3 \times 10^4}$	9	Good	Moderate	Low	
Low	Equal to substrate	0	$\frac{650}{4.5}$	$\frac{2500}{17.2}$	$\frac{5000}{34.5}$	$\frac{3.8 \times 10^6}{2.6 \times 10^4}$	9	Good	N/A	Low	
Low	Equal to substrate	0	$\frac{3000}{20.7}$	$\frac{4000}{27.6}$	$\frac{7500}{51.7}$	$\frac{4 \times 10^6}{2.8 \times 10^4}$	6	Good	Good	Low	
Low	Compat. w/substrate				$\frac{6000}{41.4}$	$\frac{2.5 \times 10^6}{1.7 \times 10^4}$	5	Excellent	N/A	Low	
Moderate	Compat. w/substrate		$\frac{1500}{10.3}$		$\frac{5000}{34.5}$	$\frac{2.5 \times 10^6}{1.7 \times 10^4}$	5	Excellent	Excellent	Moderate	
Moderate	Equal to substrate	$\frac{2000}{13.8}$	$\frac{6400}{44.1}$	$\frac{7000}{48.3}$	$\frac{8400}{57.9}$	$\frac{3.2 \times 10^6}{2.2 \times 10^4}$	9	Excellent	Low	High	ACI 304R-23
Very low	Equal to substrate	0	$\frac{500}{3.4}$	$\frac{2250}{15.5}$	$\frac{4500}{31}$	$\frac{3.8 \times 10^6}{2.6 \times 10^4}$	10	Good	N/A	Low	ACI 503.4
Low	(1.5-5) x concr.				$\frac{12000}{82.7}$	$\frac{2.2 \times 10^6}{1.5 \times 10^4}$	1	Excellent	Moderate	High	Vapor may cause problems in confined areas
Moderate	(1.5-5) x concr.	$\frac{4000}{27.6}$	$\frac{12000}{82.7}$		$\frac{12000}{82.7}$	$\frac{3 \times 10^6}{2 \times 10^4}$	1	Excellent	N/A	High	
Moderate	Equal to substrate	0	$\frac{800}{5.5}$	$\frac{3500}{24.1}$	$\frac{5000}{34.5}$	$\frac{3.8 \times 10^6}{2.6 \times 10^4}$	6	Good	N/A	Low	ACI 506R-90

\*Drying shrinkage: Low <0.05%  
 Moderate 0.05%-0.10%  
 High >0.10%

Note: The material properties shown in this table vary from manufacturer to manufacturer and are shown for comparison purposes only.

# Repair Material Ingredients

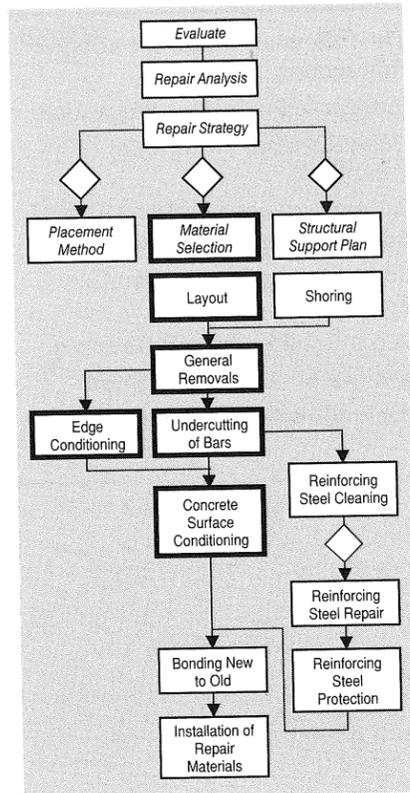
Ingredient	Description	Benefit
<p><b>Binder</b></p> 	<p>The binder is glue that binds all fillers and aggregates together to form a composite material. Binder materials include: Portland cement, other hydraulic cements, epoxy, acrylics.</p>	<p>Portland cements are used for most general repair work. Polymer materials such as epoxy and acrylics are used for special applications requiring chemical resistance, or very thin applications.</p>
<p><b>Fine Aggregate</b></p> 	<p>Aggregates are used to reduce binder volume and enhance mechanical properties. Fine aggregates may be used without the addition of large aggregates.</p>	<p>Fine aggregates properly graded reduce binder content and shrinkage. Special aggregates can be used to improve abrasion resistance. The shape of aggregates affects how well the material can be compacted and finished when used with trowels.</p>
<p><b>Coarse Aggregate</b></p> 	<p>Coarse aggregates more efficiently reduce overall binder volume than fine aggregates and enhance general mechanical properties.</p>	<p>Coarse aggregates reduce drying shrinkage. Special aggregates are used to enhance abrasion resistance.</p>
<p><b>Special Fillers</b></p> 	<p>Special fillers fill in spaces left by the fine and coarse aggregates. Some fillers (flyash, microsilica) replace some of the cement required. Fillers are also used to improve internal cohesion.</p>	<p>Microsilica increases the strength and reduces permeability.</p>
<p><b>Polymer Modifiers</b></p> 	<p>Polymer modifiers are used to enhance properties of the repair material. Latex (SBR) is the most common. Other modifiers include acrylic, PVA and epoxy emulsions.</p>	<p>Some polymers enhance the properties of the repair material. Latex is used to reduce permeability and increase bond strength with the substrate, and reduce modulus of elasticity.</p>
<p><b>Fiber Reinforcement</b></p> 	<p>Plastic or steel fiber reinforcement is used to add tensile strength and toughness to the repair material.</p>	<p>Fiber reinforcement provides control of shrinkage cracking. Steel, and in some cases plastic fiber, enhance toughness to impact and abrasion.</p>
<p><b>Misc. Chemical Modifiers</b></p> 	<p>Miscellaneous modifiers are used to enhance and modify behavior of the repair material. They include: accelerators, retarders, shrinkage-compensating additives, water reducers, flowability agents, expanding agents, and air-entraining admixtures.</p>	<p>Use of modifiers allows control of some properties of the uncured and cured materials.</p>
<p><b>Repair Material</b></p> 	<p>The repair material is a blend of binders, aggregates, fillers, and enhancers optimizing effectiveness, constructibility, durability, and predictability.</p>	<p>Material design should be kept simple. Do not use more ingredients than necessary. More complex materials generally cause more problems.</p>

# Section 4: Surface Preparation

**The following topics are covered in this section:**

- Introduction to Surface Preparation
- General Surface Preparation Procedures
- Surface Preparation: When Oxidized Reinforcement Is Encountered
- Recommended Layout of Surface Repairs
- Recommended Removal Geometry
- Removal Methods: Partial Depth
- Removal Methods: Full Depth

# Introduction to Surface Preparation

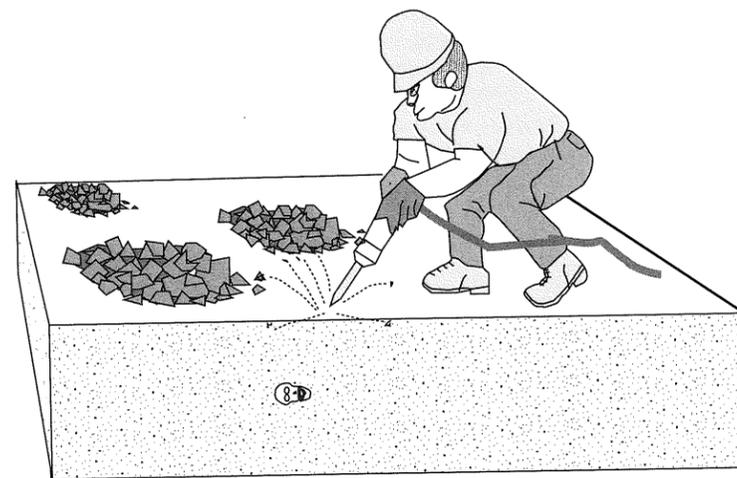


Surface repair involves the process of conditioning the existing concrete to receive repair materials. Conditioning is required to remove deteriorated, contaminated, or damaged concrete to provide surfaces that will promote bonding of the repair materials. The surface preparation process is one of the most critical phases of site work. Without proper understanding and care, the necessary requirements will most likely not be met.

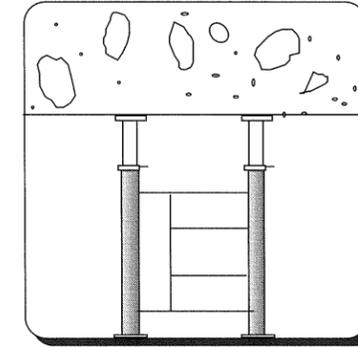
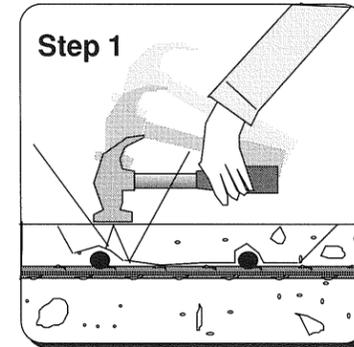
Many techniques are available to perform various aspects of concrete removal and cleaning. Each method has specific advantages and limitations. Much of the removal work is still done by small hand-held chipping hammers (15# class) because of their mobility and versatility. New technology is, however, continuously being developed. Hydrodemolition and hydromilling are two of the latest methods.

The quality of surface preparation may be best addressed in conjunction with the in-place repair material. Evaluation of the complete system (substrate/interface/repair material) can be accomplished by direct tension (uniaxial) pull-off testing. Performance can be evaluated qualitatively based on the location of the breaking surface and quantitatively by measuring the tension stress at failure. This procedure is discussed in the Section, "Bonding Repair Materials to Existing Concrete."

The Section, "Surface Preparation," addresses such topics as general removals, edge conditioning, undercutting of bars, and surface conditioning. Emphasis is placed on surfaces involving corroded reinforcement.

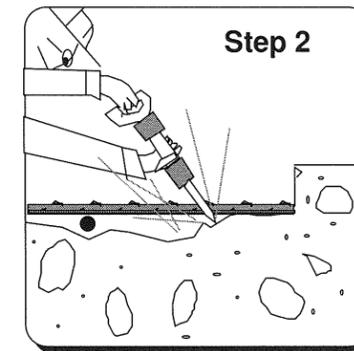


# General Surface Preparation Procedure



## Step 1

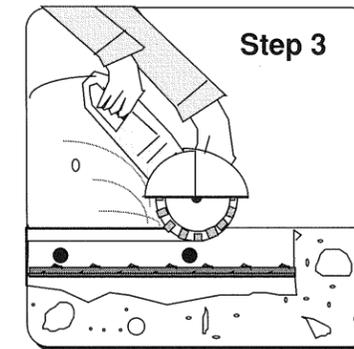
Locate area to be repaired (see "Concrete Evaluation"). Hammer sounding or chain drag are used when locating delamination. Design and install temporary support system prior to any concrete removals.



## Step 2

## Step 2

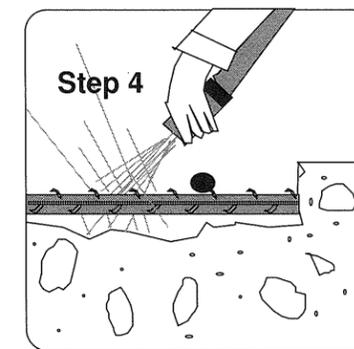
Remove deteriorated concrete using acceptable methods. When embedded steel is encountered, follow recommendations on following pages. Undercutting of exposed bars is critical to long term success of surface repairs. Bars which are damaged by the removal operation or have a significant section loss may require repair.



## Step 3

## Step 3

Prepare surface repair boundaries to prevent feather edged conditions. Geometry of boundaries should minimize edge length. Shotcrete may require some modifications to squared edges. (ACI 506R-90.)



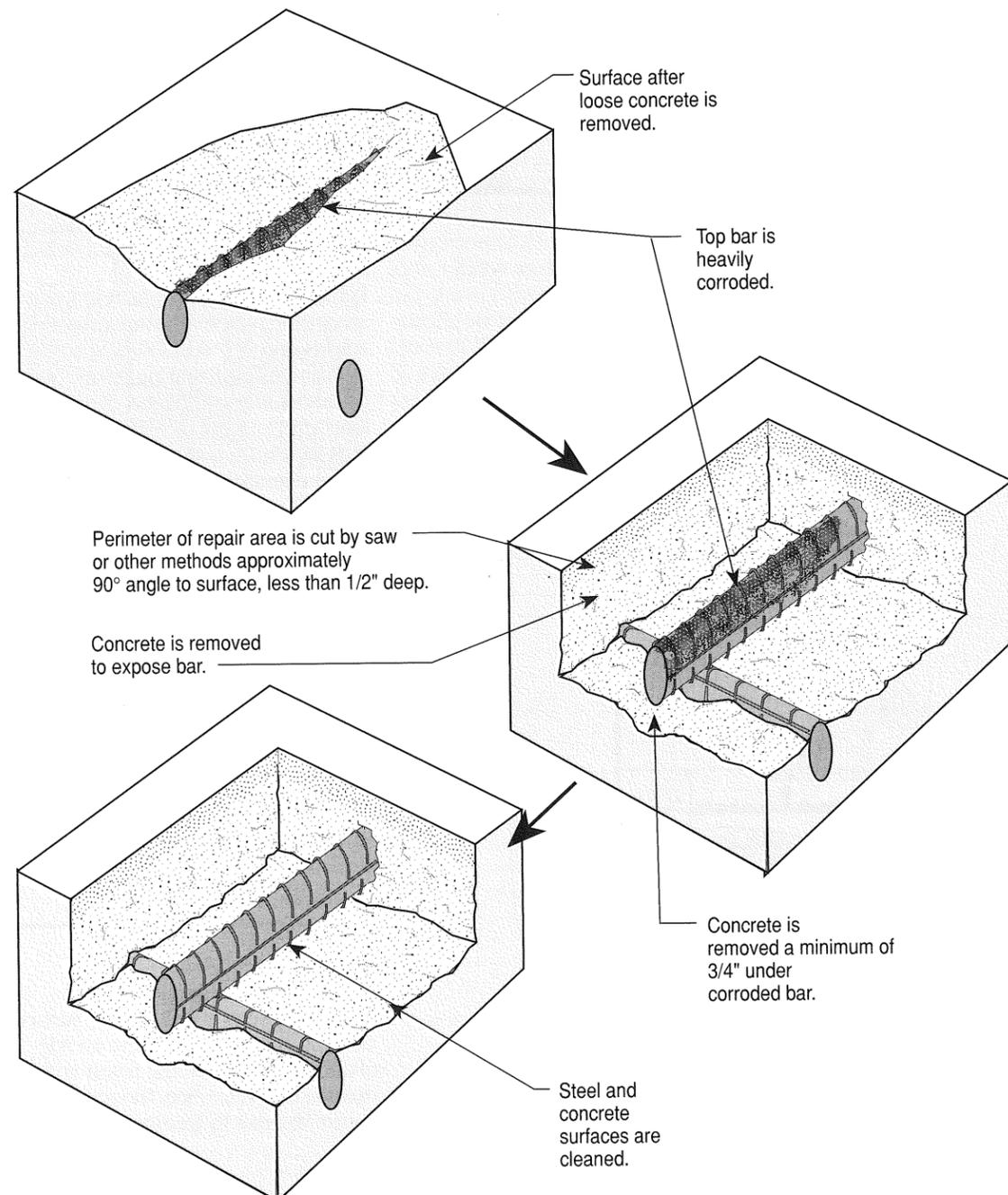
## Step 4

## Step 4

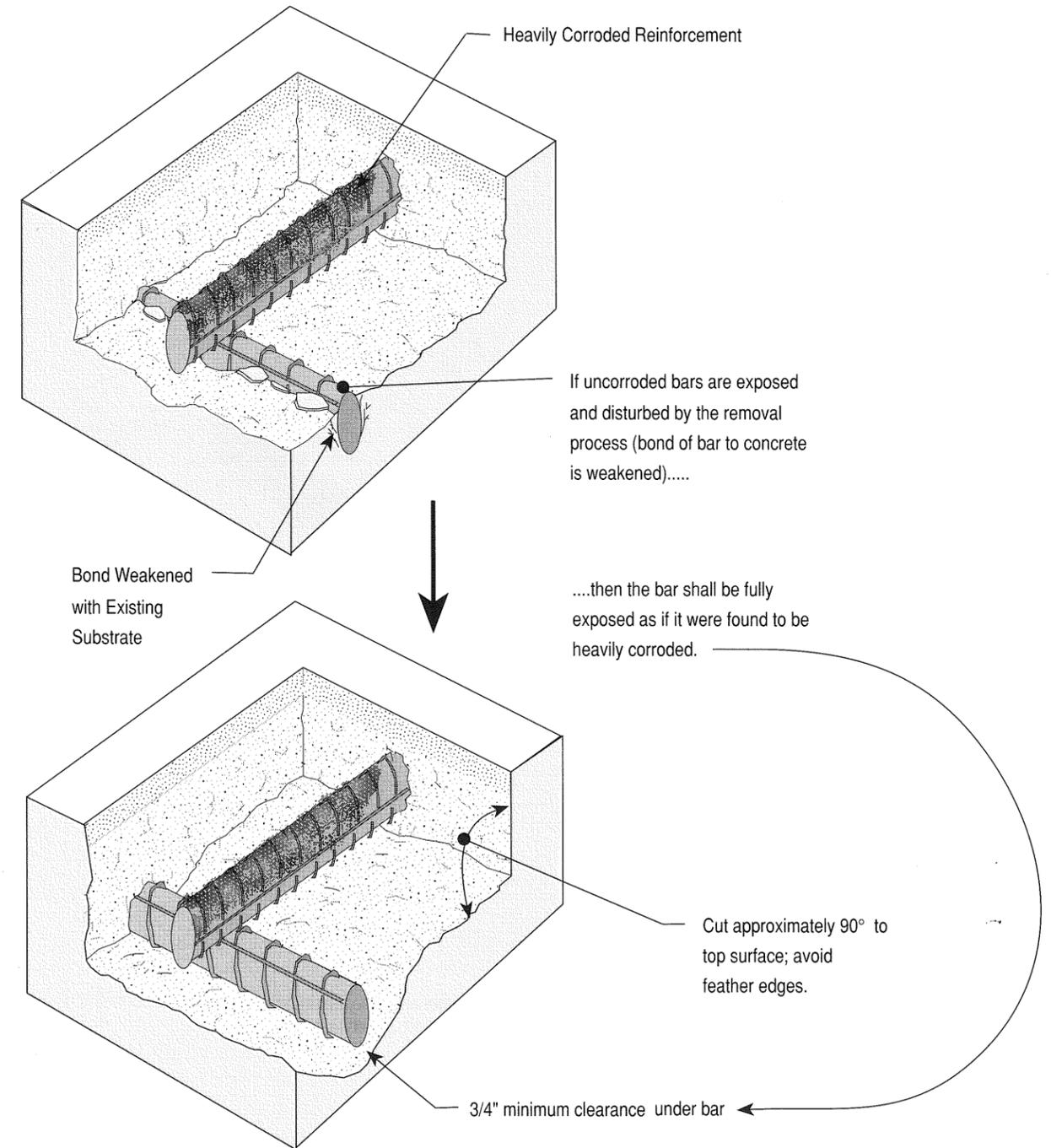
Clean the surface of the exposed reinforcing steel and concrete. Surface cleaning is critical to achieve an adequate bond between the repair and the existing concrete. (See "Bonding Repair Materials to Existing Concrete.")

