LARGE—SCALE POOL FIRE
TEST RECOMMENDATIONS

FIREMEN
FIRE MODELING AND SCALING METHODS
510—56—05

C. Perry Bankston

February 26, 1979
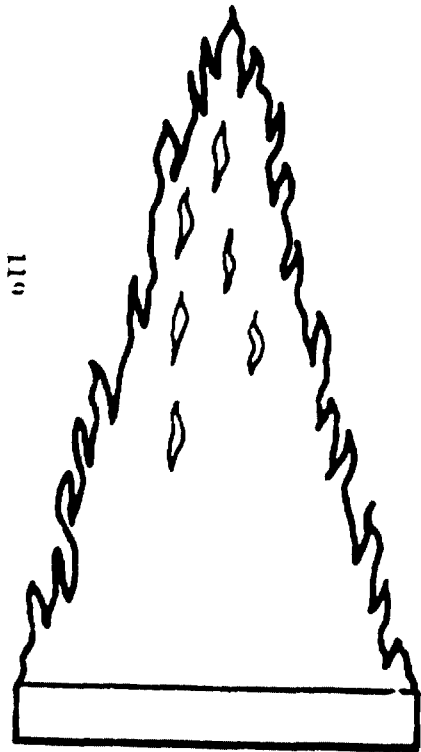
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IMPORTANT ASPECTS
OF
EXTERNAL POOL FIRES

- **HEAT TRANSFER**
    - CONVECTIVE
    - RADIATIVE
- **FLAME CHARACTERISTICS**
    - BURNING RATES
    - FLAME SHAPE, SIZE
    - TURBULENCE
    - WIND EFFECTS
- **PLUME CHARACTERISTICS**
    - ENTRAINMENT
    - TURBULENCE
    - WIND EFFECTS
- **UNSTEADY PHENOMENA**
    - FIRE OSCILLATIONS
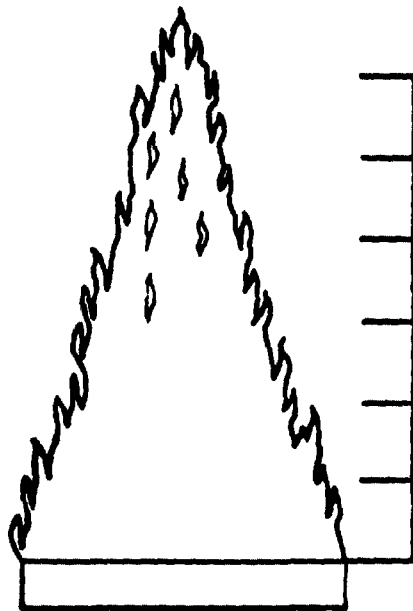   - FIRE WHIRLS

