

METATEK POWER HOUSE CONSTRUCTION

BUILDER'S GUIDE

&

CHECKLIST

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OVERVIEW

The Metatek power house design has been completed. The basic structure is a 16’ x25’4” x10’ main building, constructed of concrete block. This is divided into two rooms. The front room is for the electrical switching and control circuitry, as well as a workroom and storage for tools, etc. The back room is the Generator Room, housing 2 generators, with sufficient room for storage of oil, filters, etc to maintain them.

Attached to the basic structure is a Fuel Room, to keep the fuel storage separate from the rest of the facility, and a battery room for the Inverter system. Finishing the design are two block “courtyards” to absorb the noise and direct it upward. The electrical and generator rooms will have plastered walls. The generator room has a special ceiling with fiberglass insulation over wire fencing and screen to absorb the generator noise. The control room ceiling can follow local practice. A standard style truss roof completes the building.

CONSTRUCTION GUIDELINES

This structure was designed to be built following normal building practices, using materials locally available. In fact, the building dimensions are based on an 8x8x16 concrete block, to allow easier construction. Details of the design are mostly taken from the book “MISSION CONSTRUCTION” by Warren Daniels of SIM. A copy of this book may be helpful during construction.

While it is strongly suggested that the overall plan be followed, the builder may also use his experience and the availability of materials to simplify or reduce the cost if needed. An example of this would be

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window size and availability. Headers over doors and windows should be done following normal practice. Another area that can be modified is the roof. The truss design and spacings are suggested as a minimum requirement; the builder can modify or increase the truss numbers if so desired to fit standard practice, etc. A list of items to “do not modify” are provided.

The Builder should read through the entire checklist below before starting construction, and read each checklist section before starting that section. Any questions may be directed to kennell.jeff@gmail.com

“DO NOT MODIFY” LIST

Design items that must be done as shown:

1. The overall size of the building must remain as shown, as it is the minimum needed to allow proper access to the generators and fuel, etc.
2. The height, alignment, and size of the generator pedestals and the exhaust wall openings must be as shown. All of these measurements are CRITICAL and should NOT be changed.
3. The position and size of the wire conduits is very important—place as shown.
4. While the Cable Trough should be sized as shown, the builder may use discretion on how to best form and pour this area. A suggested procedure is given.
5. The size of the air intake openings must be 45x45 finished, as louvers are specified for this size.
6. The size of the doors, as the fuel tank and gensets must pass through them.
7. The roof overhangs in the courtyards may NOT be lengthened due to Airflow requirements.

“OPTIONAL” LIST

The following Items are optional, to be installed if desired:

1. Windows are necessary for light and ventilation, but the size and style of the windows are optional.
2. Window guard bars are advised, install as desired
3. Guard bars may be installed over the courtyard areas if desired
4. A drain may be placed in the floor of the generator room, although it usually works better to absorb any spills with sand.

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BUILDING DRAWINGS

The design presented consists of a PDF document of 26 pages of architectural prints. The prints are arranged in a general order as follows:

Overview--P01-05

P06 is the Footer Layout, and the prints generally work upward in the order of construction

Following is an itemized list of the prints, with descriptions of important points on that print. Also, under each print heading is a Checklist, provided to help make sure all steps are done before moving on to the next step of the building process. This checklist is helpful, but may NOT be all inclusive, and the builder needs to make sure that all needed steps are done following normal building practices for this type of building.

Note: All building interior electrical will be provided for with surface mount fixtures and conduit.

CHECKLIST

A02 POWER HOUSE SITING

The overview just shows the location of the new Power House on the PCH campus. This location can be adjusted slightly if needed—but wire lengths would be affected.

- Make sure site is clear of obstructions and level.

P 01-04 OVERVIEW, SIDE ELEVATIONS

This overview is a general look at the outside of the Power House, showing how it will physically look.

- Understand how the different views fit together (which side is which).

