SUMMARY

The papers in this ASTM STP 1063 are arranged in two broad categories, namely Components and Assemblages. Components are important from a quality control and production point of view. However the critical test is the performance of the assemblage particularly in light of real world situations.

The papers presented address performance of conventional and new materials under ASTM specifications, substantiation and/or deficiencies of existing ASTM specification criteria, critical examination of application of ASTM test methods, problem areas in masonry and proposed solutions, and structural design and analysis methodologies.

This publication thus contains information of interest to persons producing masonry materials and/or ingredients, masonry components, and masonry assemblages; to persons specifying masonry products; and to persons investigating and/or designing masonry systems. Potential modification to existing specifications and test methods and development of new standards may result from this symposium.

COMPONENTS

Bailey, Matthys, and Edwards have investigated the IRA of both bed surfaces of individually cored, flashed, extruded, and molded brick. Current ASTM C 67-87 allows either bed surface to be used in conducting the IRA test. The study indicated that flashed brick and molded brick may give significantly different IRA values depending on the bed surface tested.

Dunstan, Keck, and Hays present basic properties of ASTM C 90 medium and light weight block utilizing a new lightweight aggregate produced from a mixture of fly ash and hydrated lime. This product, Aardelite, met the requirements of ASTM C33 while producing an economical and technically sound concrete masonry unit.

The current ASTM standard for paving brick, C 902, while acknowledging the need for skid/slip resistance, fails to identify a recommended test procedure. Trimble examines existing slip resistance test methods for application to brick pavers and recommends action for implementation of a method into brick standards.
Hedstrom and Hogan's report addresses many of the concerns of the relationship between grout performance in concrete masonry to grout proportions and to current ASTM C 1019 evaluation procedure. This information will impact provisions of ASTM C 476 and ASTM C 1019 and also grout criteria in building codes.

The variation of aggregate gradation on properties of mortar has been of concern for some time since most masonry sands currently available do not meet the limit requirements of ASTM C 144. Buchanan and Call report the results of an ASTM C 12.04 round robin test to evaluate the effects of broadening C 144 limits. Testing indicates that acceptable mortars can be produced from aggregates slightly exceeding C 144 values.

Ribar and Dubovoy examine the bond strength and water tightness of masonry assemblages with various combinations of masonry cement mortars and clay bricks. Brick properties of IRA and surface texture in conjunction with mortar properties were the primary factors in bond development.

Dickelman traces the development of clay plasticizers for use in masonry mortars. Physical properties of bentonite clay plasticized masonry mortars are compared to conventional mortars when tested in accordance to ASTM C 270. This information will be of direct use to ASTM Committee C 12.09 on Modified Mortars. This committee is currently addressing development of a specification for such mortars.

ASTM Committee C 12 on Mortar For Unit Masonry initiated the development of a specification for Ready Mix Mortar in the early 1980's. Gates, Nelson, and Pistilli present background information and generated test methods and data in comparison to conventional mortars used for development of the specifications. In summary this report concludes that ready mix mortars are at least equivalent to and in most instances superior to conventionally produced mortar.

During development of the ready mix mortar specifications, a provision allowing use of cylinder specimens in place of mortar cubes was inserted based on a similar provision for conventional mortars found in ASTM C 780-87. To substantiate this action for ready mix mortars, Schmidt, Brown, and Tate investigated the relationship of compressive strength for cubes and cylinders for ready mix mortars.

ASTM C 270-86a was the first ASTM Standard that allowed production of any mortar type by proportion specification using masonry cement alone as the
binder. Matthys produced several Type N and Type S Mortars (masonry cement and portland cement lime) using the proportion specification of ASTM C 270 and compared their resulting properties to the property specification requirements of C 270.

Haver, Keeling, Somayaji, Jones, and Heidersbach's paper reviews the available literature on corrosion in masonry. Based on experimental comparisons, some commonly used methods of corrosion analysis in concrete are not accurate for masonry. The paper points out the need for research in this area.

Matthys and Singh's experimental study on compressive strength comparison of 2" cubes versus 3" x 6" cylinders for (1) lab mortars cured in a moist room (2) jobsite mortar cured in lab air and (3) jobsite mortar cured outside should help to establish conversion factors for existing mortar specifications and those currently under developments.

Sriboonlue and Wallo's experimental study on constituent proportions of portland cement lime mortar and grout defines trends in stiffness characteristics.

ASSEMBLAGES

The laboratory flexural bond strengths of one Type N and one Type S prepackaged masonry cement mortar was investigated by McGinley for ten different clay bricks. Bond strengths of 2 psi to 55 psi with coefficients of variation from 30% to 150% were observed. It appears that the IRA of clay units can have a greater influence on the flexural bond strength than is generally accepted by the masonry industry.