OBJECTIVES

- DETERMINE HEAT FLUX TO SURFACES AS A FUNCTION OF POOL SIZE
    - CONVECTIVE HEAT FLUX
    - RADIATIVE HEAT FLUX

- OBTAIN INFORMATION THAT CAN BE COMPARED WITH THEORETICAL MODEL FOR RADIATIVE FLUX IN THE 'NEAR FIELD'
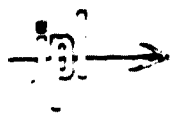
→ PREDICT RADIATIVE HEAT FLUX FOR ARBITRARY POOL SIZE
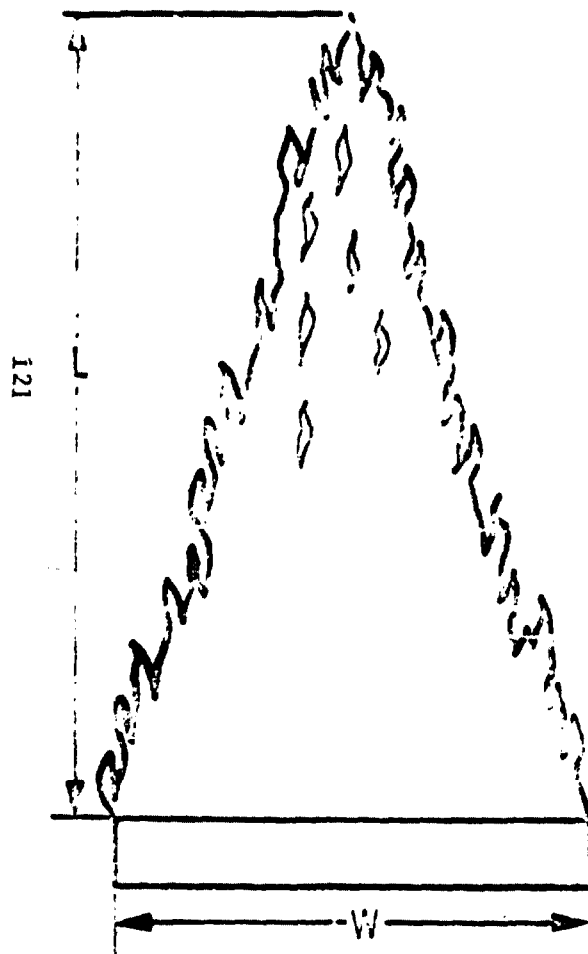
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MEASUREMENTS AND INSTRUMENTATION:

—OPEN POOL FIRES—

- HEAT FLUX: CALORIMETERS, RADIOMETERS

- TEMPERATURE: THERMOCOUPLES

- FLAME SIZE, SHAPE: PHOTOGRAPHY

- WEATHER ENVIRONMENT

# VERTICAL POSITIONING OF NEAR-FIELD HEAT FLUX CALORIMETERS AND THERMOCOUPLES

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	5 FT. POOL $L = 15'$	10 FT. POOL $L \approx 25'$	15 FT. POOL $L \approx 30'$
6	12.5' • 5/2W	25' • 5/2W	30' • 2W
5	10' • 2W	20' • 2W	② 22.5' • 3W/2
4	② 7.5' • 3/2W	② 15' • 3/2W	15' • W
3	5' • W	10' • W	① 10' • 2W/3
2	① 2.5' • W/2	① 5' • W/2	5' • W/3
1	0' • 0W	0' • 0W	0' • 0W

○ REPRESENTS THERMOCOUPLE LOCATION

▭ REPRESENTS HEAT FLUX CALORIMETER LOCATION
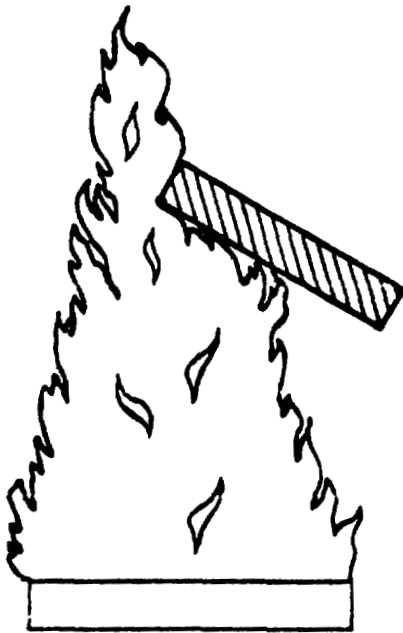
LOCATION OF POOL FIRE INSTRUMENTATION
(PLAN VIEW)