P 05. FLOOR PLAN OVERVIEW

In all overhead (top) views, Front is to the bottom of the page. This overview is a general look at the floorplan showing the relations of all components when installed. The outer dimensions of the building must be those shown. ALSO- The interior walls of the Power house MUST be plastered, ESPECIALLY between the Electrical Room and the Fuel Room.

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- Understand how the Generators, etc, Fit into the Power House.

P 06. FOOTER PLAN

This is the first “construction” print. It should be used with P 07: Foundation Detail to layout, form and finish the Footer. NOTE: the “reference point” used for dimensioning the Footer is NOT the same as that for the foundation and walls, being shifted several inches out. This should not be an issue, as long as it is understood.

- Layout, square, and dig the footer using the dimensions on P 06
- Install and level forms, 16” x 8”, Top at 12” below grade. See P 08
- Compact soil below footer.
- Suspend (2) ½” Rebar, continuous in footers (see P 08)
- Suspend lengths of minimum 35mm² (2 AWG) bare copper wire as shown. Wire must end up completely encased in concrete except for four feet extending into area for the cable trough, and 4’ outside the building. See P 06 and P 08. This will create an excellent grounding effect—do not skip this step.
- Mix the concrete for the Footer at the following ratio:
 - o 1 bag cement
 - o 3 ft³ sand
 - o 4.5 ft³ Gravel (max 1.5” stone)
 - o 7 gallons water (approx)
- Make sure the rebar and copper wire remain suspended during pour.
- Strike off the footer level with the forms.
- “Hide” the copper ground wire by slipping a piece of plastic pipe or the like over it and tucking it down away from view. This is just to discourage the wire from “disappearing”.

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P 07. FOUNDATION PLAN

This should be used with PH 06: Foundation Detail to layout and finish the foundation. NOTE: the “reference point” used for dimensioning the Footer is NOT the same as that for the foundation and walls. This should not be an issue, as long as it is understood.

- Layout the foundation on top of the completed footer
- Lay the First block course complete.
- See P08. It is suggested that the floor for the Cable Trough be formed and poured next level with the top of the first course and at least 18” out from the blocks.
- Make sure copper wire end remains free in trough area.
- The conduits should be laid in place now, and the blocks formed around them. This will be easier than attempting to break thru the blocks at a later time. See P08, 09, 10, 11.
- Form out the Cable trough area. Stuff the ends of the conduits tightly with rags, and butt fit the Conduits tight against the forms. Seal with tape/caulk/etc. to prevent concrete from running into the conduits.
- Lay Second block course.
- Insert 3/8” rebar into every other block and extending up 2” above top of block.
- Fill foundation blocks with concrete. Mix the concrete at the following ratio:
 - 1 bag cement
 - 3 ft³ sand
 - 4.5 ft³ Gravel (max 1.5” stone)
 - 7 gallons water (approx)

P 08. FOUNDATION DETAIL

This should be used with P06 & P07 to correctly layout and finish the footer, foundation, and floor.

It also shows the correct side profile of the Cable trough.

- Attach the Angle irons shown to the forms so they will be set into the concrete. Set them 1¼” below floor level.

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P 09. CONDUIT & TROUGH OVERVIEW.

This should be used with P 08, 10 & 11 to correctly layout and finish the Conduits and Cable Trough in the floor.

- All Conduits 4" PVC as noted.
- Make sure the conduit RISERS are at the dimensions noted on the print. If these are not correct, the Pedestals will not be able to be poured correctly.
- Cap (preferred) or stuff the ends of the conduits extending out of the building to prevent dirt getting in.

P 10. GENSET CONDUIT DETAIL.

This should be used with P05, 08 & 09 to correctly layout and finish the Conduits in the floor.

- Make conduit bends out of (2) 45° bends to ease radius. This makes wire pulling much easier.
- Make sure risers extend a MINIMUM of 6" above the floor level (10" above foundation).

P 11. CONDUIT SIDE VIEW.