# Surface Preparation

## When Corroded Reinforcement Is Encountered



## When Corroded Reinforcement Is Encountered

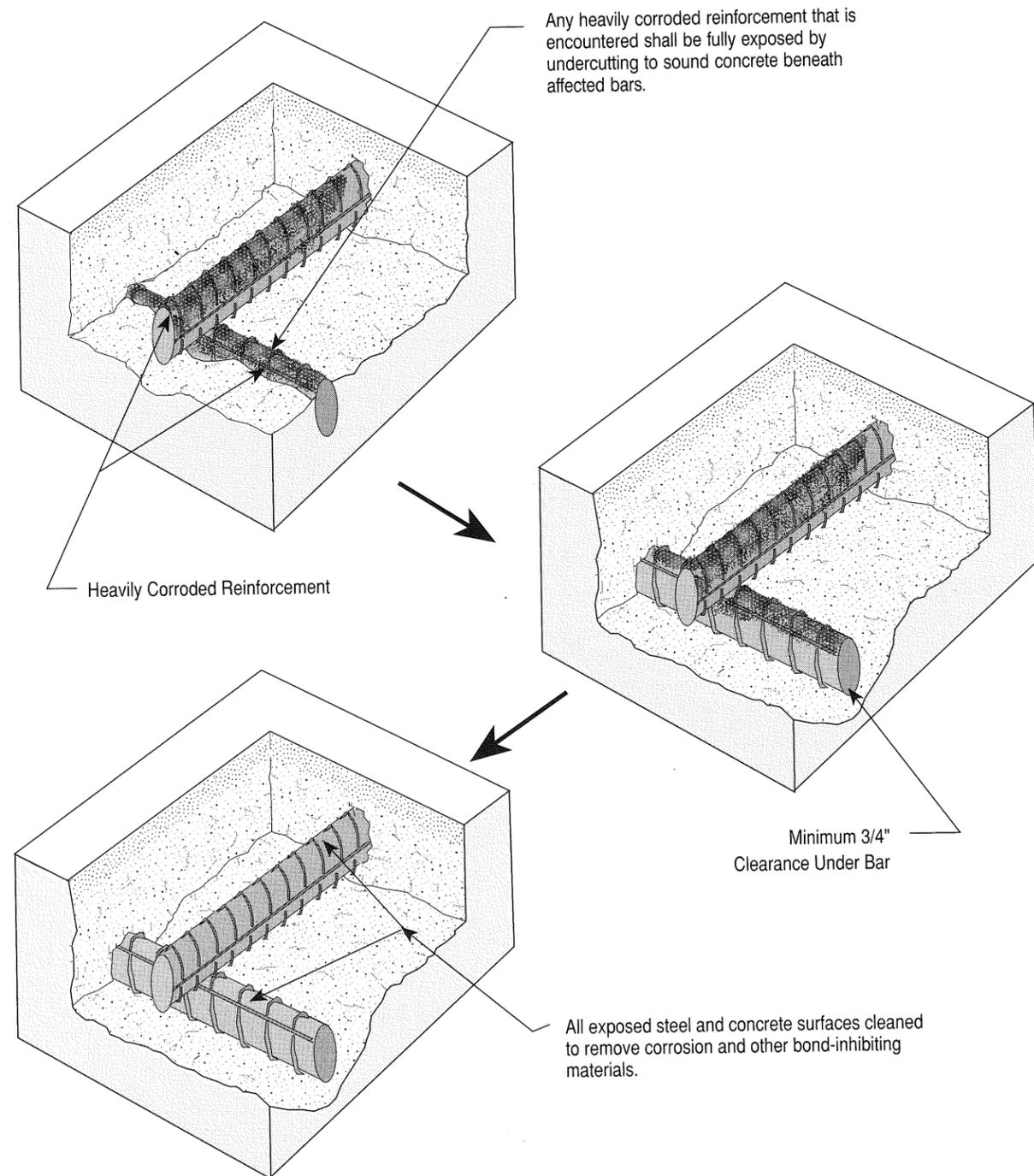


Adapted from IACRS—Surface Preparation Guideline 03730, 31, 32, 34 dated 10/15/89.

Adapted from IACRS—Surface Preparation Guideline 03730, 31, 32, 34 dated 10/15/89.

# Surface Preparation

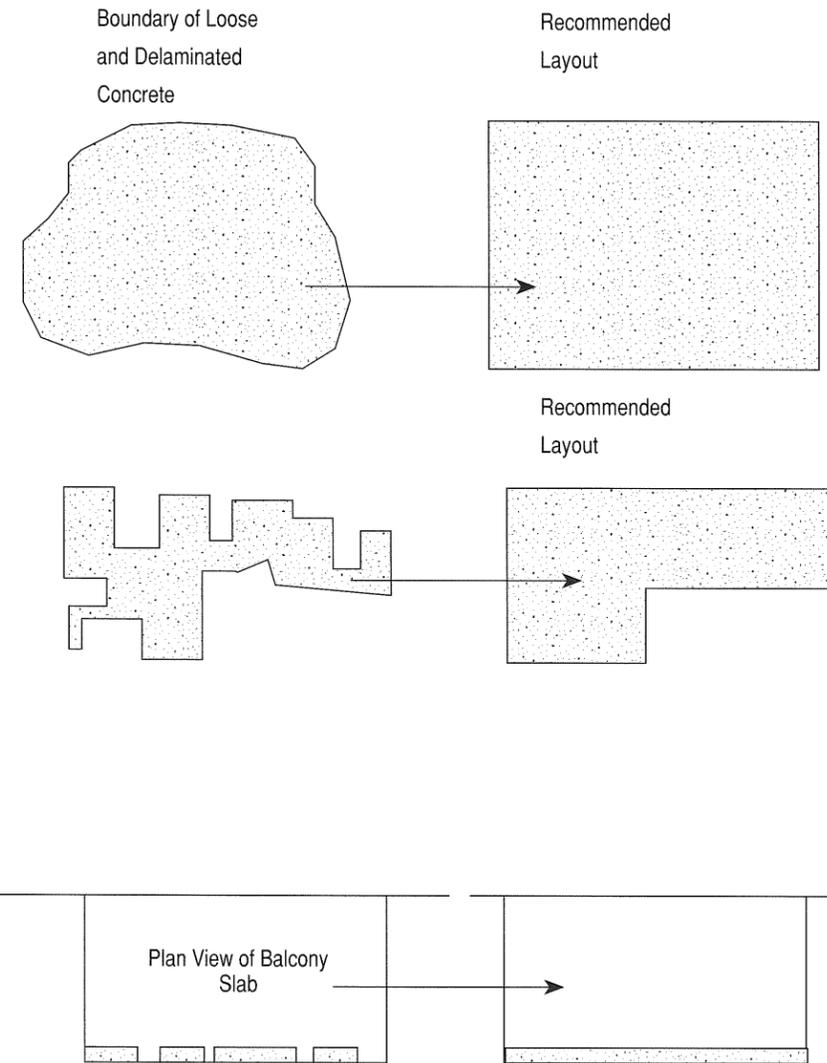
## When Corroded Reinforcement Is Encountered



Adapted from IACRS—Surface Preparation Guideline 03730, 31, 32, 34 dated 10/15/89.

# Recommended Layout of Surface Repairs

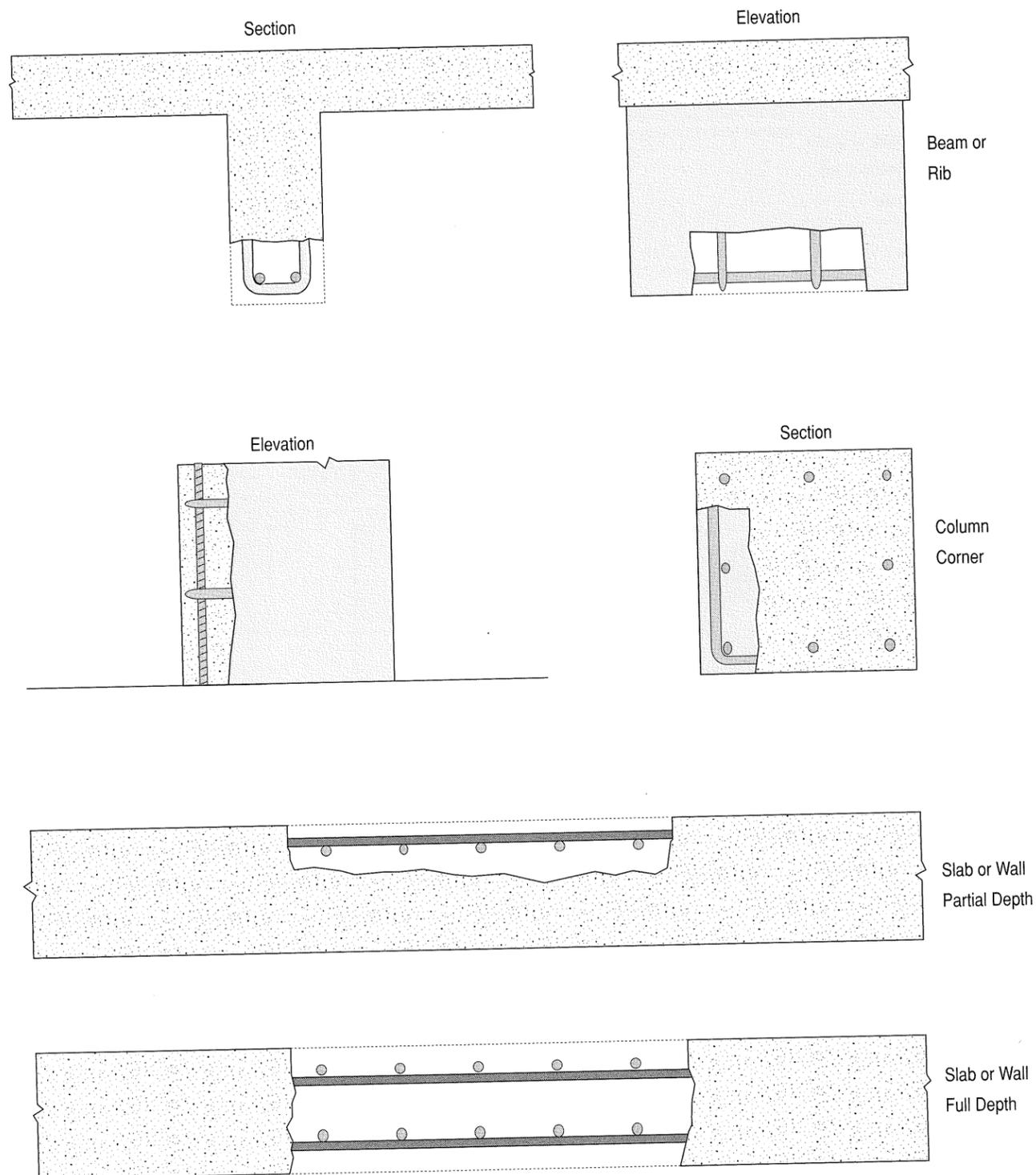
Layouts should be made as simple as possible.



Deterioration of concrete surfaces generally is not uniform. Areas requiring repair should be modified to provide for simple layouts. The layouts should be designed to reduce boundary edge length. Excessive or complex edge conditions result in shrinkage stress concentrations and cracking. If using sawcutting as a method for edge conditioning, keep in mind that saws cut straight and that, at turns, the saw may be required to overcut.

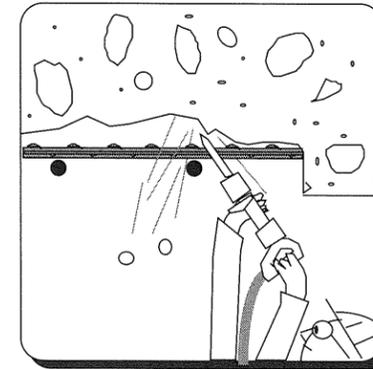
Adapted from IACRS—Surface Preparation Guideline 03730, 31, 32, 34 dated 10/15/89.

# Recommended Removal Geometry



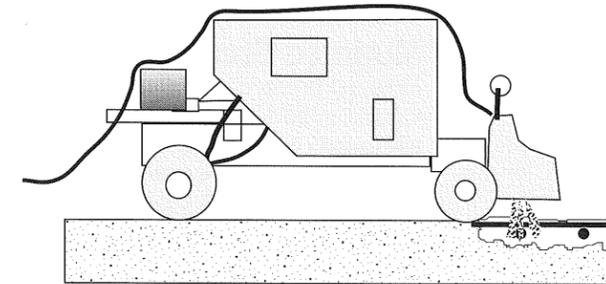
Adapted from IACRS—Surface Preparation Guideline 03730, 31, 32, 34 dated 10/15/89.

# Concrete Removal Methods: Partial Depth



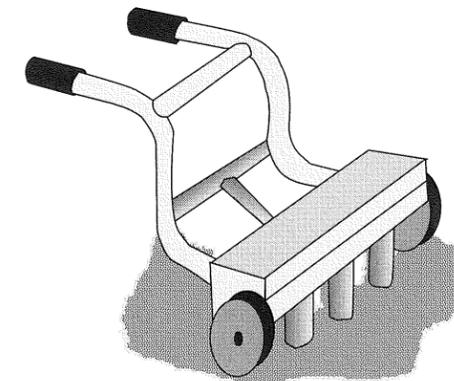
## Pneumatic Chipping Hammer

The 15# to 30# class chipping hammers are the most common removal tools for surface repair. The 15# hammer is light enough for use on vertical and overhead surfaces. Chipping points are used for general removals. Hammers larger than 30# can damage encountered reinforcing steel and should be avoided for partial depth removals. Electric and hydraulic chippers are also available.



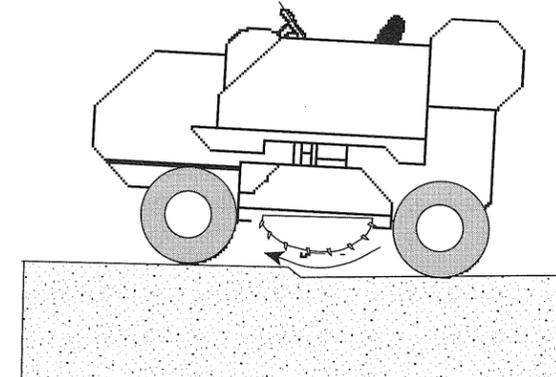
## Hydro Removal

High pressure water (20,000 to 40,000 psi (138 to 276 MPa)) projected on affected concrete surfaces effectively removes concrete. Equipment is remotely controlled and mounted on a movable vehicle. Some robotic equipment can remove concrete not only on horizontal surfaces, but also on vertical and overhead surfaces. Water removals do not damage reinforcing steel. Undercutting of reinforcement can also be accomplished using this method. Cleanup of slurry and water requires extra effort.



## Pneumatic Scabblers

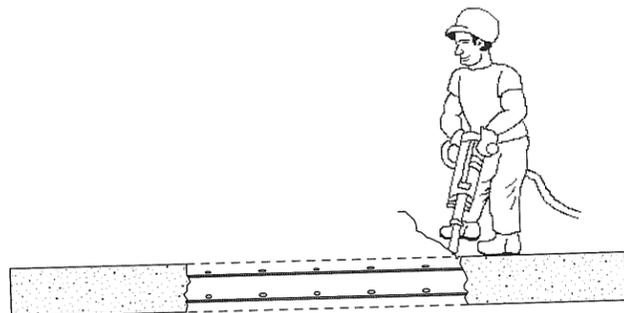
Pneumatic scabblers utilize reciprocating bushing tools hitting the concrete surface. After each hit, small amounts of concrete are removed. Pneumatic scabblers are effective tools for removing up to 1/4" (6.4mm) of surfaces for preparation of overlays. When using pneumatic scabblers, caution should be exercised to avoid bruising of the concrete surface.



## Rotary Milling Machine

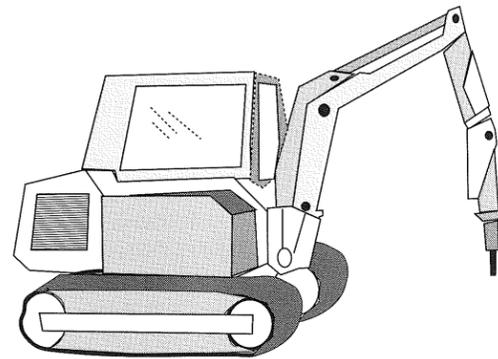
Milling machines are available in all sizes for varying field situations. Most utilize carbide-mounted tips on a rotary drum. The drum rotates, causing the carbide to chip away at the concrete surface. Milling is generally used for removing concrete surfaces in preparation for an overlay. Milling can only be used for removal of concrete down to the top surface of reinforcing steel.

## Concrete Removal Methods: Full Depth



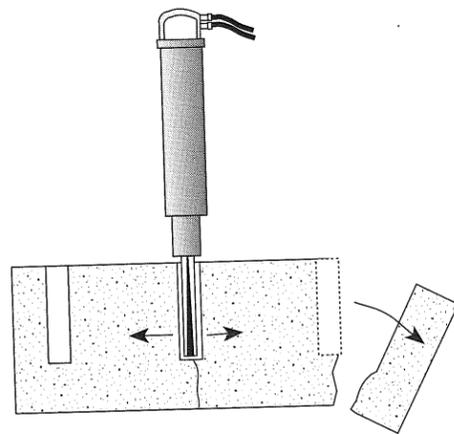
### Hand Held Pneumatic Breakers

Hand held breakers 30# to 90# class are effective tools for concrete removal. Care must be taken not to damage reinforcing steel that may be encountered.



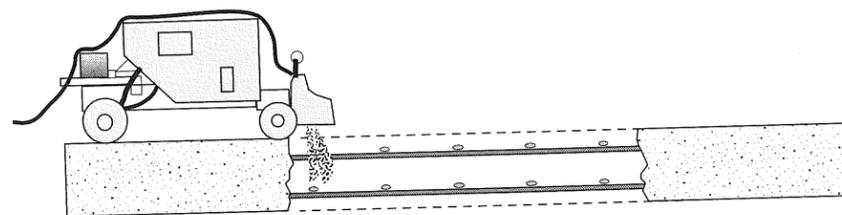
### Pneumatic/Hydraulic Mounted Breakers

Mounted breakers are effective high-volume removal tools. They are generally found on backhoes, skid steer loaders, and remote-controlled robots. When using breakers, caution should be exercised to avoid bruising of the concrete surface.