PREVAILING WIND

W

2W

4W
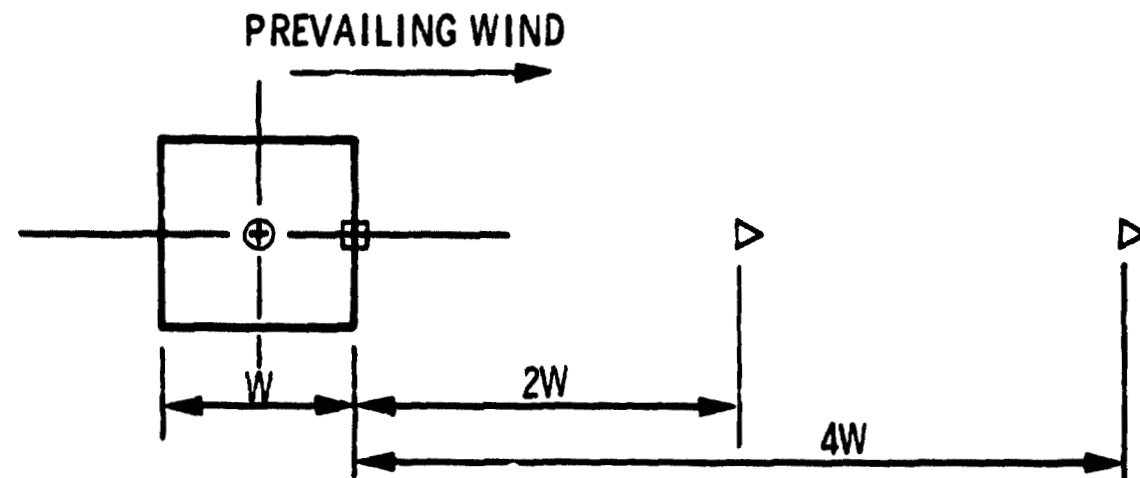
○   IN-THE-FLAME CALORIMETER AND THERMOCOUPLE
(DIRECTED DOWN AT HEIGHT OF 0.6 L)

□   NEAR-FIELD CALORIMETER/THERMOCOUPLE TREE

▷   FAR-FIELD RADIOMETERS

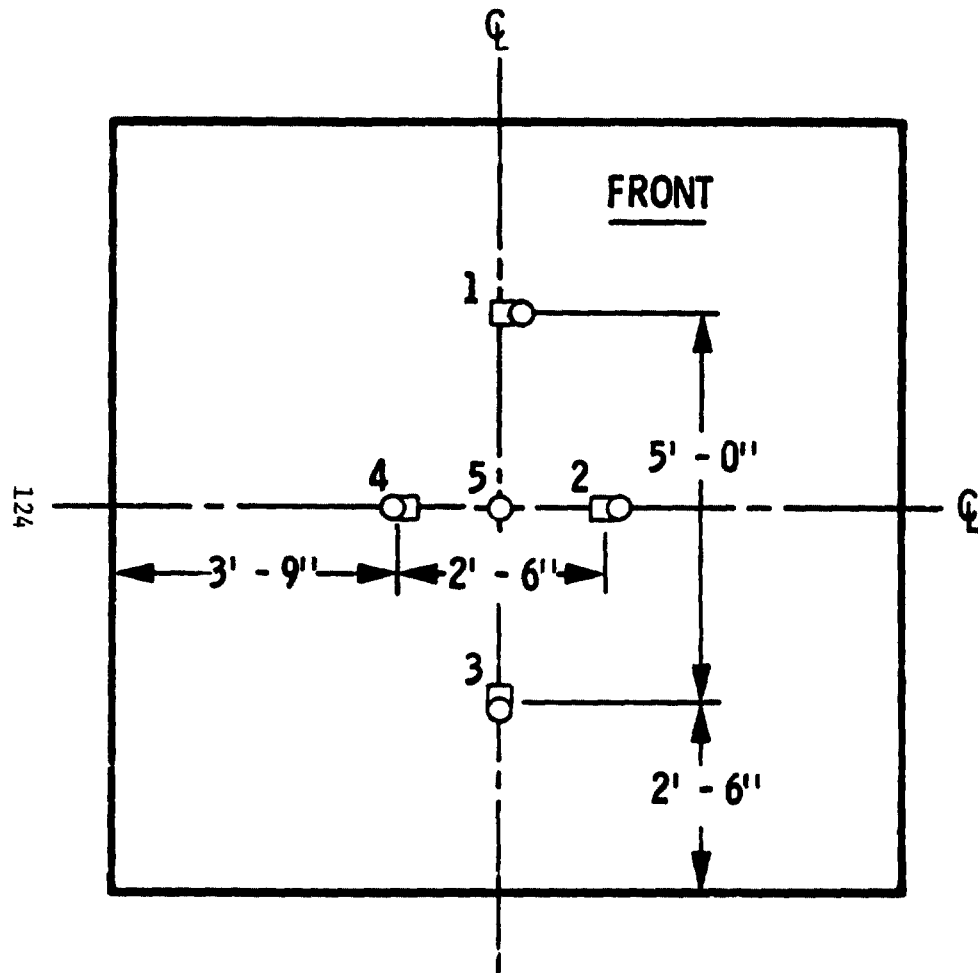# MEASUREMENTS AND INSTRUMENTATION:

———10 FT. X 10 FT. PANELS———

- HEAT FLUX: CALORIMETERS

- TEMPERATURE (GAS, SURFACES): THERMOCOUPLES

- FLAME SIZE, SHAPE: PHOTOGRAPHY

- WEATHER ENVIRONMENT

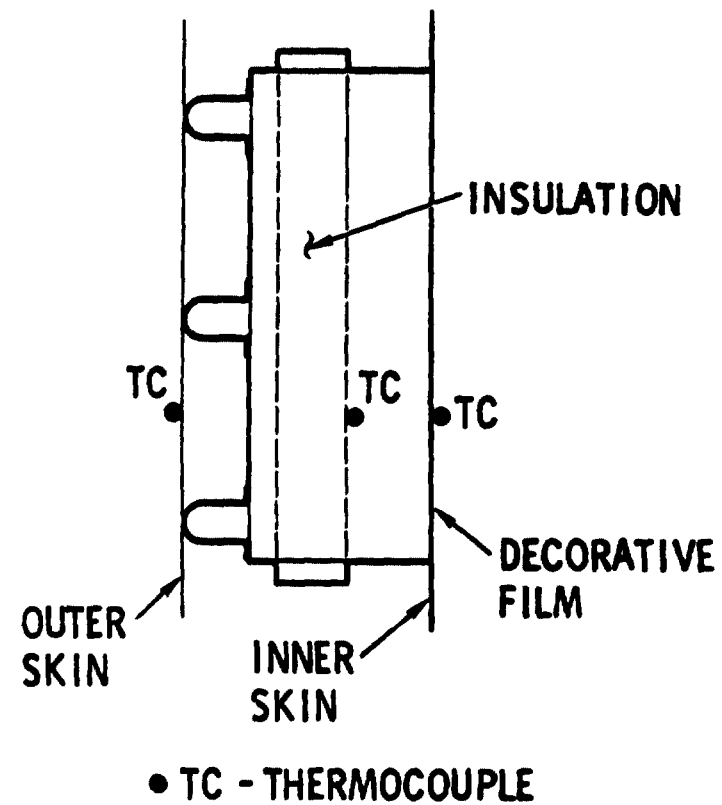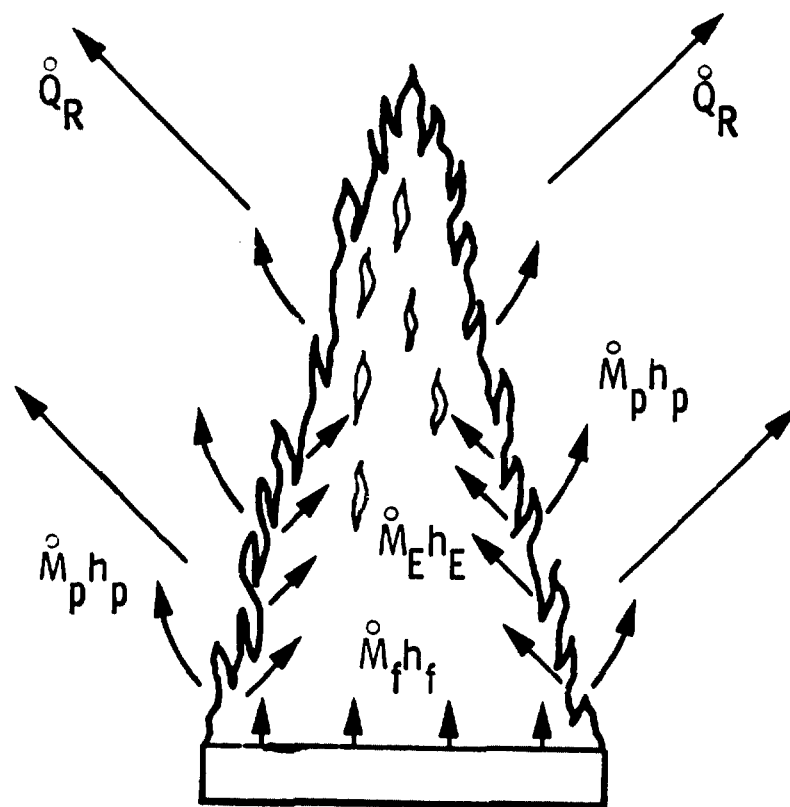# 10 FT X 10 FT PANEL INSTRUMENTATION