Gabby presents a compilation of clay masonry flexural bond stresses for portland cement lime mortars as determined from ASTM E 72, ASTM E 518, and ASTM C 1072. Comparison between test methods shows that there is insignificant differences between results from ASTM E 72 and ASTM C 1072. This information should be of use to ASTM Task Group C 12.03.03/C.15.05.02 which is currently addressing flexural bond performance criteria for masonry.

Nondestructive techniques are becoming more predominant in the overall consideration of evaluating, strengthening, and retrofitting masonry structures. ASTM Task Group C 15.04.06 is currently developing strands in this area. Noland's update reviews existing NDE technologies and points out those that should be considered as possibilities for masonry evaluation.
Brown and Borchelt investigate the relationships between ASTM C 652 hollow clay brick units and portland cement lime mortar type to assemblage strength and stiffness. This information will be of value in addressing performance specification and building code criteria.

A common system of construction in commercial application is attachment of stone panels to buildings. Cement criteria of anchoring procedures are generally empirical. Amrhein, Hatch, and Merrigan investigate the strength of common anchor systems and show large factors of safety to existing code criteria.

A field adapted ASTM E 514 water permeability test is often used by masonry consultants to investigate moisture penetration problems in brick masonry. Such results have influenced decisions on existing structures when debated both inside and outside of courtrooms. Brown addresses the significant differences between the standard ASTM E 514-74 test method and the current field adapted ASTM E 514 method.

Crooks and Herget review the development of masonry construction systems in the U.S. Theory and practical experience have produced recommended masonry practices. Such practices are often abused, particularly in light of differential movement, workmanship, and moisture control. The authors give examples of observed abuse and subsequent repair solutions.

Based on 25 years of experience, Tomasetti reveals situations that have caused physical problems to masonry structures or unacceptable appearance to the design professional and/or owner. Reasons for these occurrences and solutions to the problems are addressed.

Laska, Ostrander, Nelson and Munro report results of a study to generate masonry test data which reflect the actual properties of masonry expected under field conditions. This information will be of use in correlating component properties to assemblage properties and lab properties to field properties. Also an assessment of actual strength versus published code values is made. The authors suggest changes to the ASTM C 270 mortar specifications.

In recent years, with the adoption of ASTM C 270-86a and development of ASCE/ACI 530 Masonry Code, there has been significant interest in the flexural bond capacity of masonry assemblages. Matthys presents bond results of ASTM C 1072
stackbonded concrete block prisms and airbag tests of 4' x 8' concrete block walls using both masonry cement and portland cement lime mortars. This data will be of use to Task Group C 12.03.03/C 15.05.02 in addressing flexural bond performance criteria of masonry.

Mehta reviews the theoretical background on noise level reduction by barriers and its application to thin masonry panels.

In existence is a U.S. - Japan Coordinated Program for Masonry Building Research funded by the National Science Foundation. This program consisted of coordinated research projects that address basic issues of masonry material and structural response to gravity and seismically induced loads. Antrobus, Leiva, Merryman, and Klingner present results of their experimental evaluation of fullscale reinforced masonry two story structures. This work along with others from the TCCMAR program will provide the technical basis for improved building code provisions and appropriate design and analysis methodologies.

Krogstad examines the current ASTM tests for water penetration in light of masonry veneers and cavity walls. He then proposes a new test method for field testing which can be used as a quality control check for new masonry walls or as an investigative tool in evaluating existing masonry leakage problems.

The major structural materials in the U.S.A. have developed an ultimate strength design methodology for structural design. To keep pace clay and concrete masonry need to accurately define the nonlinear stress distribution in compression at ultimate condition. Hamid, Assis, and Harris present such experimental data for grouted concrete masonry.

The potential of explosions occurring in an industrial society is severe enough that a blast resistant design should be considered for public and commercial structures. Volkman examines blastload characteristics, current building code criteria, and a proposed design procedure.

CLOSING REMARKS

The information presented in these papers covers a wide breadth of masonry activity currently in existence from testing laboratories, trade associations, universities, research centers, material manufacturers, ASTM committees, and consulting firms. As usual, reported results often provide potential solutions to problems while also creating other areas
needing attention. It is significant that this most traditional universal building material of components and assemblages is being technically addressed. Let us hope this situation continues and expands. The end result can be no less than proper application and more confidence in the use of these enduring materials.

John H. Matthys
Professor, Civil Engineering
Director, Construction Research Center
University of Texas at Arlington
Symposium Chairman