### Splitters

Splitters are tools used to fracture concrete into easily removable debris. Splitters are available in three types: *hydraulic wedges*, *fluid pressure*, *expansive cements*. The most common are hydraulic wedges and expansive cements. Holes are drilled for all types. Hydraulic wedges utilize steel wedges inserted into the drill hole spread via a hydraulic ram. Expansive cement is mixed with water and poured or tamped into the drilled hole. Within 24 hours, the cement expands, exerting forces great enough to fracture the concrete.



### Hydro Demolition

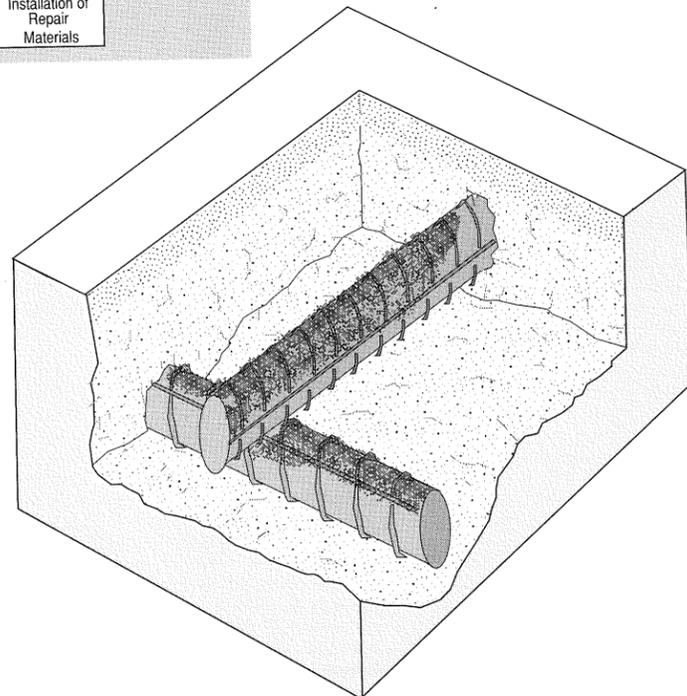
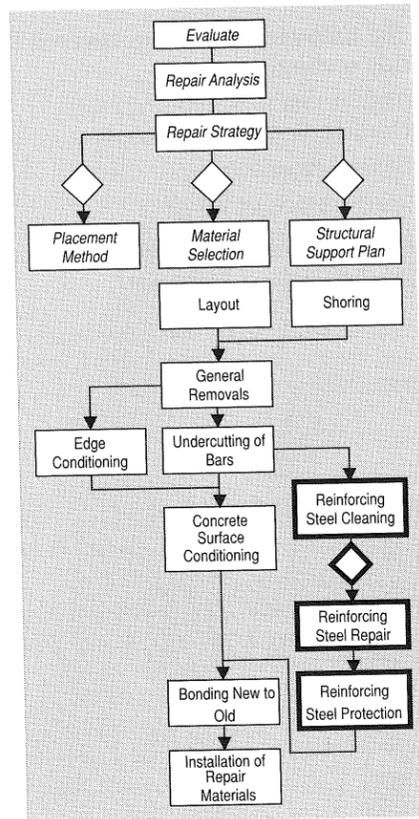
Hydro demolition equipment utilizes high pressure water (20,000 to 40,000 psi (138 to 276 MPa)) projected on to the concrete surfaces. Full depth removals with this equipment can be effective on thin slabs.

## Section 5: Reinforcing Steel Cleaning, Repair & Protection

The following topics are covered in this section:

- Introduction to Reinforcing Steel Cleaning, Repair & Protection
- General Procedure
- Reinforcing Steel Repair
- Reinforcing Steel Cleaning
- Reinforcing Steel Protection

# Introduction to Reinforcing Steel Cleaning, Repair & Protection

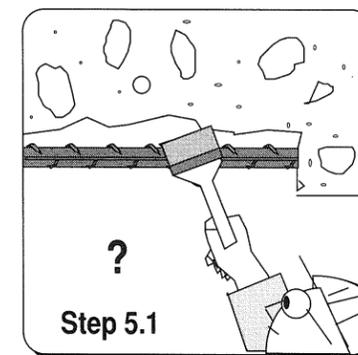
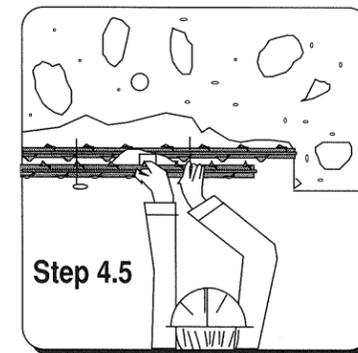
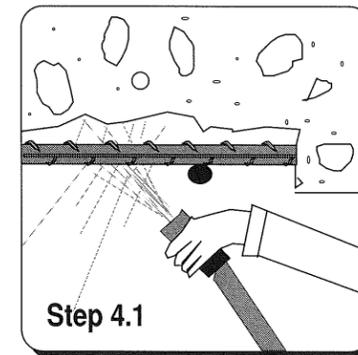
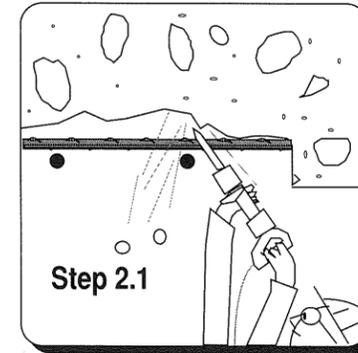


Corroded or otherwise damaged reinforcing steel is usually found in conjunction with concrete deterioration. Heavy rust layers that build up on reinforcing steel during the corrosion process are the cause of concrete delamination and spalling. Removal of oxide build-up is critical to the long term success of surface repairs. Many repairs have failed within a few years of completion because of insufficient cleaning. Proper cleaning of corroded bars requires removal of concrete around the full circumference of the bar, although in the past, practice required removal only when corrosion exceeded more than 50% of the circumference. By removing the full circumference, the contaminated concrete can be removed. Chlorides and carbonated concrete may be present around the rebar, even though corrosion is not present. Two other reasons for removing the concrete around the bar are (1) to allow the repair material to encapsulate the bar, providing a relatively uniform electrochemical environment, and (2) to anchor the repair to the substrate.

Whenever bars corrode, they also lose valuable section, thereby reducing the ultimate load carrying capacity. In some instances, bars lose all section through the corrosion process. Structural evaluation is required to understand the effects of section loss and whether repairs are required to restore it.

Common sense would seem to recommend placing protective coatings or using other means to prevent the recurrence of corrosion. However, quality concrete is generally all that is necessary to protect embedded reinforcing steel. While the current practice of protecting exposed bars is controversial, many systems are available. Several protective systems are discussed in this section.

## General Procedure



### Step 2.1

Exposed corroded reinforcing steel encountered in the repair process requires concrete to be removed around the full circumference of the bar. This allows the reinforcing bar to be cleaned and allows a uniform material to be placed around it.

### Step 4.1

Heavy oxides or other bond-inhibiting materials must be removed by any acceptable cleaning method. (See "Reinforcing Steel Cleaning.")

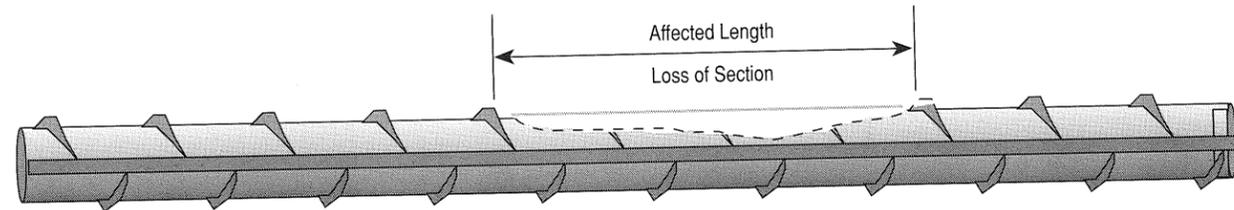
### Step 4.5

Bars damaged during removal operations or with critical section loss may require repair or replacement. (See "Reinforcing Steel Repair.")

### Step 5.1

In certain situations, special coatings may be applied to add additional protection to the reinforcing bars. (See "Reinforcing Steel Protection.")

# Reinforcing Steel Repair (from Section Loss)

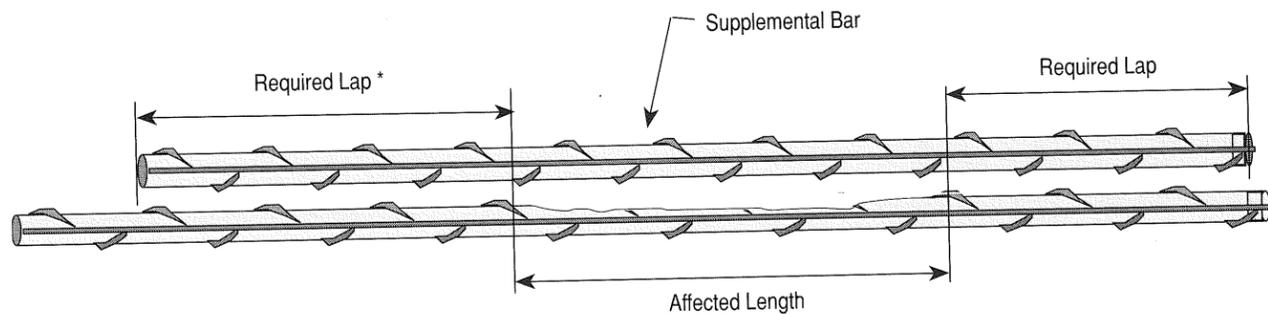


If the reinforcing steel has lost more than 25% of its cross section (or 20% if two or more adjacent bars are affected), then reinforcing steel repair is generally required.

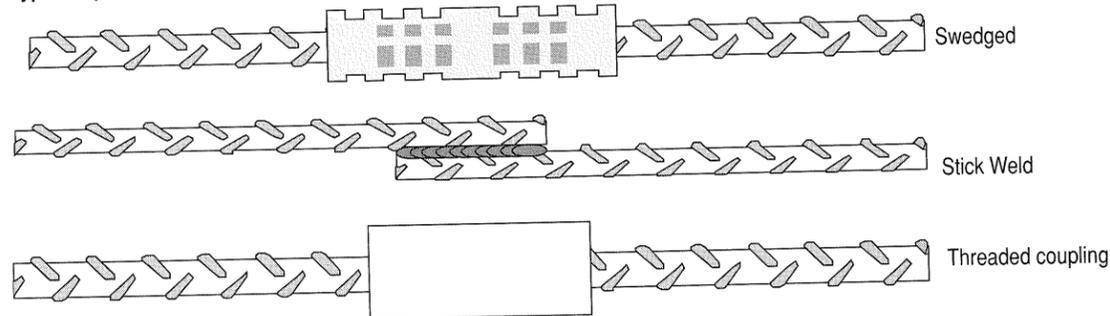
Note: When damage to reinforcing steel is uncovered, it is good practice to perform a structural review of situation.

If repairs are required for the reinforcing steel, one of the following methods should be used:

1. Supplemental bar over affected length. New bar may be mechanically spliced to affected bar or placed parallel to existing bar.
2. Complete bar replacement.



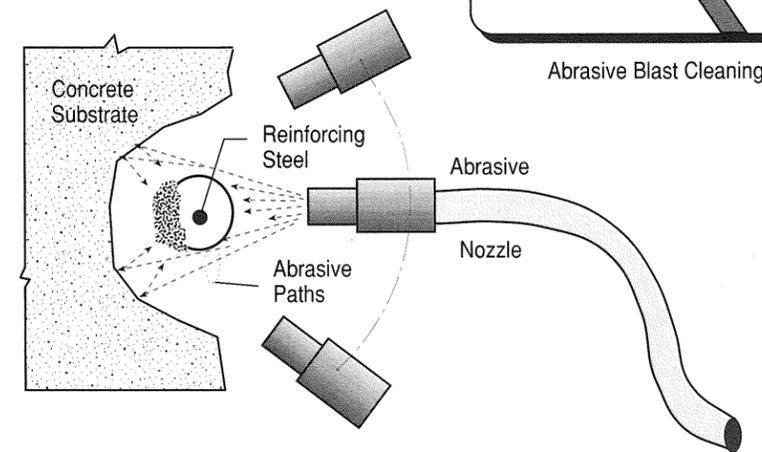
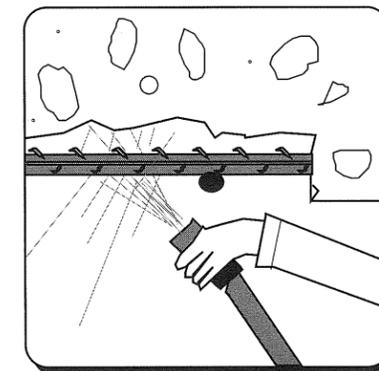
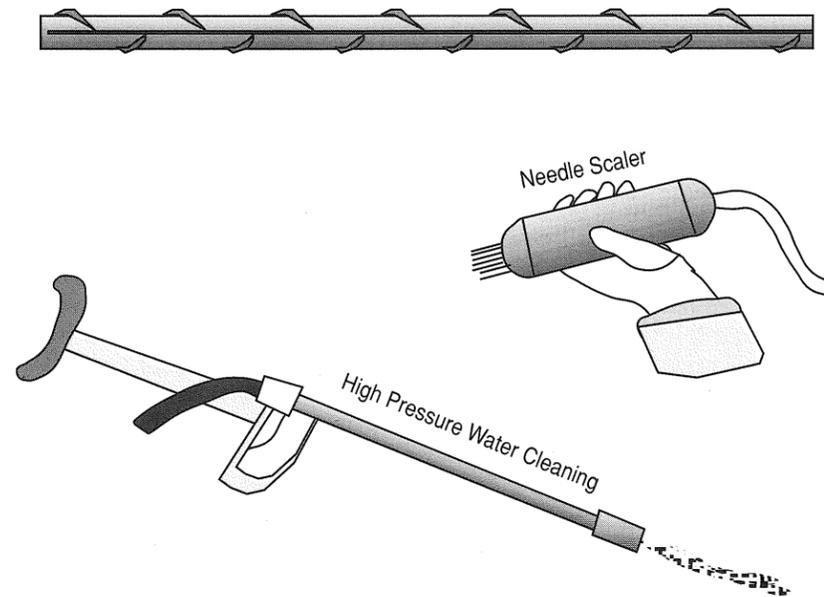
### Typical Splice Methods



\* Lap length shall be determined in accordance with ACI 318; also refer to AASHTO and CRSI Manuals.

Adapted from IACRS—*Surface Preparation Guideline 3730*, 31, 32, 34 dated 10/15/89.

# Reinforcing Steel Cleaning



Adapted from IACRS—*Surface Preparation Guideline 3731*, October 15, 1989.

## General Procedure

All heavy rust and scale should be removed from the rebar to promote maximum bond with repair materials. A tightly bonded light oxide build-up may develop after cleaning. This is usually not detrimental to bond. If a protective coating is being applied to the rebar, the manufacturer's recommendations for surface preparation should be followed.

## Needle Scalers

Needle scalers are pneumatic tools utilizing a group of small diameter steel rods powered by an internal piston. The steel rods hit the intended surface, causing removal of surface materials. Needle scalers are effective tools for removal of heavy oxide layers, as well as for surface cleaning of small areas of concrete.

## High Pressure Water Cleaning

High pressure water (3,000 to 10,000 psi (20.7 to 69 MPa)) cleans concrete and steel surfaces, removing unsound materials. Water mixed with sand cleans faster and results in a roughened surface which will promote a better bond with coatings or with repair materials.

## Abrasive Blast Cleaning

Abrasives mixed with pressurized air and projected through a nozzle are the best method of providing steel or concrete surfaces with a clean profiled surface. Airborne debris (dust) is an environmental concern when using this method. Water can be injected at the nozzle to reduce dust in this process.

## Power Wire Brushing

A power wire brush is an effective tool for removing unwanted oxide from steel surfaces. Wire brushing is a very slow and ineffective operation when rebar has to be cleaned on the back side.