FRONT

1

5' - 0"

4   5   2

3' - 9"   2' - 6"

3

2' - 6"

C

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INSULATION

TC   TC   • TC

OUTER
SKIN

INNER
SKIN

DECORATIVE
FILM

● TC - THERMOCOUPLE

○ - THERMOCOUPLE

□ - HEAT FLUX CALORIMETER

POOL FIRE FLAME HEAT BALANCE

$\overset{\circ}{Q}_R$

$\overset{\circ}{Q}_R$

$\overset{\circ}{M}_p h_p$

$\overset{\circ}{M}_p h_p$

$\overset{\circ}{M}_E h_E$

$\overset{\circ}{M}_f h_f$

ENERGY IN:

$$\overset{\circ}{M}_F h_F + \overset{\circ}{M}_E h_E + \beta \overset{\circ}{M}_F \Delta H$$

FUEL   ENTRAINED   COMBUSTION
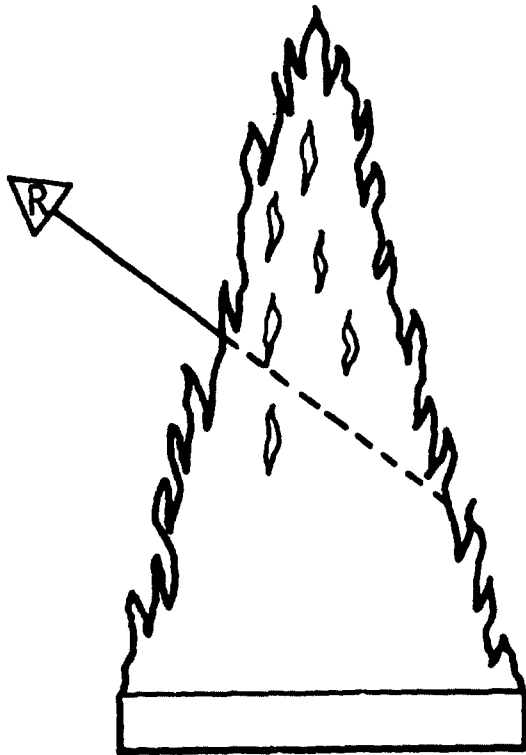AIR

$\boxed{\text{EQUALS}}$

ENERGY OUT:

$$\overset{\circ}{Q}_{R_{TOT}} + \overset{\circ}{M}_p h_P$$

RADIATION   COMBUSTION
PRODUCTS

RADIATIVE HEAT TRANSFER MODELING

- HOMOGENEOUS, ISOTHERMAL ASSUMPTION
  INPUT: FLAME SHAPE
          FLAME TEMPERATURE
          EMISSIVITY
  OUTPUT: SPATIAL DISTRIBUTION OF
           RADIATION IN THE NEAR-FIELD

- NON-HOMOGENEOUS CASE (DETAILED FLAME MODEL)
  INPUT: THERMOCHEMICAL PROPERTIES
          BOUNDARY CONDITIONS
  OUTPUT: FLAME SHAPE, TEMPERATURE, EMISSIVITY
           BURNING RATE, ETC
           SPATIAL DISTRIBUTION OF RADIATION
           IN THE NEAR FIELD