P11 shows an west cross section of the generator building, showing general positioning of the conduits and the cable trough. Use with P08, 09 & 10 to lay in the conduits

- Conduits exiting the building to the North (2) and South installed
- Conduits to generators installed

P 12. FLOOR SLAB PLAN

Pouring the floor slab should only be done after all other steps above are complete. Pour Generator Pedestals FIRST, then pour floor slab.

- Complete all steps above this point.

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- Make sure ALL conduits are in place.
- Pour Generator Pedestals FIRST. See P13, Pedestal Detail
- Remove generator pedestal forms.
- Set forms around outside of Foundation, 4" above foundation EXCEPT at outer courtyard walls. Lower these forms ½"-1" to allow slope of courtyard for drainage.
- Double check position and height of Cable trough form.
- If necessary, install a permanent form for the outside of cable trough wall to hold back the sand.
- Repack sand where necessary
- Install concrete wire mesh across entire floor area to pull up into floor while pouring. Do not install over cable trough area.
- IF desired, the concrete pillar bases can be dug and formed for the North Porch at this point. See P12 & P28. Excess concrete from pouring the floor can be used.
- Pour the Floor 4" thick. Make sure to stay at correct height on inner walls, just slope out the courtyards. Mix the concrete at the following ratio:
 - 1 bag cement
 - 2 ft³ sand
 - 3 ft³ Gravel (max ¾" stone)
- Strike, float, and trowel Floor.
- Insert small rebar "ties" into floor every 3' along wall locations to hold walls in place on floor. (Or follow normal construction practice)
- Remove all Forms when floor is set.

P 13. PEDESTAL DETAIL

Form and pour the generator pedestals after the conduits are in place, but before the floor slab. See P12 for the correct position of the pedestals within the building. The position and height of these are precise, care should be taken to get these forms positioned correctly

- Backfill the foundation with sand to the top of the foundation (except by Cable Trough)

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- Pack sand well, particularly under generator pedestals.
- Form up the outside of the pedestal, set 4" above floor level (8" above foundation)
- Suspend outer ring of Rebar, suspend grid at 2 levels
- Double check position and height of forms
- Fill pedestal forms with concrete. Mix the concrete at the following ratio:
 - o 1 bag cement
 - o 2 ft³ sand
 - o 3 ft³ Gravel (max 3/4" stone)
 - o 6 gallons water (approx)
- Strike and level pedestals and trowel.

P 14. DOOR OPENINGS PLAN

P14-16 show the TOP views of the walls, at different levels. P14 shows the wall dimensions and openings (doors) for the FIRST course of wall block

- Complete all steps above this point.
- Layout Walls on top of floor, marking door locations

P 15. WALL PLAN- FIRST COURSE

P14-16 show the TOP views of the walls, at different levels. P15 shows a SUGGESTED block layout for the FIRST course of wall block.

- Lay the first course of block, spacing block as shown for courtyard drainage.
- Fill the first course with concrete
- If desired, put in tie rebar to next course.

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P 16. WALL PLAN- OPENING DETAILS

P14-16 show the TOP views of the walls, at different levels. P16 shows a sample block layout for courses above the first course. All openings are shown, with the Course numbers noted (except doors). Further measurements are shown on the Exterior views P17-25.

NOTE: The course#'s suggested assume a typical 7 ¾" block with ¼" mortar, for a 8" course height. They must be adapted to local construction materials and techniques!