# Reinforcing Steel Protection

Reinforcing steel is naturally protected from corrosion when surrounded by an alkaline environment of newly cast, good quality concrete. In certain repair situations, additional protection for the encased reinforcement is prudent. Protection systems fall into four (4) categories:

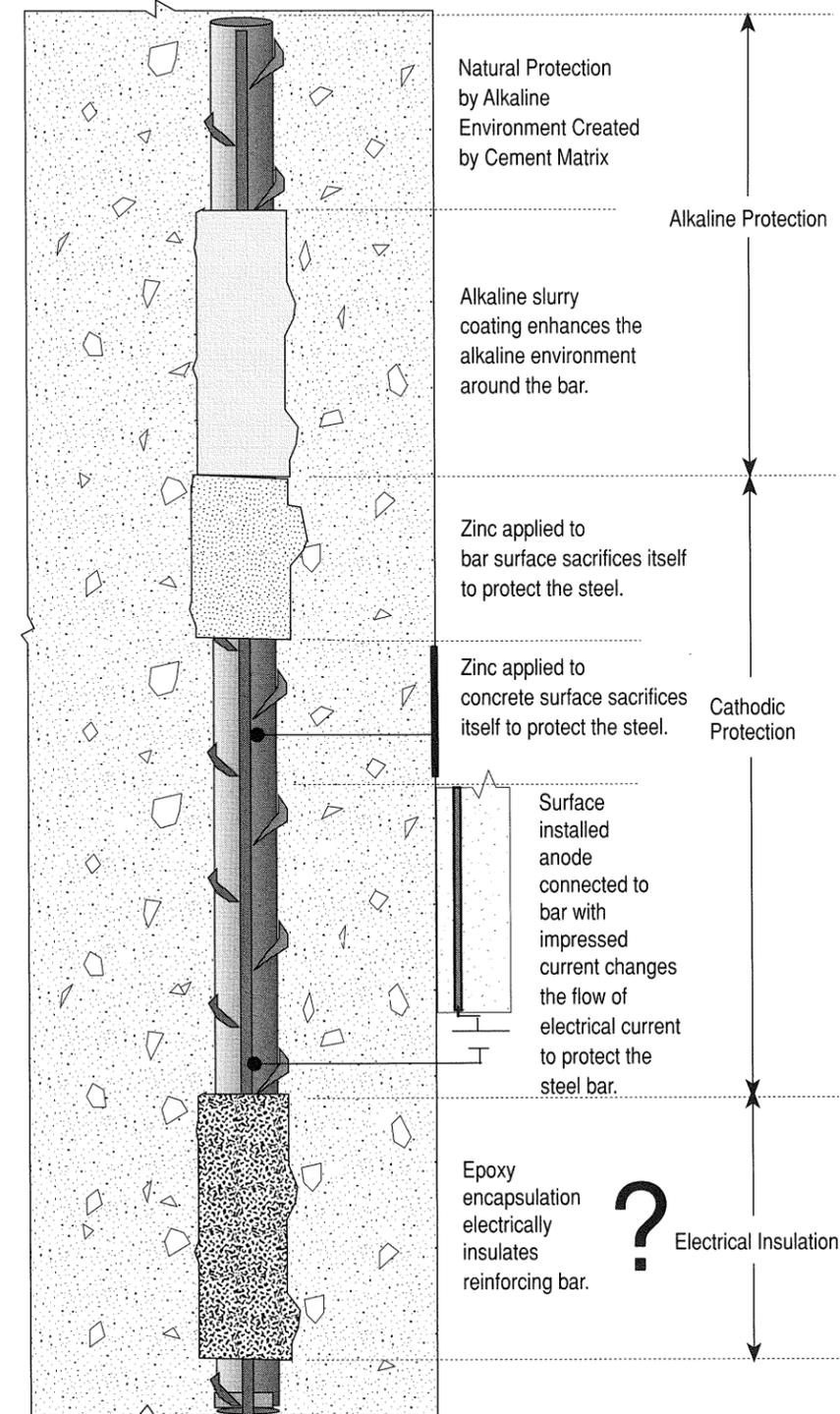
1. Encapsulation: Insulating the bar from electrical currents in the surrounding concrete can be accomplished by encapsulating the bar with epoxy. When new bars are used, fusion-bonded epoxy provides the best protection. Bars are shot-blasted and heated, and powdered epoxy is sprayed onto them under a controlled environment. In field applications where encapsulation of existing bars is necessary, epoxy resin is sprayed or, more commonly, brushed onto the bars. With field application of epoxy it is very difficult to achieve 100% coverage of the exposed bars. Intersections and back sides of bars create almost impossible access. Encapsulation works well when all bars in the affected member are protected; however, when bars are partially coated, either within the repair zone or adjacent to the repair, electrical currents can become concentrated in the unprotected bars, and accelerated corrosion may be a problem.
2. Cathodic Protection/Sacrificial Anode: Protecting bars from corrosion can be accomplished by coating them with a sacrificial metal. Zinc is the metal commonly used for this purpose. Zinc is applied to the bar with a brush. Recently, molten zinc has been used (California DOT) as a sacrificial surface-applied coating. This method is used after all surfaces are repaired. The surface-applied zinc is electrically connected to the reinforcing steel cage. Since this method is sacrificial, the service

life is dependent upon the degree of exposure to a corrosive environment and anode activity. This method of protection is used only on an experimental basis.

3. Cathodic Protection/Impressed Current: Protecting bars from corrosion can be accomplished by reversing the electrical current flow which causes the corrosion process. Anodes are installed on or near the concrete surface and are electrically connected to the reinforcing bars. Electrical current is pumped into the circuit, protecting the bars. Impressed current must be balanced with the environment on a continual basis in order to provide protection. Constant monitoring and necessary adjustments are required.
4. Alkaline Slurry Coating: Like uncarbonated concrete, alkaline slurry coating protects the reinforcing steel from corrosion. Some systems utilize non-passivating epoxies as a binder for the passivating (alkaline) fillers. Some questions exist concerning whether the epoxy insulates the alkaline fillers from direct contact with the rebars and whether the epoxy provides any benefits other than electrically insulating the bar.

There are many unanswered questions regarding reinforcement protective systems and their effect on surrounding reinforcement. By protecting reinforcing steel in a repaired area we have created an island of new material. In doing so, potentially more corrosion could occur than would have originally. Only independent research, testing and monitoring will answer these questions.

Reinforcing Steel Protection

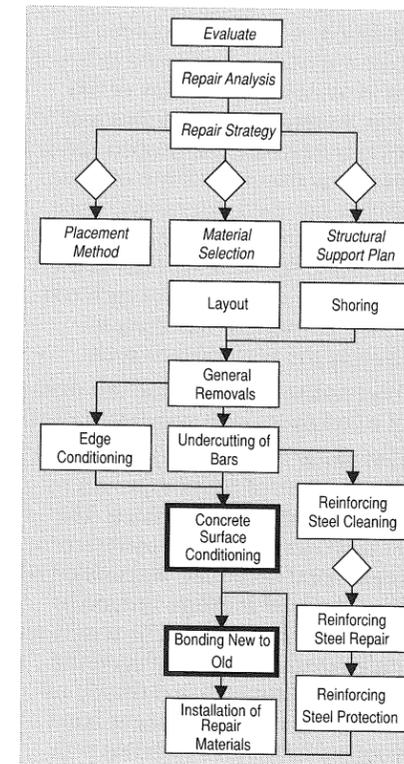


# Section 6: Bonding Repair Materials to Existing Concrete

**The following topics are covered in this section:**

- Introduction to Bonding Repair Materials to Existing Concrete
- Measuring Bond Strength
- Evaluating Bond Strength
- General Procedures
- Bonding Agents
- Additional Sources of Information

## Introduction to Bonding Repair Materials to Existing Concrete



**Keys to developing bond**

1. Clean, sound substrate.
2. Roughened profile of substrate for mechanical interlock.
3. Open pore structure in substrate.
4. Repair material/bonding agent with sufficient paste for absorption into substrate pores.
5. Repair material is applied with sufficient pressure to facilitate contact between the repair material and the substrate at the bond line.

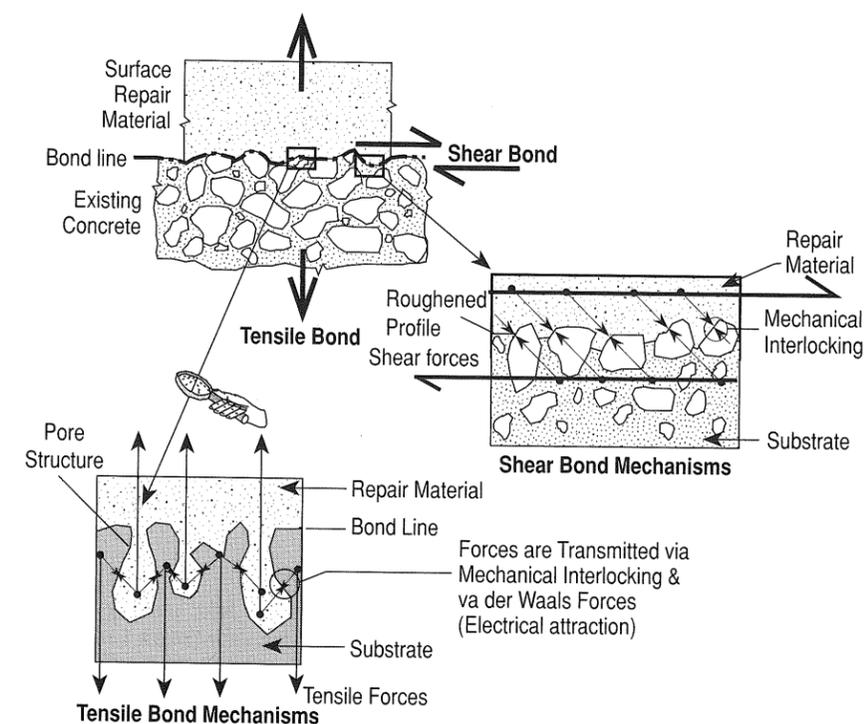
Achieving an adequate bond between repair materials and existing concrete is a critical requirement for durable surface repairs. Various techniques are available to achieve the required bond. This section presents a brief review of some of the test methods for determining the bond of repair or overlay materials to existing concrete, and a description of the step by step process of achieving an adequate bond.

The bond at the interface between the repair material and concrete substrate is likely to be subject to considerable stress from volume changes, freeze-thaw, force of gravity, and sometimes, impact and vibration. The stress states that develop at the bond lines will vary considerably, depending on the type and use of the structure. For example, the bond on the bridge deck overlay may be subject to shear stress in conjunction with tensile or compressive stress induced by shrinkage or thermal effects, and to compression and shear from service loads.<sup>1</sup>

It is essential that the repair material achieve a strong bond to the substrate and that subsequent stresses are not sufficiently great as to cause debonding. Repairs which have bond lines in direct tension have the greatest dependency on bonding.

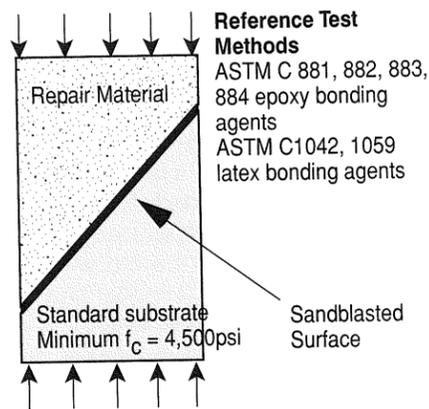
Repairs that are subject to shear stresses at the bond line are capable of stress resistance not only by bonding mechanisms, but also by aggregate interlock mechanism, which add greatly to shear bond capacity.

It should be remembered that high initial bond strength is generally not as important as bond durability.



<sup>1</sup>Wall, J.S., and Shrive, N.G., Factors Affecting Bond Between New and Old Concrete, ACI Materials Journal, Mar.-Apr. 1988, pp. 117-125.

# Measuring Bond Strength



**Reference Test Methods**  
 ASTM C 881, 882, 883, 884 epoxy bonding agents  
 ASTM C1042, 1059 latex bonding agents

**Comments:**

- Laboratory test only.
- Measures materials only.
- Value affected by compressive strength of materials\*.
- Value affected by degree of sandblasting\*.
- \*Not controlled by test method.

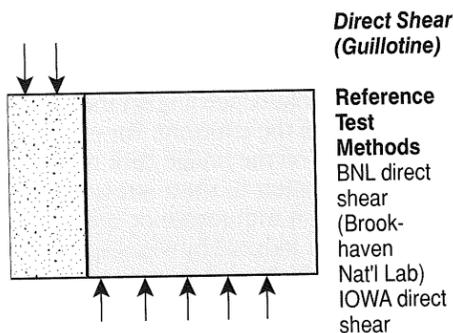
Evaluation of the bond between the repair material and substrate is important in assessing the quality of the repair. In recent years, various test methods have been developed and are available at this time. Some of these methods are used extensively, while others have had little use in the field. Understanding the limitations in the reliability or applicability of each test method is critically important in achieving the performance goals.

A brief review of some of the test methods currently in use is presented below.

**Slant shear test** is used by most manufacturers of repair materials to evaluate product performance. The test is economical and is easily reproduced. Bond values are determined by taking the load at failure divided by the elliptical bond area. The results are highly variable depending upon the compressive strength and degree of sandblasting used. Slant shear bond values are difficult to correlate with field performance.

The method used for assessing repair materials, the slant shear test, is far from being representative of the actual in situ conditions. When the results of other test methods are compared with those obtained from the slant shear test, it is evident that the latter can give rise to inaccurate conclusions. Bond strength values are generally higher when evaluated by the slant shear method or by the direct shear method, as compared to the direct tension method.<sup>1</sup>

<sup>1</sup>Knab, L.I., Sprinkel, M.M., and Lane, O.J., Preliminary Performance Criteria for the Bond of Portland Cement and Latex Modified Concrete Overlays, NISTIR 89-4156, National Institute of Standards and Technology, 1989.

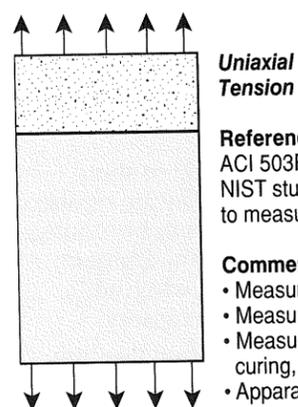
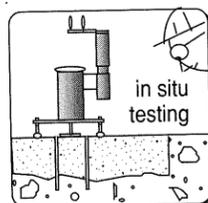


**Direct Shear (Guillotine)**

**Reference Test Methods**  
 BNL direct shear (Brookhaven Nat'l Lab)  
 IOWA direct shear

**Comments:**

- Can measure both laboratory and field specimens.
- Value affected by compressive strength of materials.
- Value affected by degree and method of surface prep.
- Measures shear bond.



**Uniaxial Tension**

**Reference test Methods**  
 ACI 503R uniaxial direct tension  
 NIST study NISTIR 4648 Uniaxial tensile tests to measure the bond of in situ concrete overlays.

**Comments:**

- Measure field specimens in-situ or removed.
- Measures direct tensile strength of bond.
- Measures actual field conditions; surface prep, curing, mat'l.
- Apparatus must be attached concentrically with core.

**Direct shear method** measures shear bond between the repair material and the substrate. Field and laboratory core specimens are tested in a special guillotine apparatus. Shear bond values are determined by taking the load at failure divided by the bond area. Correlations can be developed between laboratory and field tests.

**Uniaxial tensile test** measures the tensile bond or tensile strength of surface repairs and overlays. Direct tension bond testing establishes the location of the weakest link of the composite. Uniaxial testing can be performed in situ or in a laboratory. In situ testing is performed by coring through the repair material into the

substrate. While the core remains connected to the substrate, a tensioning device is connected to the core and loaded until failure occurs. Tensile values are determined by taking the load at failure divided by the cross sectional area of the core. The advantage of in situ testing is the benefit of evaluating actual repairs, providing feedback directly to the parties involved, establishing acceptance or necessary adjustments to the repair procedures.

# Evaluating Bond Strength

**Table 1.** Preliminary Performance Criteria for Portland Cement Concrete (PCC) and Latex Modified Concrete (LMC) Overlay Materials Based on the BNL (Brookhaven National Laboratory) Direct Shear Bond Test Method<sup>1\*</sup>

Class	Overlay Material	Minimum Bond Strength (psi/MPa)*	Average Bond Strength (psi/MPa)*	Minimum Compressive Strength of Overlay psi/(MPa)*	Compressive Strength of Base Concrete psi/(MPa)*
1	LMC/PCC	200/1.4	325/2.2	$\frac{3000}{20.7}$	$\frac{3000-3500}{20.7-24.1}$
2	LMC/PCC	230/1.6	375/2.6	$\frac{3750/4000}{25.9/27.6}$	$\frac{\geq 3000}{> 20.7}$
3	LMC/PCC	260/1.8	425/2.9	$\frac{4250/5000}{29.3/34.5}$	$\frac{\geq 4000}{> 27.6}$

\*The metric conversion is produced by the author.

**Table 2.** Relationship Between Bond Test Methods\* (Adapted from Table B1<sup>1</sup>)

Conditions	Bond Test Method	Bond Strength (psi/MPa)** Avg. of 7-10 Tests	Relationship Between Test Methods
Sandblasted, 2 day PCC overlay on 50 day old PCC	Slant shear	1190/8.2	360%
	Direct shear BNL	330/2.3	100%
	Uniaxial tension	189/1.3	57%

\*The relationship between test methods is not well defined except in general. The purpose of utilizing the test data gathered in the NIST study to compare test methods is that the data represents a unique study which has compared test methods under controlled and relatively consistent conditions.

\*\*The metric conversion is produced by the author.

Acceptable bond values for materials and in situ repairs are not established. Table 1 presents the range of acceptable bond properties. It is strongly recommended that the entire referenced report be read when using the preliminary performance criteria table. The values are derived from direct shear tests and are not comparable to uniaxial tensile bond test results that are generally lower as demonstrated in Table 2.

When bond strength values evaluated by this method are inadequate, adjustments to surface preparation methods and placement techniques can be made, and adequate bond achieved. By evaluating the location of the break in composite structures, the decision can be made as to whether changes in procedures or materials are necessary. The following examples demonstrate how in situ testing is used:

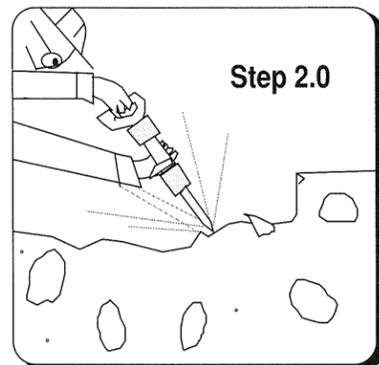
- Hydrodemolition techniques are used to remove concrete from a parking or bridge deck. Cleaning the slurry is time consuming and a tedious operation. By in situ tension testing, the degree of cleaning can be optimized.
- Removal of concrete by some techniques may cause damage to underlying concrete surface. By using in situ tension testing, the acceptable techniques can be selected.
- Final surface cleaning techniques may provide different degrees of bruising, profile, and pore cleaning. By in situ tension testing, various cleaning techniques can be optimized, i.e., milling without abrasive blasting vs. milling with abrasive blasting; abrasive blasting vs. high pressure water blasting.
- The effectiveness of different bonding agents can also be evaluated by these tests.

Acceptable bond values, when using the uniaxial in situ test method, are not established. The uniaxial in situ test can be used to establish general acceptance criteria for surface repair. Quantitative test results are highly dependent upon:

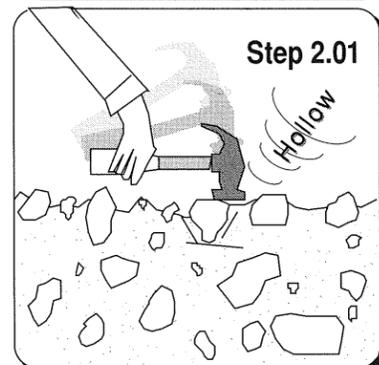
1. Compressive and tensile strength of substrate concrete
2. Surface preparation
3. Placement techniques
4. Repair material

<sup>1</sup>Knab, L.L., Sprinkel, M.M., and Lane, O.J., Preliminary Performance Criteria for the Bond of Portland Cement and Latex Modified Concrete Overlays, NISTIR 89-4156, National Institute of Standards and Technology, 1989. (Order #PB90-204520 NIST).

# General Procedures

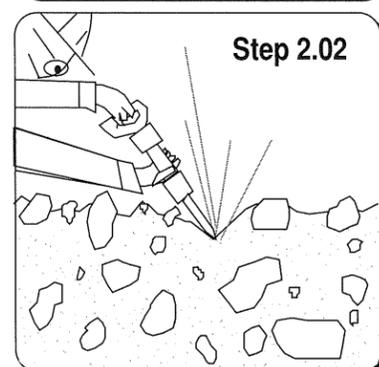


Step 2.0

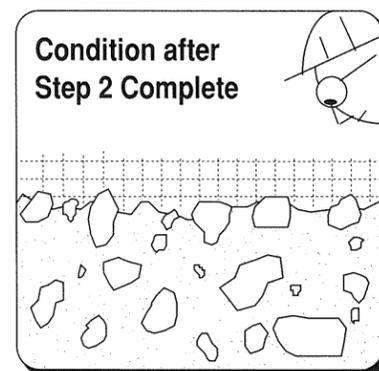


Step 2.01

Hollow



Step 2.02



Condition after Step 2 Complete

## Step 2 General

Existing concrete surfaces need to be roughened to a profile necessary to achieve mechanical interlock. The necessary profile (distance between high points and low points over a specified distance between the points) is a function of the magnitude of shear forces that will be acting, the repair material properties, the placement technique or any combination of these. Field testing is required to establish the optimum profile.

### Typical Tools Used for Development of Profile

Tool	Profile
Hand chipper	1/2" (13mm) +
Hydro milling	1/2" (13mm) +
Rotary milling	1/8"-1/4" (3-6mm)
Scabblers	1/8" (3mm) -
Shotblasters	1/8" (3mm) -
Abrasive blasting	1/8" (3mm)

A standard practice of preparing existing concrete bridge decks for overlays is rotary milling followed by abrasive blast cleaning. Excellent results are achieved with profiles less than 1/4".

## Step 2.0

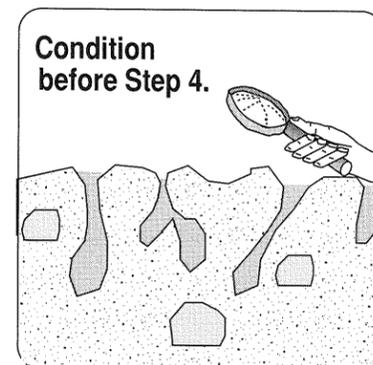
Surfaces of existing concrete expected to receive the repair material must be sound, clean, and free of bond inhibiting materials (oil, fats, hardened epoxy, etc.). An ideal sound surface is one of adequate compressive strength, free of any defects, with aggregate bonded to the cement matrix.

### Step 2.01

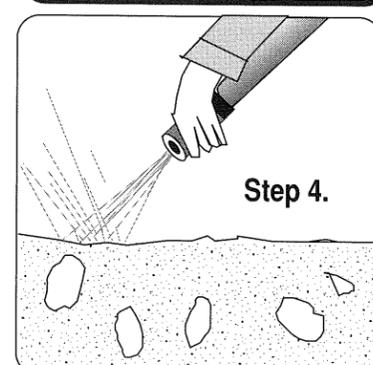
After initial removals, surfaces should be sounded for delaminations and voids.

### Step 2.02

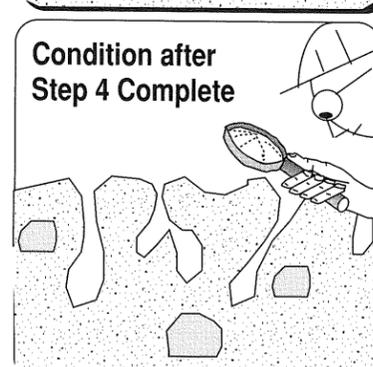
Any concrete areas found to be unsound should be re-chipped.



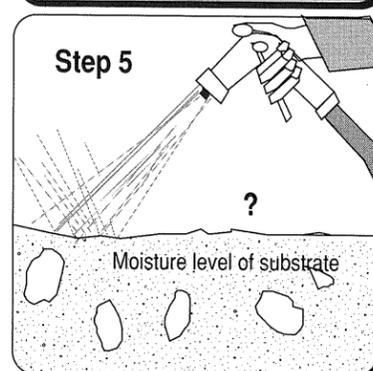
Condition before Step 4.



Step 4.



Condition after Step 4 Complete



Step 5

Moisture level of substrate

## Step 4 General

The surfaces of existing concrete must have an open pore structure. The absorption of the repair material into the substrate's pore structure is a critical bonding mechanism. If the

pore structure is clogged with dust, slurry or water, the absorption process will be hindered, and bond strengths reduced.

### Step 4

Desirable results in opening the pore structure can be achieved using one of the following methods:

- Shotblasting (horizontal surfaces)
- Abrasive blasting
- Hydroblasting
- Combinations of abrasives and water
- Vacuum

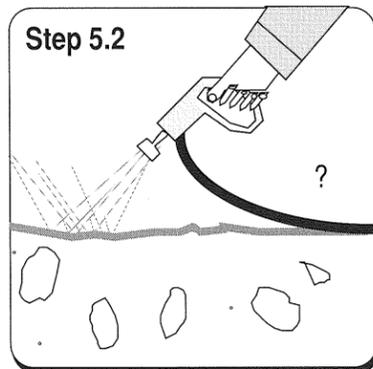
The open pore structure will provide capillary suction of the repair material, or bonding agents, into the substrate concrete. Before application of the repair materials, surfaces should be inspected for any foreign materials which might inhibit the bond.

## Step 5

The moisture level of the substrate may be critical to achieving bond. An excessively dry substrate may absorb too much water from the repair material. This will result in excessive shrinkage. Excessive moisture in the substrate may clog the pores and prevent absorption of the repair mate-

rial. In situ tension testing to evaluate the optimum moisture condition for a particular substrate and repair material may be appropriate. Saturated, surface dry condition can be considered to be the best solution, unless otherwise determined.

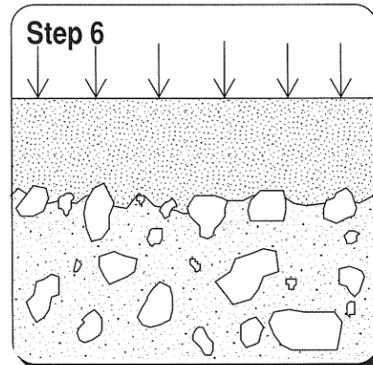
## General Procedures



### Step 5.2

The repair material must contain a sufficient amount of fluid paste for absorption into the open pore structure of the substrate. In some cases, a separate bonding agent is used. The

bonding agent must be easily absorbed into the pore structure and must be compatible with the repair material and substrate.

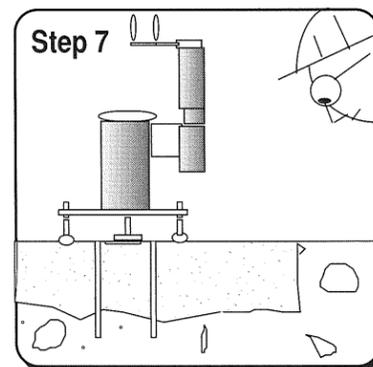
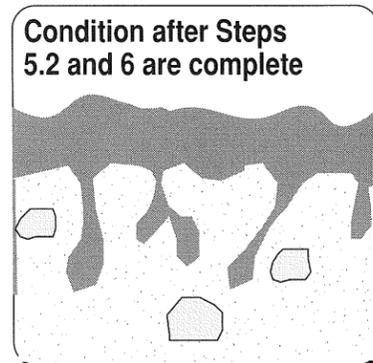


### Step 6

The surface repair material should be installed in a manner which produces intimate contact between the new and the old at the bond line. Intimate contact is produced by a number of mechanisms, including:

- Internal vibration (produces fluid flow, hydraulic pressure and dissipates air pockets).

- Internal hydraulic pressure (created by pump pressure in confined spaces, utilizing form and pump or grouted preplaced aggregate repair techniques).
- High velocity impact (created by the thrusting of repair material on the prepared surface, utilizing pneumatically placed mortar).
- Low velocity impact (created by the compaction of repair material by rodding and tamping, utilizing hand applied or dry pack technique).



### Step 7

Making sure that all necessary steps for achieving adequate bonding are taken, a pull-off test can be performed to monitor the tensile bond strength between repair and substrate. This in situ test involves the use of partial coring down through the repair mate-

rial and into the substrate. The method is more qualitative than quantitative. Ideally, the bond strength should be such that the composite structure should behave monolithically under load; the failure should occur in original concrete substrate.

## Bonding Agents

Adequate bonding can be achieved by placing repair material directly against properly prepared substrate. There are special conditions when bonding agents are used. Three main types of bonding agents are frequently used: cement-based slurries, epoxies, and latex emulsions.

For Portland cement based repairs and overlays, cement or sand-cement slurry is used. After the substrate has been prepared, and immediately before placing the repair material, a thin coating of "creamy" grout must be vigorously and thoroughly broomed or brushed into the prepared surface.

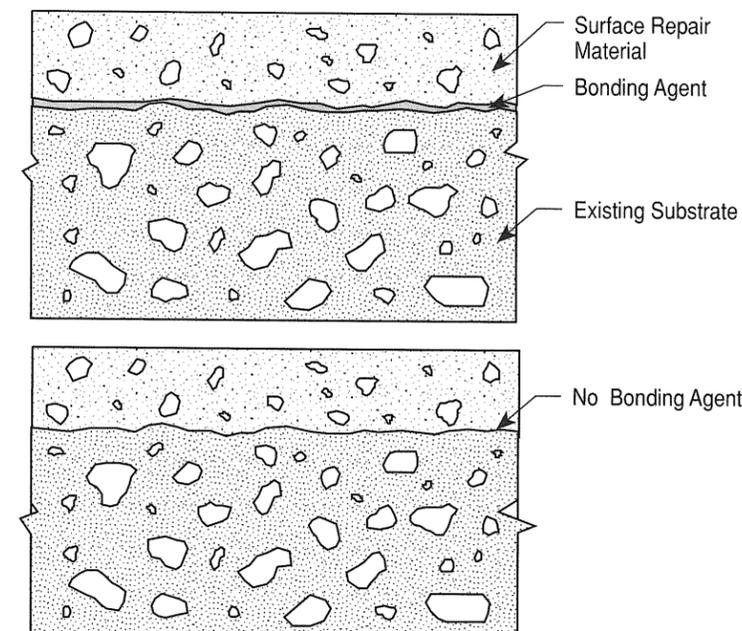
In the case of latex-modified or microsilica-modified repair materials or overlays, the bonding grout can be broomed in from the mix itself. For latex-modified material, it can also be mixed separately. There are, now available, factory blended latex-modified cement slurry bonding agents which are mixed with water on site and applied to the prepared concrete surface.

Latex bonding agents are also used in the industry. The material must meet the requirements of ASTM C 1059. Manufacturers' instructions should be strictly followed when using latex products because not all are compatible with concrete. The following latex products are used as bonding agents:

- Styrene Butadiene (SBR)
- Acrylic
- Polyvinylacetate (PVA)

Re-emulsifiable Polyvinylacetate (PVA) bonding agents should not be used in structural applications. This agent can re-emulsify after being subject to wet-dry cycles, resulting in eventual loss of bond.

A variety of epoxy products are available for use as bonding compounds. The material must meet the requirements of ASTM C 881—"Epoxy-Resin Based Bonding Systems for Concrete," related to physical properties such as bond strength, viscosity, thermal compatibility, and shrinkage. Use of an epoxy bonding agent may produce a vapor barrier, resulting in the failure of the bond. Epoxies have poor creep properties and should be avoided when the repair is subject to constant loading. The additional step in the repair process, application of a bonding agent, may create an additional quality assurance problem. Bonding agents are not designed to compensate for poor surface preparation. Successful use of bonding agents must include the seven-step bonding process outlined above.



## Additional Sources of Information

ACI 503R-89, Use of Epoxy Compounds with Concrete, ACI Manual of Concrete Practice.

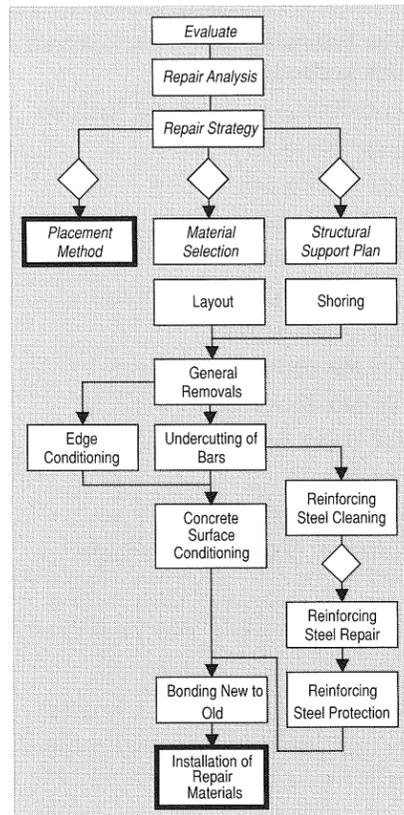
Guide Specifications for Concrete Overlays for Pavements and Bridge Decks, AASHTO-AGC-ARTBA, Task Force 30 Report.

## Section 7: Placement Methods

**The following topics are covered in this section:**

Introduction to Placement Methods  
Summary of Methods  
Dry Packing  
Form and Cast in Place  
Form and Pump  
Grouted Preplaced Aggregate  
Full Depth Repair  
Dry Mix Shotcrete  
Wet Mix Shotcrete  
Full Depth Repair  
Overlays  
Hand-Applied  
Summary of Overlay Materials

# Introduction to Placement Methods



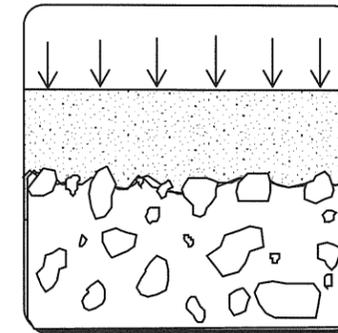
Selection of a surface repair placement method includes the following important steps:

1. Selection of a repair material that best reconstitutes the strength, integrity and performance required by the structure's original design and current situation.
2. Selection of a method of placement that will successfully deliver the repair material onto the prepared concrete substrate.
3. Checking the constructibility of the selected repair material and installation method.
4. Adjusting the material and installation methods to provide a constructible repair.

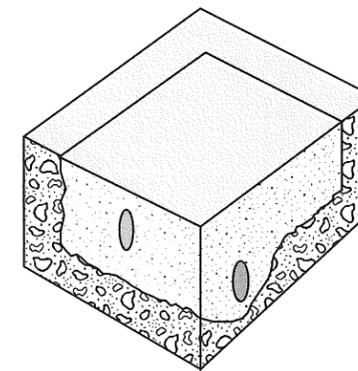
## Important Considerations

The placement technique must deliver the selected repair material to the prepared substrate with specified results. The repair material must achieve satisfactory bond to the existing substrate, must fill the prepared cavity without segregation, and fully encapsulate exposed reinforcing steel. Without achieving the above requirements, the surface repair may not perform its intended structural, protective, and aesthetic duties.

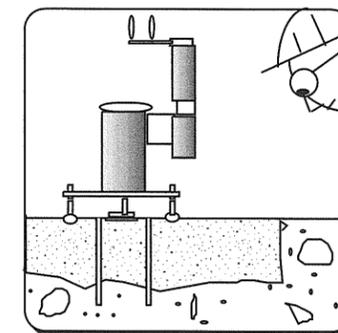
Bond of the repair to the substrate depends to a large degree on mechanical interlocking with the prepared concrete surface. For this to occur, an adequate force should be applied to the repair material to bring it into intimate contact with the prepared surface. The repair material must also have an adequate amount of binder to interact with the prepared surface. The way in which force is applied to the repair material to achieve bond depends on the application technique. In trowel-applied systems, the repair material is forced into the prepared surface by the trowel pressure applied by the finisher/cement mason.



The placement method must consolidate the repair material and create intimate contact between the repair material and the substrate.



The placement method must also fully encapsulate any exposed reinforcing steel and produce a uniform cross section without segregation, cold joints, or voids.



1. Drill core through repair into substrate.
2. Attach uni-axial tension testing device to the core.
3. Observe location of break, measure tensile strength of composite.

Dry pack techniques use pressure created when the rodding tools pound the dry pack material against the substrate. When using cast-in-place methods, the pressure is applied by internal vibration or hydraulic pressure induced by the concrete/grout pump. Pneumatically placed repair materials are propelled against the prepared surfaces, resulting in the necessary intimate contact.

The requirement for the repair material to remain uniform during placement is very important. Any segregation of repair material components will alter the repair material's physical properties. Segregation can occur during mixing when adequate time is not allowed to disperse all components. The result is high filler and low binder or high binder and low filler content. Segregation can also occur when pneumatically placed dry mix repair material is used. Air turbulence around large or clustered reinforcing steel can cause segregation, sand pockets and voids.

Complete filling of the surface cavity is also an important step. With certain placement techniques, complete filling may not occur. The form and pump or preplaced aggregate methods are susceptible to incomplete filling. Both methods use formwork which hides the filling process. To ensure proper installation, qualification of techniques and materials is recommended for most applications.

Engineering and durability aspects are the most important considerations when selecting the repair material and application method. The ultimate long-term properties of the repair material are far more important than the ease of application. Before finalizing the repair material and installation procedure, check the constructibility.

## Constructibility

Constructibility is defined by these questions: Can the repair be built within the constraints specified by the engineer and the owner? Will the necessary equipment be accessible to the repair area? Will the specified installation technique allow the repaired structure to be placed in service within the time specified? Is the working environment conducive to a particular installation technique? Are there experienced contractors available for the project?