- DURING THE BUILDING OF THE WALLS, normal procedure for filling/rebar, etc, should be followed for a one story block building.
- Lay the second course of block. See PH 23 for air block as shown.
- Lay the 3rd-4th course, allowing Exhaust air openings as shown. These openings must be as shown, with a minimum 45" framed size. See P20, 21.
- Lay the 5th course, adding ventilation spacing in fuel room and battery room outer walls. See P19, P23.
- Lay the 6th -8th course, adding window and air intake openings. See P17, 19, 22, 23, 24, & 25.
NOTE: Window openings can be adjusted to fit available windows. A rough opening of 40" x 40" is shown—this can be adjusted to fit available windows. You may wish to make them 48" tall, to align top of door and top of window.
- Insert window guard grills as needed while building walls.
- Lay 9th course. Form Header over Exhaust openings. See P20, 21.
- Lay 10th course, deleting air vent spacing. See P19, 23.
- Lay 11th course, Form Headers over window if needed (see note above). See P17.
- Continue laying courses until the correct height is reached for the Fuel room and Battery room walls. See P17. Cap these walls—insert Tie downs for the roof.
- Continue laying courses until the correct height is reached for the Courtyard Walls. See P19, P23. Note that last 2 courses end 16" away from fuel & battery room rear walls. Cap these walls.
- Finish the main building walls to full height. See P 17, 18, 20, 22 & 24. Cap the walls
- Insert Tie Downs for the roof trusses into the top blocks when filling

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P 17. FRONT EXTERIOR

P15 shows the Front view, without the porch.

- Lay gable blocks on the main building and over the side rooms. You may wish to set a truss first as a guide.
- Insert Air block as shown
- Install Doors and Window.

P 18. INTERIOR, ELECTRICAL ROOM, FRONT VIEW

P18 shows the Electrical Room Interior view, with details of the inner wall, back fuel room wall, and conduits exiting the building.

- Plaster Inner walls of Electrical Room
- Install Inner Doors

P 19. EXHAUST SIDE EXTERIOR PLAN

P19 shows the west exterior view, with details of the fuel room wall and exhaust courtyard wall. Also, this print shows a side view of the porch area

- Gap lower blocks on courtyard for drainage
- Gap blocks in fuel room for air circulation
- Note setback on courtyard wall for roof overhang

P 20. EXHAUST SIDE - GENERATOR EXHAUST WALL

P20 shows inner exhaust side wall of the main building (courtyard wall removed). This shows the position and size of the generator exhaust air openings.

- Frame exhaust openings in wall exactly as shown—Critical positioning. Also see P21

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P 21. AIR EXHAUST OPENING DETAILS

P21 shows details of the Air Exhaust openings: framing, ductwork, and louvers. The sizing of the wood framing should be adjusted as needed for local usage, but the inner framed size must be maintained. See P20 as well.

- Frame opening to inner dimensions shown to within ¼"
- Install Inner "face" frame to mount the Ductwork to.

P 22. REAR EXTERIOR

P22 shows the south exterior of the building.

- Air block installed for ventilation
- Courtyard walls built to correct height

P 23. AIR INTAKE SIDE EXTERIOR

P23 shows the air intake exterior of the building.

- 1st course of courtyard wall spaced for drainage
- Gap blocks in battery room for air circulation
- Note setback on courtyard wall for roof overhang

P 24. AIR INTAKE INNER WALL

P24 shows air intake wall of the main building (courtyard wall removed). This shows the position and size of the generator intake air openings. See also P25.

- Frame intake openings in wall exactly as shown—size is important.
- Air block installed for static ventilation
- Form Headers over door and intakes.
- Frame and install access door.

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P 25. AIR INTAKE OPENING DETAILS

P25 shows details of the Air Intake openings: framing, and louvers. The sizing of the wood framing should be adjusted as needed for local usage, but the inner framed size must be maintained. See P24 as well.

- Frame opening to inner dimensions shown to within ¼"

P 26. TOP- ROOF TRUSS PLAN

P26 shows a top view of the roof trusses, with suggested spacing and overall roof dimensions.

- Install top plate on walls (2x6, or to local practice)
- Truss spacing laid out and marked
- Trusses set as needed and tied down to walls

P 27. FRONT/REAR - TRUSS DESIGN

P27 shows a view of the suggested truss design from the front and back. It also shows the purlins, and gives measurements for the truss top and bottom chords, etc.

NOTE: The drawing is "sectioned" in half, with the left side showing the roof and truss design of the rear half of the building (courtyards). The right side shows the roof and trusses at the front, over the side rooms as well.