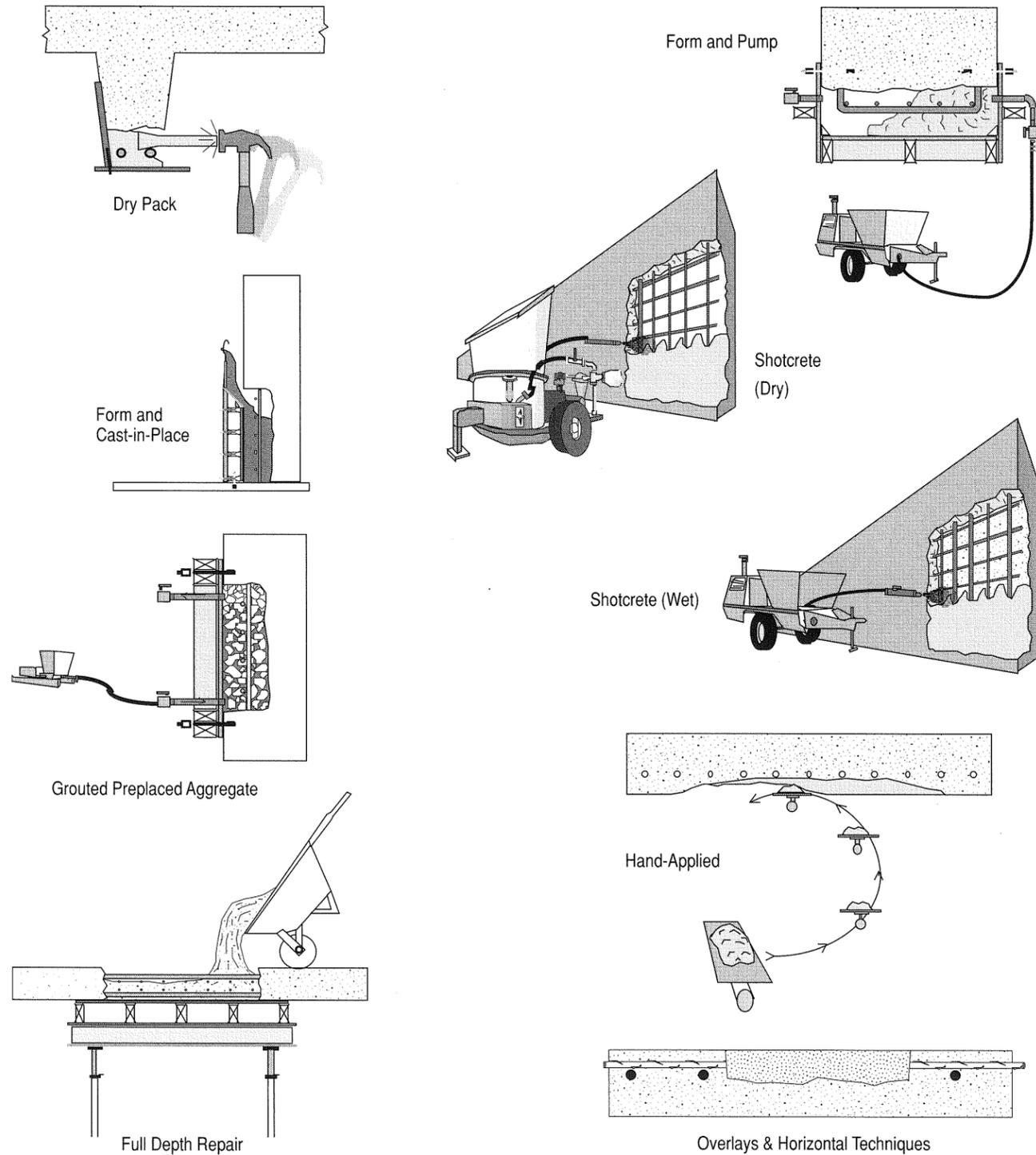
If the answers to these questions are "maybe" or "no," then the repair material and installation method need to be reassessed.

## Quality Assurance and Control

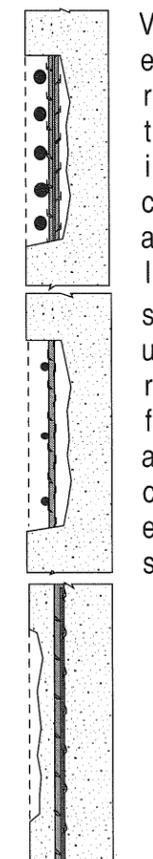
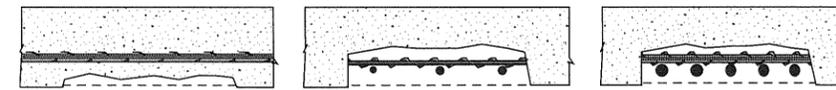
The combination of working conditions, existing concrete, structural design, and repair material is unique to every job. Many problems can arise unless proper quality assurance and routine quality control are exercised. Start by selecting a qualified contractor who has to demonstrate long-term, successful repair jobs performed with the intended installation method. If any questions exist regarding the contractor's qualifications, the repair material, or the installation technique, consider a pilot project. During the repair project, develop routine feedback as to the engineering requirements. Physical properties can be verified by sampling and testing. Bond strengths can be verified by coring through the repair and into the substrate, followed by applying a tensile force to the core.

# Summary of Methods

## Summary



## Overhead surfaces



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For vertical surfaces involving small bars, form-and-pump, form and cast-in-place, grouted preplaced aggregate, or shotcrete methods are the best choices. Formed methods may provide for more uniform surface appearance.

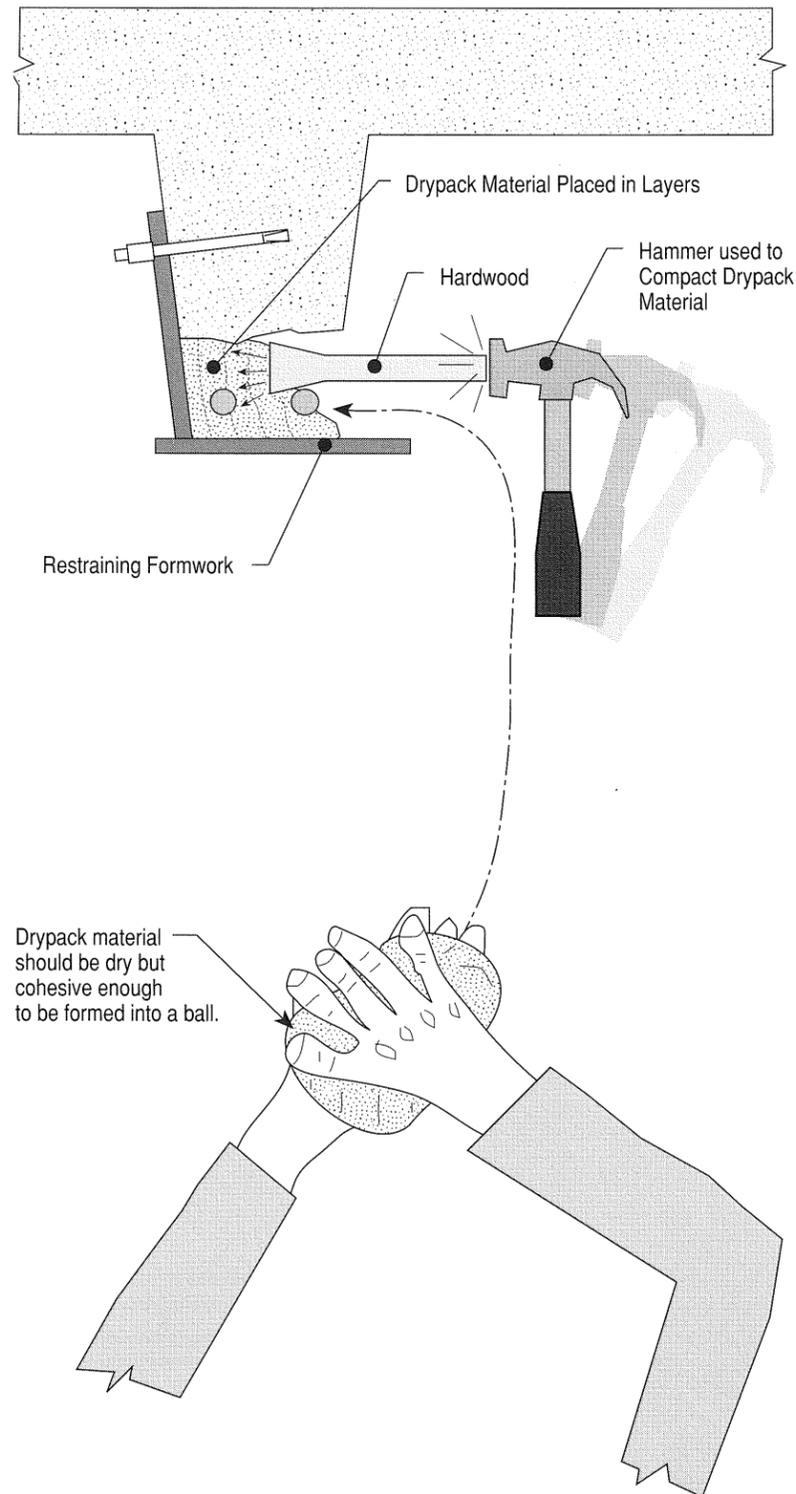
Surfaces incorporating closely spaced bars ( $> \#6$ ), are best repaired by the form-and-pump technique. Use of other methods may result in poor consolidation around the reinforcing steel. On vertical surfaces, any of the formed methods can be used.

Small, deep repairs are best accomplished with dry packing techniques. Thin surface repairs, which do not incorporate reinforcement, are best accomplished with hand-placed mortar or dry or wet mix shotcrete. For very thin (less than  $1/4"$  (6.5mm)) or very small areas, hand placement works well. For large areas, shotcrete is the best choice. A combination of wet mix low pressure shotcrete and hand troweling are ideal techniques for resurfacing exposed aggregate or bug hole surfaces.



Surfaces incorporating small diameter bars ( $\#6$  and less) and not congested reinforcing, can be repaired with either the form-and-pump or shotcrete techniques. When using shotcrete, care must be exercised not to form sand pockets or voids on the backside of the reinforcement.

# Dry Packing



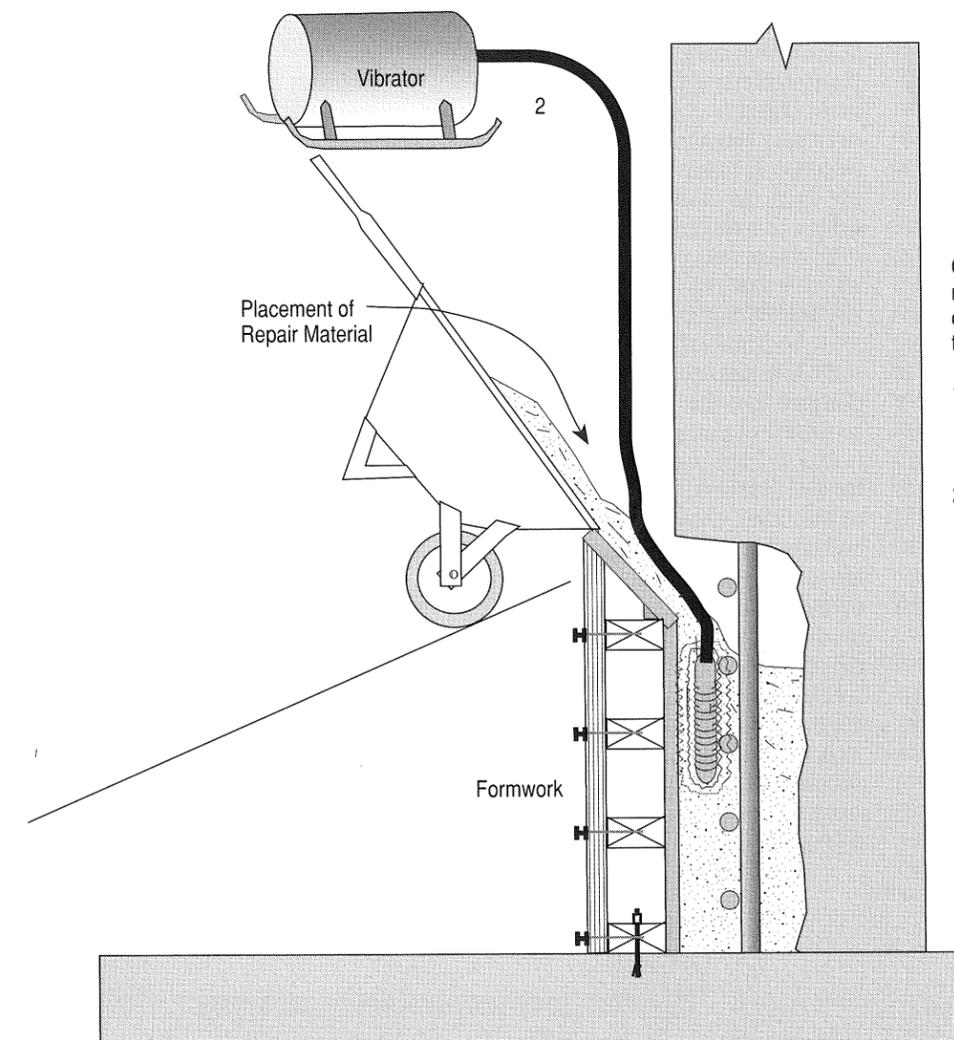
Dry packing is a method of placing zero-slump, or near zero-slump, mortar or concrete, by ramming, into surface cavities. The consistency of dry pack mortar must be such that it can be molded into a ball without excessive bleeding. Compaction densifies the mortar and provides the necessary intimate contact with the existing concrete for achieving bond. Dry packing techniques can be used in all locations: overhead, vertical and flat. Best applications are generally small cavities such as tie holes, small areas of surface honeycomb, or rib bottoms (shown in illustration).

Each dry pack mortar repair is placed in layers. Compaction is achieved with a hardwood stick to prevent polishing of the surface. Curing is accomplished with a continuous 7-day moist cure.

# Form and Cast-in-Place

One of the most common methods of surface repair of vertical and, in some cases, overhead locations is the placement of formwork and casting of repair material into the prepared cavity. Formwork facilitates the use of many different repair materials, selected on the basis of in-place performance vs. constructibility. The repair material must be of low shrinkage and provide the necessary flowability. Placement of repair materials follows normal placement practice. Rodding or

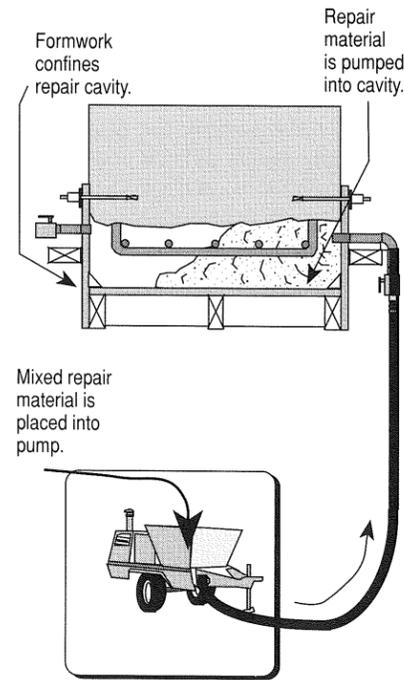
internal vibration is necessary to remove air and provide intimate contact with the existing concrete substrate. Formed surfaces make the placement of bonding agents difficult and, in most applications, unnecessary. Forms are made with necessary shoots to provide access of the repair material into the formed cavity. In some applications, complete filling of the cavity may be difficult. In those cases, a final step of dry packing the remaining cavity works well.



Consolidation of the repair material is accomplished with one of the following techniques:

1. The repair material is formulated to be extremely flowable and self-consolidating, or...
2. the repair material is placed into top of form and free falls into the prepared cavity where conventional internal vibrators are used, or...
3. rodding of the repair material from an access point in the formwork, or...
4. external vibration of formwork.

# Form and Pump



There are many techniques available to restore damaged or deteriorated concrete surfaces. Each surface repair technique offers advantages and limitations, depending upon the specific conditions of the repair project. Form and pump technique is a relatively new method developed over the past 20

years, coinciding with the development of variable output concrete and mortar pumps. Form and pump technique is used for vertical and overhead applications. Form and pump technique is an alternative to shotcrete (gunite), hand placement, and grouted preplaced aggregate techniques.

## What Is the Form and Pump Technique?

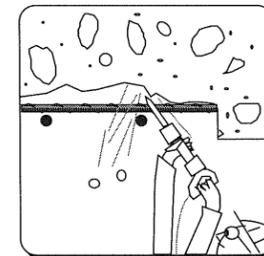
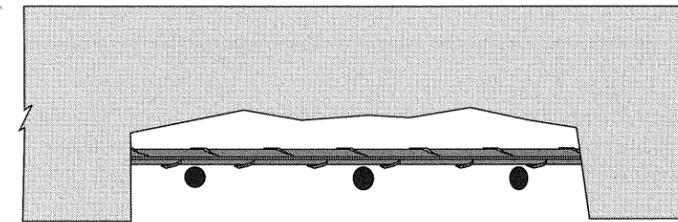
The form and pump repair method is a two-step process of constructing formwork and pumping repair material into the cavity confined by formwork and existing concrete. The form and pump technique allows the use of many different repair materials. The necessary requirement for material selection is pumpability. Various pumps are used, depending upon the mix design (particularly the aggregate size). Prior to construction of formwork, any surfaces that may cause air to become trapped during the pumping process must be trimmed, or vent tubes installed. Repair materials are mixed and pumped into the confined cavity. The sequence of pumping is from low points to high points and when performed overhead, from one extremity to the other. Large areas may require bulkheading to separate placements into manageable areas. When the cavity is full, pump pressure is exerted on the form, causing the repair material to consolidate and make intimate contact, and effect bonding with existing concrete surfaces. Form and pump technique offers many advantages to alternative techniques, such as shotcrete, hand-placement, and preplaced aggregate. Advantages include:

- The use of almost any repair material—from fine grained mortars to coarse aggregate concrete, including polymers and hydraulic cement materials.
- Placement is not limited by depth of repair or by size or density of exposed reinforcement.
- Repair materials are premixed and placed to provide a uniform cross section without segregation or intermediate bond lines.
- The process does not depend on fighting the forces of gravity; all materials are supported by formwork during the placement and curing process.
- The pressurization process consolidates the repair material, providing for full encapsulation of exposed reinforcing steel.
- The formwork protects the repair material during the curing process.
- The process is less subject to individual operator error.
- Quality assurance of the in-place repair is easier to provide.

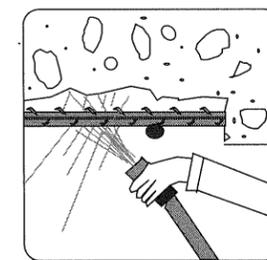
## Surface Preparation

Regardless of the repair method, surface preparation is essentially the same. Concrete is removed until sound concrete is located. Exposed bars are undercut, and surfaces are cleaned with high pressure water or are abrasively blasted.

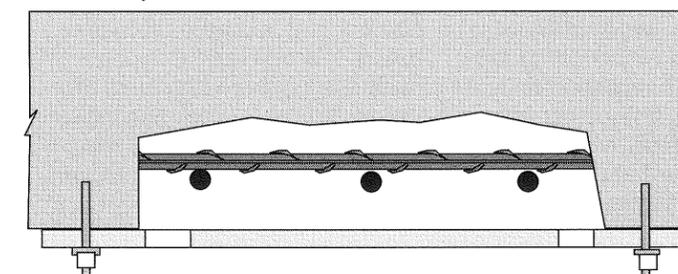
With form and pump techniques, it is important to understand how the existing surfaces will permit the repair material to penetrate and flow. Surfaces that might trap air need to be trimmed, or vent pipes may be provided in the formwork. Profile roughness from hand chipping or hydrodemolition is not generally a problem for entrapping air. Flow of the repair material (while flowing within the formed cavity) will most likely remove air from the profile.



Surface preparation requires removal of loose and deteriorated concrete, and also includes concrete removal behind exposed bars.



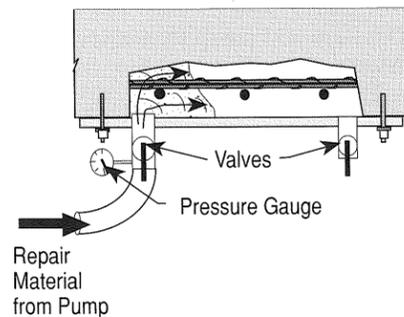
After completion of removals and cleaning, formwork is erected to enclose cavity.