- Truss layout designed 6/12 pitch, 16' wall spacing, 16" overhangs.
- Extend truss as a rafter over fuel room.
- Notch rafter to fit fuel room wall as shown

P 28. PORCH ROOF DETAIL

P28 shows a view of the porch roof from the side. See also P01.

- Pour porch slab if not already done (see P12).
- Build porch roof as shown (see also P01).

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P 29. CEILING RAFTER PLAN

P29 shows a plan view of the ceiling rafters. See also P18 and P30.

- Frame ceiling in generator room as shown. (see also R30)
- Hang Screen and Fence wire on the ceiling.
 - o Staple screen on rafters first
 - o Use fence staples to hang fencing wires up under screening
- Install insulation (2 layers R21)
- Frame ceiling in control room as shown
- Frame access hatch
- Install typical ceiling to local spec
- Install Insulation (2 layers R21)

P 30. REAR-GENERATOR ROOM DETAIL

P30 shows a cross section view of the generator room from the south. This shows placement of the generators, air intake and exhaust openings, and ceiling and insulation. It also has details on exhaust piping and fuel lines, to be installed with the generator.

- Exhaust openings as shown
- Intake air opening as shown
- Plaster inner walls of Generator Room.
- Hang Screen and Fence wire on the ceiling.
- Install insulation

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MATERIALS LIST

The following is a ESTIMATED rough guide to the materials required. It is NOT all inclusive, or complete, but gives a rough idea for the major elements in the building. Your local builder should be able to more accurately determine what is needed.

1. Footer: 150 ft³
 - a. Cement: 35 bags
 - b. Sand: 95 ft³
 - c. Gravel: 150 ft³
2. Concrete Block
 - a. 2000 standard
 - b. 12 air block
 - c. Cement: 400 ft³
 - d. Sand: 1200 ft³
 - e. Concrete to fill block as needed: calculate locally.
3. Concrete Floor, Porch & Pedestals: 275 ft³
 - a. Cement: 75 bags
 - b. Sand: 150 ft³
 - c. Gravel: 225 ft³
 - d. Wire grid: 660 ft²
4. Rebar
 - a. ½" –400 ft
 - b. 3/8" – 120 ft
 - c. Any rebar used in walls must be added to this
5. Doors: 3- 42", 1-32", 2-28"
6. Ground Wire: 45' of 35MM² (4 AWG) bare solid copper
7. Windows: 1- 40" x 40" rough or as desired.

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8. Conduit:

- a. Pipe: 12- 4" PVC x 10'
- b. 10-- 45° 4" Elbows
- c. 4 – 4" straight coupling (or use preflared sewer pipe)
- d. 10 – Caps
- e. Pipe: 1-1/2" PVC x 3'
- f. Pipe: 1" PVC x 3'
- g. 1—(90" 1" elbow)

9. Trusses (as Drawn)

- a. 11 – 2x8x16' (main room, bottom chords)
- b. 20- 2x6x12' (main roof- top chords)
- c. 12 - 2x6x8' (Side room)
- d. 3- 2x6x8' (vertical braces)
- e. Purloins: 2x4, approx 425 ft

10. Sheet roofing

- a. Roof: 900 ft²

11. Assorted

- a. Tiedowns, J bolts for framing to wall, etc.
- b. Framing for openings
- c. Nails (truss, framing, roofing)
- d. Hardware for doors
- e. Window grates
- f. Posts for Porch: 1-8', 2 – 10'8"
- g. Lumber needed for forms, etc

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MATERIALS TO BE IMPORTED

The following items will be shipped with the generators, to be installed.

1. Generators
2. Fuel tank, piping, valves, and filters.
3. Exhaust pipe, mufflers
4. Electrical controls and enclosures
5. Fiberglass Insulation
6. Electrical wiring
7. Intake and Exhaust air louvers
8. Ground rods
9. Interior electric fixtures and wiring