## Formwork

Formwork must accommodate the weight and pressure of the repair material. Design of the forms should follow standard practice for cast-in-place concrete construction except for the calculation of form pressure. Form pressure should be designed for a minimum of 14 psi (96.5 kPa). Maximum pressure exerted on formwork occurs after the formwork cavity is full and pressurized. Formwork is best attached directly to the concrete surface with expansion anchors or standard form ties. All anchors should be preloaded to prevent slippage during placement. In some applications shoring or scaffolding can be used to support the formwork. Forms should be constructed to fit tightly against existing concrete surfaces. Preformed foam gaskets or cast-in-place foam works well to address difficult-to-match surfaces. Attachment of pump hose to form work is achieved with various techniques including plumbing fittings with flanges and ball valves or with the use of pump line attachment with hand-held friction fit insertion followed by wooden plugs.

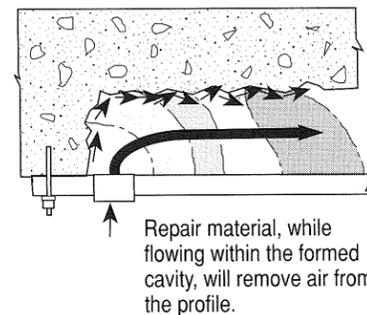
## Form and Pump, continued



### Pumping Equipment

Pumping equipment is generally matched to the type of repair material and the size of the repair project. The specified repair material requires pumping through a pump line to the formed cavity. Cementitious repair materials have various aggregate contents and aggregate sizes. Fine-grained repair mixes with little or no coarse

aggregate can be pumped with mono-type pumps or piston/ball valve pumps. Repair materials with large aggregates (larger than 3/8" (9.5mm)) are best pumped with hydraulic/swing valve pumps. All pumping equipment must have adequate controls to regulate flow rates.



### Materials

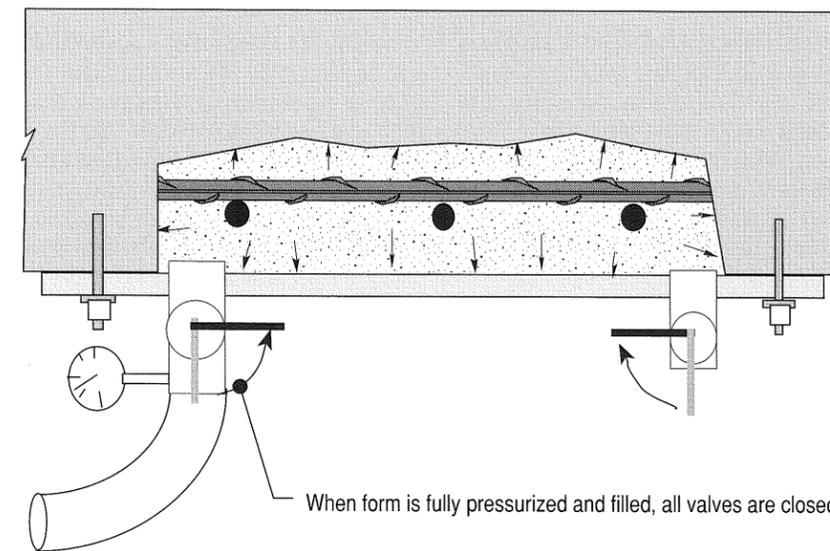
Constructibility requirements for materials used with form and pump technique are limited only by their ability to be pumped and their flow characteristics. More important than constructibility are the materials' in-place properties, such as low drying shrinkage, compatible strength, thermal and elastic properties, and any durability requirements. While constructibility of the repair materials requires good pumpability and flowability, these required characteristics should not sacrifice the requirement of low drying shrinkage. Drying shrinkage can cause cracking, delamination, inability to carry loads and low durability. Pump-

ability and flowability can be brought to the material with aggregate shape and chemical admixtures which preserve low water-cement ratio, yet provide high slump. Prepackaged repair materials, which are designed for pumping and incorporate shrinkage compensating additives, are appropriate for many applications. Materials should be screened for drying shrinkage to find those with low shrinkage. Shrinkage testing in accordance with ASTM C 157 (modified in accordance with ASTM C 928 and measured over a 120 day period) will provide meaningful shrinkage properties.

### Placement

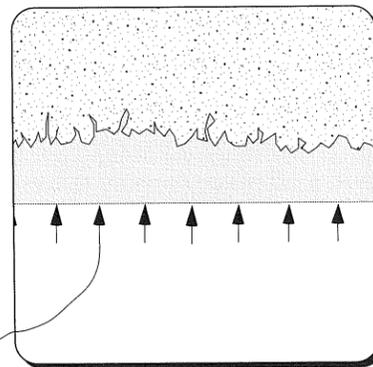
The sequence of material placement into the formed cavity depends upon the geometrics involved. Vertical surfaces start at the lowest point, filling in a manner that prevents air entrapment. Arrangement of ports for pump line attachments is usually horizontal with spacing of 3 to 4 feet (90 to 120 cm) in grid form. Pumping continues even after material flow occurs from adjacent ports in order to expel air. When the flow is without intrusion of air, the pump is temporarily shut off,

the port closed off, and the pump line connected to the adjacent port which has seen flow. The sequence is continued until the cavity is filled. In some conditions, the cavity can be pumped from one port. In this situation, each adjacent port is capped off as flow occurs. It is necessary to monitor pump line pressure to prevent excessive backpressure when pumping long distances. Once the cavity is filled, the full line pressure is available to pressurize the formed cavity.



Care must be exercised in the final pressurization, since the excessive pump line pressure (hydraulic pumps can exert in excess of 800 psi (5.5 MPa)) may cause the form to fail. In most applications pressure gauges should be attached to the pump line near the exit port to monitor cavity pressure, which should not exceed the formwork design pressure. If the formwork fails due to over-pressurization, the failure will generally occur as a slight movement in a panel seam or perimeter seal. The failure is not explosive since there is no stored energy. Overhead placements are accomplished by starting at an extremity of the surface and proceeding in a fashion similar to vertical placements. Material will flow radially from the injection port to adjacent ports. Repairs involving soffit and vertical faces of members can be combined into one placement. In this case, placement begins at the lowest elevation and follows the procedure detailed above for each orientation. Large areas of repair should be sectionalized utilizing bulkheads. Bulkheads can be constructed of repair material and left in place. Utilizing bulkheads and manageable placement volumes limits the risk of problems associated with large placements and allows pressurization to occur within shorter durations of material mixing.

## Form and Pump, continued



Hydraulic pressure from pump drives repair material into pore structure of substrate.

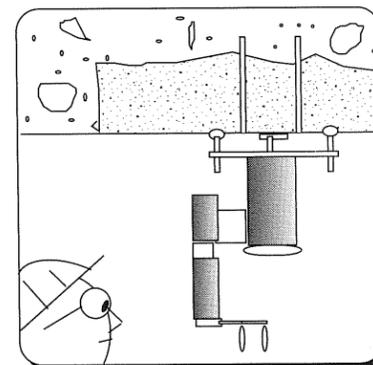
### Bonding of the New Repair Material to Existing Concrete

Achieving an adequate bond between repair material and existing concrete is a critical requirement for surface repairs. To receive the repair material, surfaces of existing concrete must be sound, clean and free of bond-inhibiting materials (oil, fats, hardened epoxy, etc.). The surfaces of existing concrete must have an open pore structure.

An important bonding mechanism is the absorption of the repair material into the surface pore structure. If the pore structure is clogged with dust, slurry, or water, the absorption process

will be hindered. The surface repair material must have a sufficient amount of fluid paste for absorption into the open pore structure of the substrate. The surface repair material must be installed in a manner which produces intimate contact between the new and existing materials at the bond line.

Internal hydraulic pressure created by pump pressure in confined spaces provides additional driving force to knit the new and existing materials together. With most pumpable repair materials, separate bonding agents are not required.



Direct Uniaxial Tension Device

### Quality Assurance

Any surface repair technique is subject to less than expected results. Care and understanding must be exercised to perform the various steps involved. With all techniques, each step is critical to the success of the completed repair. A perfect repair material will not compensate for imperfect surface preparation. The beginning of any repair project should include a mock-up or pilot project which tests the proposed procedure and repair material against required objectives of the project. Once the procedure and materials are deemed satisfactory, the repair project will require ongoing quality control and assurance.

Measuring uniformity, density, bond, and strength are the most common quality control procedures. Measuring in situ uniformity, density, and bond is best performed by extracting core samples which pass through the new and existing materials. Visual examination of the cores reveals uniformity and density defects. Attachment of a direct uniaxial tension pull device to

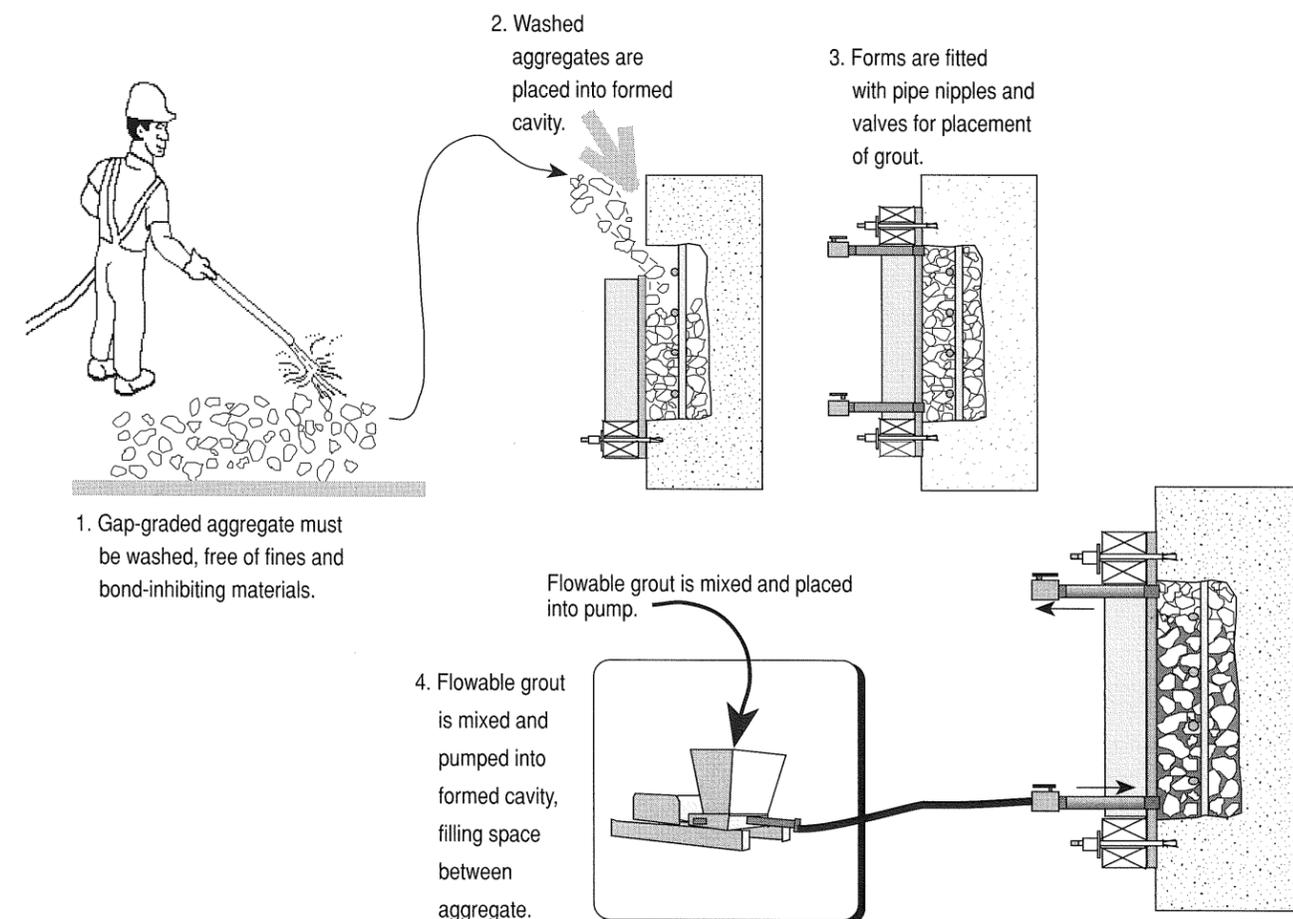
the in-place core quantitatively measures tensile stress capability of the composite material. Generally, the tension device is loaded to failure. Upon failure of the core specimen from the member, a visual examination of the failure plane location reveals whether the failure occurred at the bond line, within the substrate, or within the repair material. The most desirable location of the failure plane is within the substrate. Failures at the bond line at unacceptably low tension stress levels generally point to problems with surface preparation procedures or improper form pressurization.

The most common problem associated with form and pump repairs is lack of pressurization of the formed cavity, which may result in areas without repair material or poor bond. Upon completion of the surface repair (after formwork has been removed) surfaces should be sounded with a hammer to locate any areas that might be unbonded or contain voids.

## Grouted Preplaced Aggregate

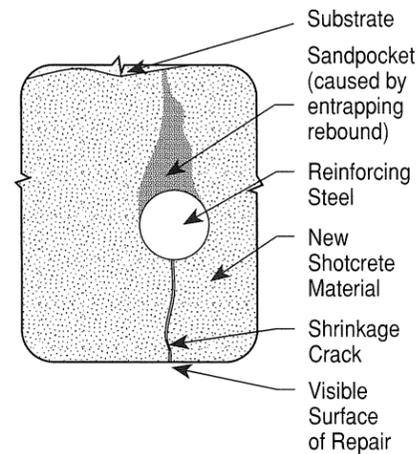
Grouted preplaced aggregate is a two-step process. The first step involves aggregate placement into the cavity during the erection of formwork. The aggregate is gap-graded and washed of all fines. The void ratio of the cavity, after the aggregate is placed, ranges from 40% to 50%. The second step involves pumping a highly flowable grout through the formwork and into the preplaced aggregate. Grout flow fills the lower voids and progressively fills the cavity, eventually flowing to higher elevation ports. After grout flows from adjacent ports, the grout hose is disconnected from the port being pumped, and reconnected

to the port showing new flow. The process continues until the cavity is full and pressurized. The grout flow makes contact with the prepared substrate as the cavity is filled, providing intimate contact and bonding. A unique advantage of this method is the low drying shrinkage of the repair material due to the point-to-point contact between the coarse aggregates. The aggregate contact restricts the volume change of the cement grout as drying shrinkage occurs. Various grouts can be used for the grouting process. Most popular are Portland cement-based grouts and, for special applications, epoxy resins.



# Dry Mix Shotcrete

Enlarged View of Sandpock Formed Behind Reinforcing Steel

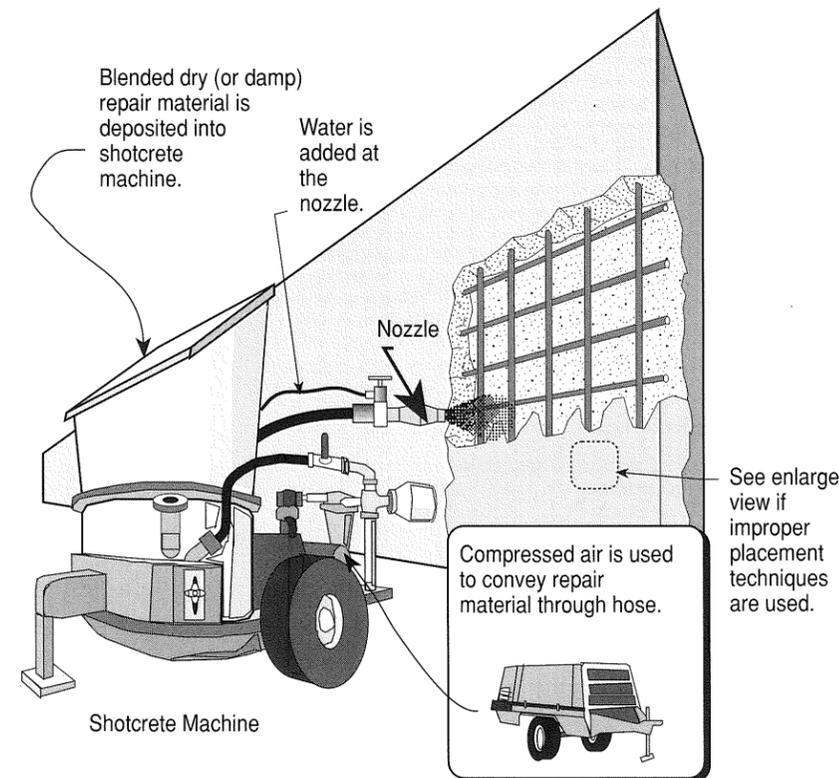


Dry mix shotcrete is a method that involves the premixing of binder and aggregates, which are then fed into a special mechanical feeder metering the premixed materials into a hose. The material is conveyed through the hose with compressed air to a nozzle which is outfitted with a water ring where additional water is mixed with the binder and aggregates. The mix is jetted from the nozzle at high velocity onto the prepared concrete surfaces. The process varies, depending upon the necessary thickness and orientation. Where the repair is thick, the process may involve the placement of multiple layers. Excessive thickness of

individual layers may result in sloughing off. The use of special admixtures has helped improve the workability and performance of shotcrete. Silica fume is a good property enhancer. It improves the concrete's adhesive and cohesive properties, along with its ability to provide for larger placement thicknesses. The resulting hardened properties include increased flexural and compressive strengths and increased durability to freeze-thaw and chemical attack. The use of chemical accelerators should be avoided where not absolutely necessary. Accelerators have been found to cause increased drying shrinkage<sup>1</sup>.

## Typical Problems Associated with Shotcrete Repairs

- Presence of voids due to encapsulated rebound; common when multiple layers are used or when heavy reinforcing is encountered.
- Shrinkage cracking caused by high cement content, improper curing, or excessive water content.



## Additives for Dry Mix Shotcrete

Additives	Benefit	Comments
Silica Fume	<ul style="list-style-type: none"> <li>• Increased thickness</li> <li>• Increased density</li> <li>• Increased freeze-thaw resistance</li> <li>• Increased chemical resistance</li> <li>• Reduced rebound</li> <li>• Increased adhesion</li> <li>• Increased flexural and compressive strength</li> </ul>	
Accelerators	<ul style="list-style-type: none"> <li>• Increase/buildup of layers</li> <li>• Reduced initial set time</li> <li>• Increase early strength gain</li> </ul>	<ul style="list-style-type: none"> <li>• Increased drying shrinkage</li> <li>• Reduced shotcrete strength with age</li> <li>• Not necessary if silica fume is used</li> </ul>
Steel Fiber	<ul style="list-style-type: none"> <li>• Elimination of shadows and voids which are created with conventional reinforcement</li> <li>• Improved impact resistance.</li> </ul>	
Polypropylene Fibers	<ul style="list-style-type: none"> <li>• Reduced plastic shrinkage cracking</li> </ul>	
Latex	<ul style="list-style-type: none"> <li>• Improved flexural, tensile bond strengths</li> <li>• Increased resistance to freeze-thaw and chemical attack.</li> </ul>	<ul style="list-style-type: none"> <li>• Latex hardened film may occur between layers, causing delamination.</li> </ul>

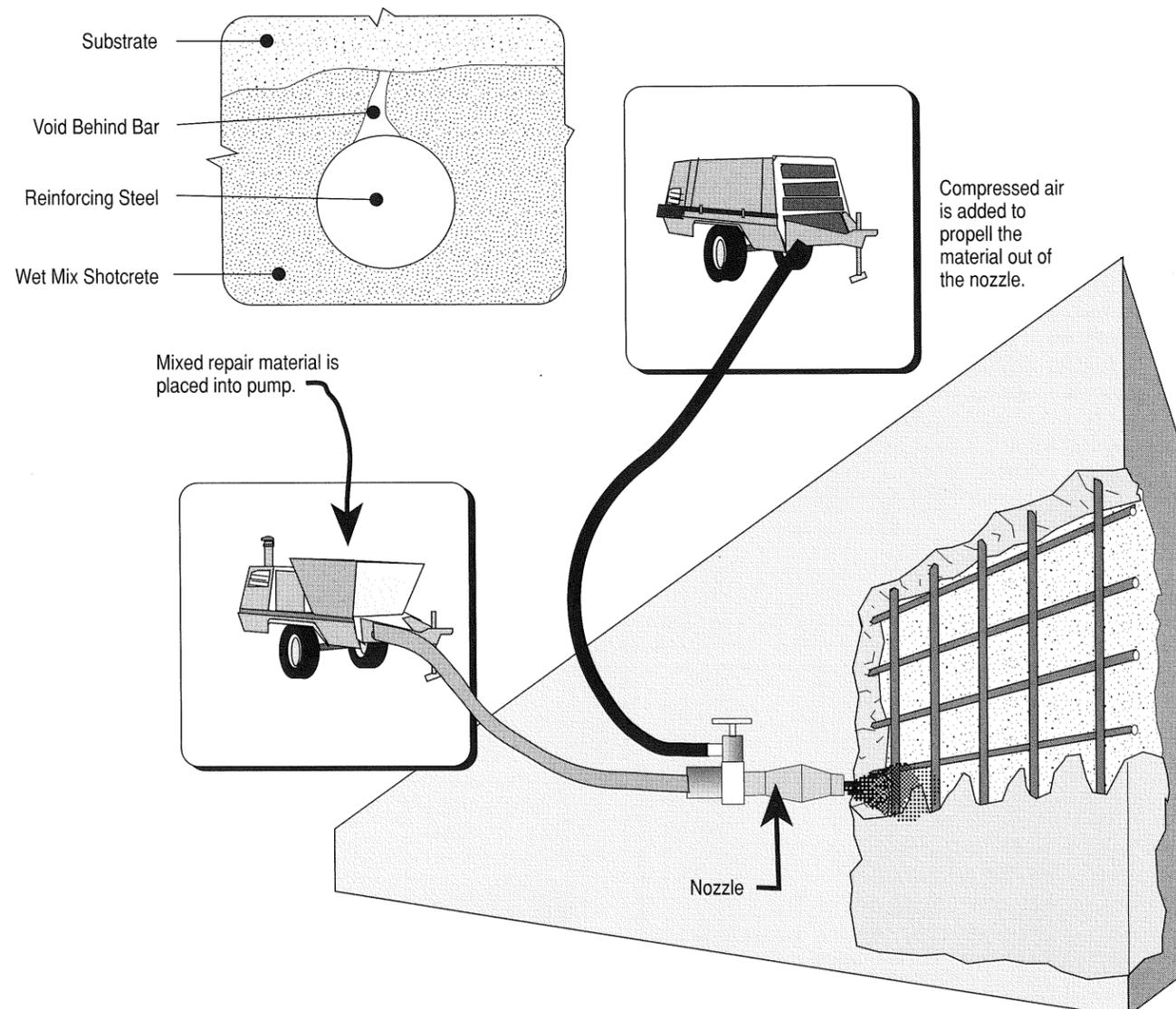
<sup>1</sup>Morgan, D.R., Developments in Shotcrete for Repairs and Rehabilitation, Concrete Construction, No. 9, September 1991.

# Wet Mix Shotcrete

Wet mix shotcrete is a method that involves premixing of all ingredients (except accelerators) including binder, aggregates, admixtures, and mixing water. The premixed repair materials are deposited into a pump or pressure vessel which transports the materials to an exit nozzle, where compressed

air is introduced. The repair material is propelled onto the substrate with compressed air. Admixtures can be used to enhance the shotcrete material. Silica fume and fibers are commonly used to enhance durability. Air entrainment is required for freeze-thaw resistance.

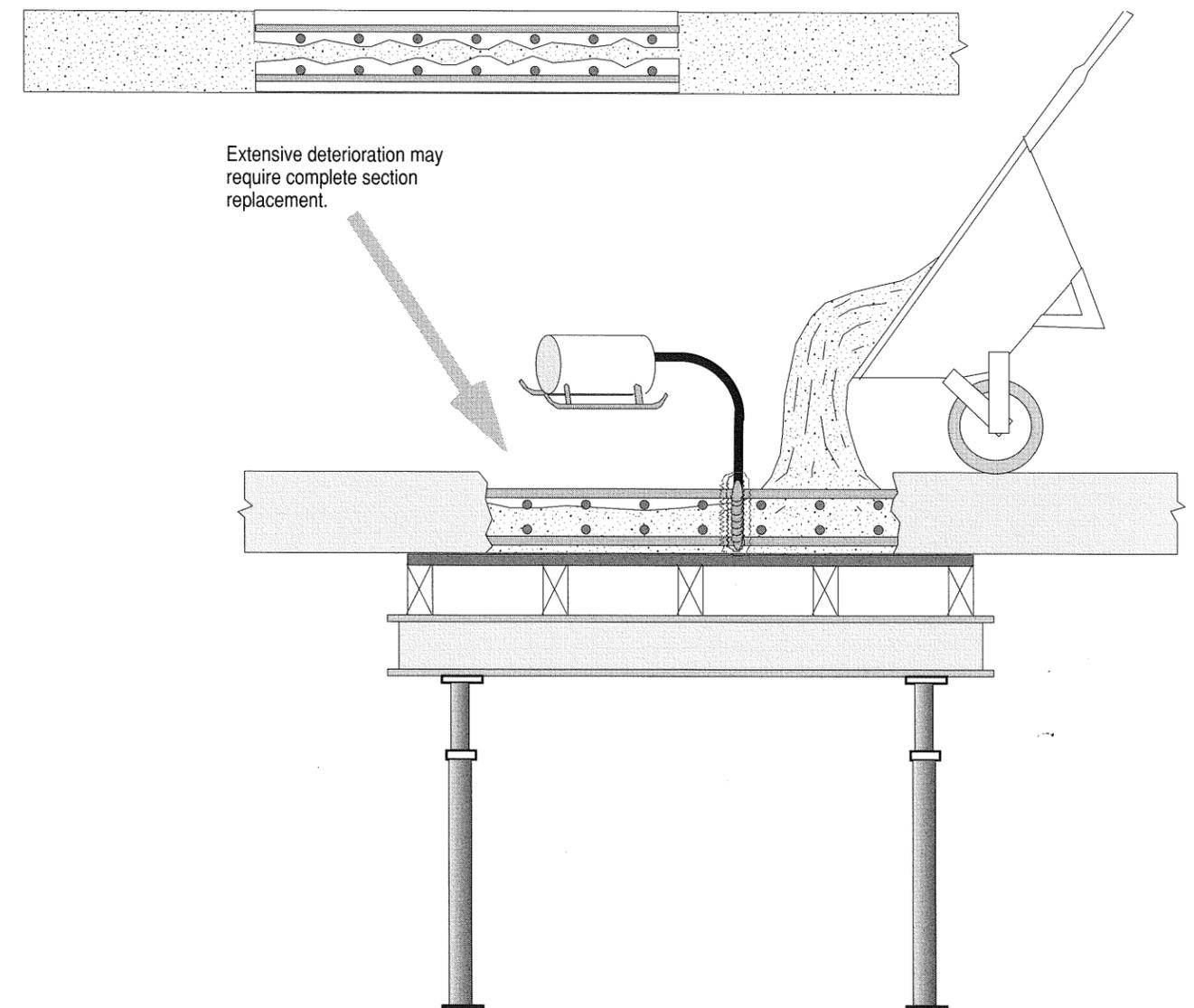
Potential Problem if Improperly Placed



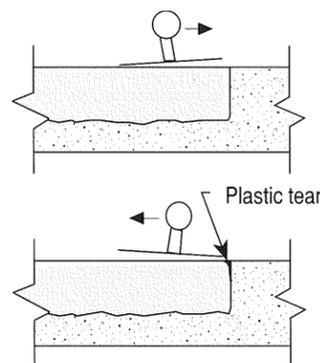
# Full Depth Repair

In certain situations, surface repair may be better served by full depth repair. For example, when concrete surfaces have extensive surface damage, it may be more economical and provide for longer lasting repairs if the affected part of the member is removed and reconstructed. Consideration should be given to minimizing the restrained perimeter drying shrink-

age. After placement of the new concrete, drying shrinkage results, causing tension within the newly reconstructed member and at the bond between new and old. In most cases, if tension stresses are not addressed, unplanned cracking may result. Low shrinkage concrete mixes should be used to reduce shrinkage stresses.



# Overlays



Overlays are used to repair concrete structures as a remedy for a variety of concrete problems. They may be used to improve drainage, rideability, or load carrying capacity; to increase skid resistance; or to protect underlying concrete from aggressive environments. Many overlays also address underlying surface deterioration problems. Overlays can be constructed of different materials from very thin (1/8" (3mm)) to very thick.

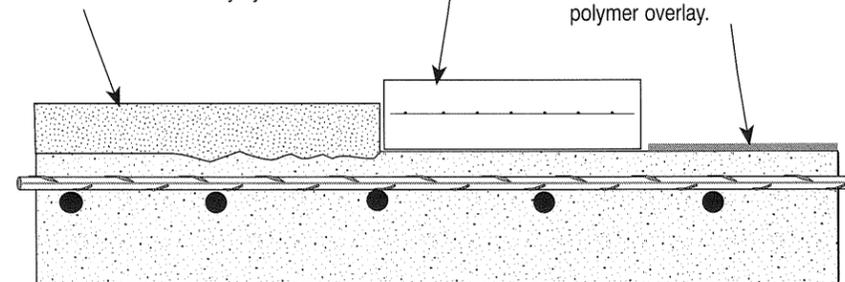
Bridge and parking decks, as well as concrete pavements, are common locations for the use of bonded overlays for restoring existing worn and deteriorated concrete. Surface preparation of existing decks utilizes milling, hydromilling, and hand chipping techniques. Common materials used in the overlays are low water/cement ratio Portland cement concrete, latex-modified Portland cement concrete, and microsilica-modified Portland cement concrete. Most bonded overlays used in parking and bridge decks and pavement repairs involve thickness ranges of 1.5" to 3" (38mm to 76mm). Many applications do not require additional reinforcement. Overlays require special attention to placement techniques to prevent various problems such as plastic shrinkage cracking, lack of consolidation, segregation, or poor bonding.

Other types of overlays involve the use of polymer and polymer-modified mortars for thin applications (less than 1/8" (3mm)). The most common polymer is epoxy, which is combined with graded sand to form a mortar. Polymers also offer additional protection from aggressive environments.

Overlays for bridges and parking structures generally include surface repairs to deteriorated areas of the deck. Hand or power screeds are used to level and consolidate the overlay materials. Normal Portland cement, latex modified or microsilica modified concrete are used for overlay systems.

Thick unbonded overlay, these require internal reinforcement.

Thin hand or power troweled polymer overlay.



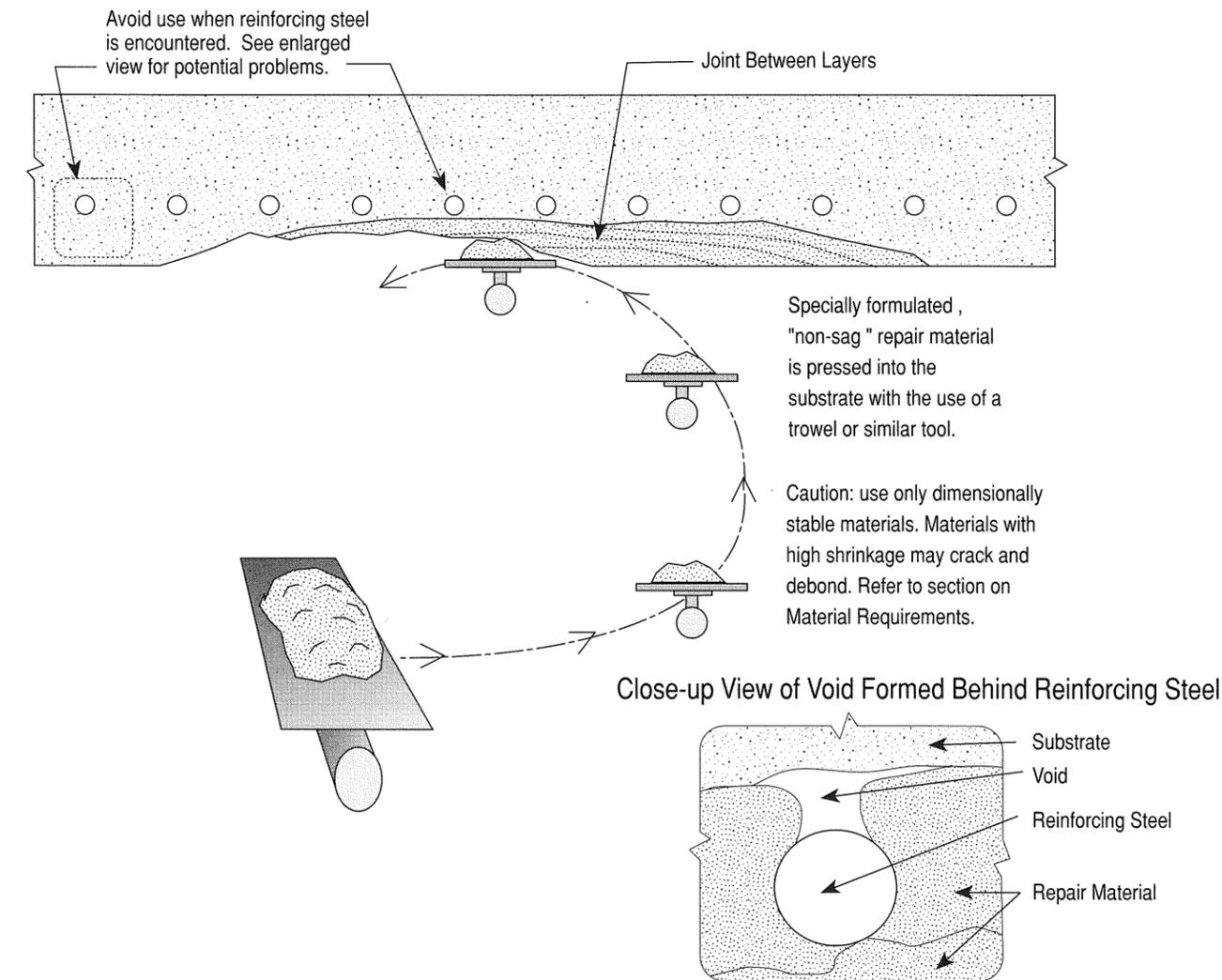
# Summary of Overlay Materials

	Low Slump Dense Concrete (LSDC)	Low Water-Cement Ratio Concrete (LW/C)	Latex Modified Concrete (LMC)	Microsilica Modified Concrete (SFC)	Portland Cement Concrete Over Deck Membrane	Polymer Concrete (Epoxy, MNA, PC)	Comments
<b>Thickness:</b>							
0.125"-0.75"			✓			✓	
0.75"-2"			✓	✓			
2"-3"	✓	✓	✓	✓			
>3"	✓	✓	✓	✓	✓		
<b>Performance:</b>							
-reestablishes new grade	✓	✓	✓	✓	✓	✓	Improves drainage
-Wearing surface	✓	✓	✓	✓	✓	✓	
-Concrete and reinforcement protection	✓	✓	✓	✓	✓	✓	Minimizes penetration and diffusion of aggressive agents.
-Waterproofing the deck					✓		Including cracks and construction joints
-Placed with surface repair	✓	✓	✓	✓			
-Dead load on structure	Moderate	Moderate	Moderate	Moderate	High	Low	Strengthening of superstructure may be necessary.
-Monolithic with slab	✓	✓	✓	✓		✓	Surface of existing deck should be properly prepared for adequate bond.
<b>Overlay Reinforcement:</b>							
-W.W.F.	✓	✓	✓	✓	✓		
-Rebar mat					✓		
-Steel fiber	✓	✓	✓	✓			For high impact conditions
-Plastic fiber	✓	✓	✓	✓		✓	Controls plastic shrinkage
-None	✓	✓	✓	✓		✓	
<b>Compatibility:</b>							
-With elastic membrane	✓	✓	✓	✓			
-Penetrating sealer	✓	✓		✓	✓		

# Hand-Applied

Hand-applied techniques are used to place non-sag repair materials on vertical and overhead locations. Most hand-applied materials are special blends of cement, finely graded aggregates, non-sag fillers, shrinkage compensating systems, and water. The mixed material is applied to the prepared surface with either a trowel or by hand. The applied pressure drives the repair material into the pore structure of the exposed concrete. The repair material is designed to "hang"

in place until subsequent layers are added. Each layer is roughened to promote bond with the next layer. The best use of this technique is for topical cosmetic repairs not involving reinforcing steel. When reinforcing steel is encountered, it is very difficult to consolidate and provide for complete encapsulation of the reinforcing steel. Problems associated with this technique involve poor bond between layers and voids around embedded reinforcing steel.



# Additional Sources of Information

ACI 304R-39, Guide for Measuring, Mixing, Transporting and Placing Concrete.  
 ACI 304.2R-71 (Revised 1982), Placing Concrete by Pumping Methods.  
 ACI 506R-90, Guide to Shotcrete.  
 Guide Specifications for Concrete Overlays for Pavements and Bridge Decks, Task Force 30 Report, AASHTO-AGC-ARTBA.  
 Evaluation and Repair of Concrete Structures, Engineer Manual EM 1110-2-2002, U.S. Army Corps of Engineers, 1986.  
 American Concrete Paving Association Technical Bulletin TB-007.0-C, Guidelines For Bonded Concrete Overlay