

Innovations in green buildings: the GRIHA approach

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Evolving landscape of sustainable habitats in India

2009: by TERI, MNRE & sectoral experts establish ADaRSH

CII-Sorabhji Godrej Green Business Centre, Hyderabad



2007: GRIHA adopted by MNRE



2005: TERI-GRIHA with TERI-BCSD

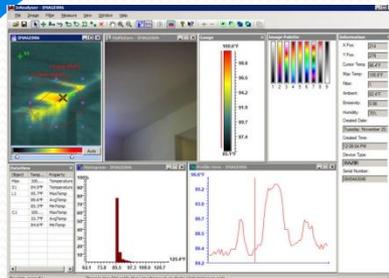


Ministry of New and Renewable Energy, GoI



Up to 2000

2003: 1st LEED Platinum building



Over 100 audits



Achievements- 2011: Resource use optimisation
through design

GRIHA & TERI-GRIHA Projects

Centre for Environmental Science and Engineering Kanpur



TERI- GRIHA Rated



पर्यावरण विज्ञान एवं अभियंताओं के केंद्र
CENTRE FOR
ENVIRONMENTAL SCIENCE
& ENGINEERING





IIT Kanpur: Good architectural features

- Building designed according to trees on site for preserving more trees and integrating them into the design
- Longest facades face North and South
- Limited Window-Wall Ratio
- Well shaded windows coupled with good glass result in good daylighting inside the spaces
- Roof covered with China mosaic tiles along with bamboo pergolas for additional shading in order to reduce heat gains

GRIHA Performance

- Energy reduction compared to benchmarks: 43%
- Water consumption reduction compared to conventional buildings: 50%

Suzlon One Earth Campus Pune, Maharashtra



GRIHA Rated







SUZLON OneEarth: Good architectural features

- Excellent site planning. Building form designed to self shade a lot of the facades
- Thin floor plates with glazing on both sides for maximising daylight penetration
- Good interior design for better daylight penetration
- Angled louvres installed to control direct sunlight from coming inside the building

GRIHA Performance

- Energy consumption reduction compared to GRIHA benchmarks: 56%
- Reduction in water consumption compared to conventional building: 50%
- 2,50,000 units of electricity generated annually on site

Police Training School

Turuchi, Tasgaon, Maharashtra



GRIHA Rated





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ଶିକ୍ଷା କେନ୍ଦ୍ର

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PTS: Good architectural features

- Site planning done according to site slope
- Low WWR and well shaded windows
- Building plans and windows designed for cross ventilation to provide thermal comfort
- Use of local stone and other low-energy materials for cladding and finishing
- Non-AC building but yet designed to be extremely comfortable

GRIHA Performance

- Energy savings compared to GRIHA benchmark: 31%
- Water saving compared to conventional building: 52%

FORTIS Hospital

Shalimar Bagh, New Delhi



TERI-GRIHA Rated

First hospital in the country to receive TERI-GRIHA Rating

32% Savings in energy

58% Savings in water



Fortis



Hindustan Unilever Ltd. Development Centre Mumbai



TERI-GRIHA Rated

12% Savings in energy

57% Savings in water

Existing trees transplanted and protected and incorporated into building design

Tree cover doubled on site



Doon School

Dehradun



GRIHA Rated

73.3% reduction in energy consumption
from TERI GRIHA benchmark

50% reduction in water consumption than
conventional buildings via use of low-flow
plumbing fixtures



Shapoorji Pallonji Infocity

Manesar, Haryana



GRIHA Rated

45% reduction in Energy Consumption from TERI
GRIHA benchmark

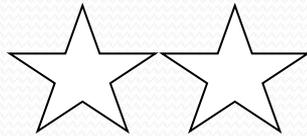
50% reduction in water consumption

50% reduction in landscape water requirement through
native trees and shrubs, high efficiency sprinkler and
drip irrigation systems



Commonwealth Games Village

New Delhi



TERI GRIHA Rated

Energy consumption reduction: 61% below
TERI GRIHA benchmark

Water consumption reduction: 60% below
TERI GRIHA benchmark



DELHI 2010
COMMONWEALTH GAMES





PCNTDA Headquarters, Pimpri Chinchwad,
Maharashtra

Yet to be rated



Source: Landmark Design

PCNTDA: Good architectural features

- Good orientation: longest facades face North and South
- Well shaded facades on East and West
- Thin floor plates for good daylight penetration
- Air vents provided above the roof slab, a traditional architectural feature borrowed from Rajasthani Havelis. The air flows across the slab and reduces the heat gain through the roof.
- Water bodies on the podium to cool the air flowing into the building through evaporative cooling



Achievements-2011:

Implementation of good practices on site

GRIHA criteria addressed during construction

- **Criterion 2**
Preserve and protect landscape during construction/compensatory depository forestation.
- **Criterion 3**
Soil conservation (post construction)
- **Criterion 8**
Provide minimum level of sanitation/safety facilities for construction workers
- **Criterion 9**
Reduce air pollution during construction
- **Criterion 12**
Efficient water use during construction
- **Criterion 22**
Reduction in waste during construction



Criterion 2

Preserve and protect landscape during construction/compensatory depository forestation.



Bad Examples



GRIHA Examples



GRIHA Examples



GRIHA Examples



GRIHA Examples



Criterion 3
Soil conservation (post construction)



Bad Examples



GRIHA Examples



Criterion 8

Provide minimum level of sanitation/safety facilities for construction workers



Bad Examples



Bad Examples



GRIHA Examples



GRIHA Examples



GRIHA Examples



Criterion 9
Reduce air pollution during construction



Bad Examples



GRIHA Examples



GRIHA Examples



Criterion 12
Efficient water use during construction



GRIHA Examples



Criterion 22
Reduction in waste during construction



Bad Examples



GRIHA Examples



Achievements-2011:
Influencing and implementing policy

Salient features of GRIHA

- Climate specific energy performance indices for various building typologies (defined in kWh/sqm/year)
- Mandatory compliance with Energy Code
- Separate rating criteria for air conditioned and non air conditioned spaces
- Upper limit of window wall ratio mandatory to be met
- Window solar heat gain limit specified (mandatory)
- Adaptive comfort encouraged to be followed
- Daylighting mandatory
- 1% connected load of space conditioning and lighting to be met through RE

Ministry of New and Renewable Energy

- Solar buildings program for energy efficient buildings
- GRIHA- national building rating system (partly mandatory)
- Solar cities programme
- Incentives for integration of renewable energy & GRIHA

Bureau of Energy Efficiency, Ministry of Power

- Energy Conservation Building Code (voluntary)
- Appliance labelling (partly mandatory)
- Star rating programme for existing buildings (rates commercial buildings on energy performance)

Ministry of Environment & Forests

- Environmental Clearance (Mandatory)
- Resource (energy, water) efficiency integral part of clearance
- ECBC mandatory

Ministry of Urban Development

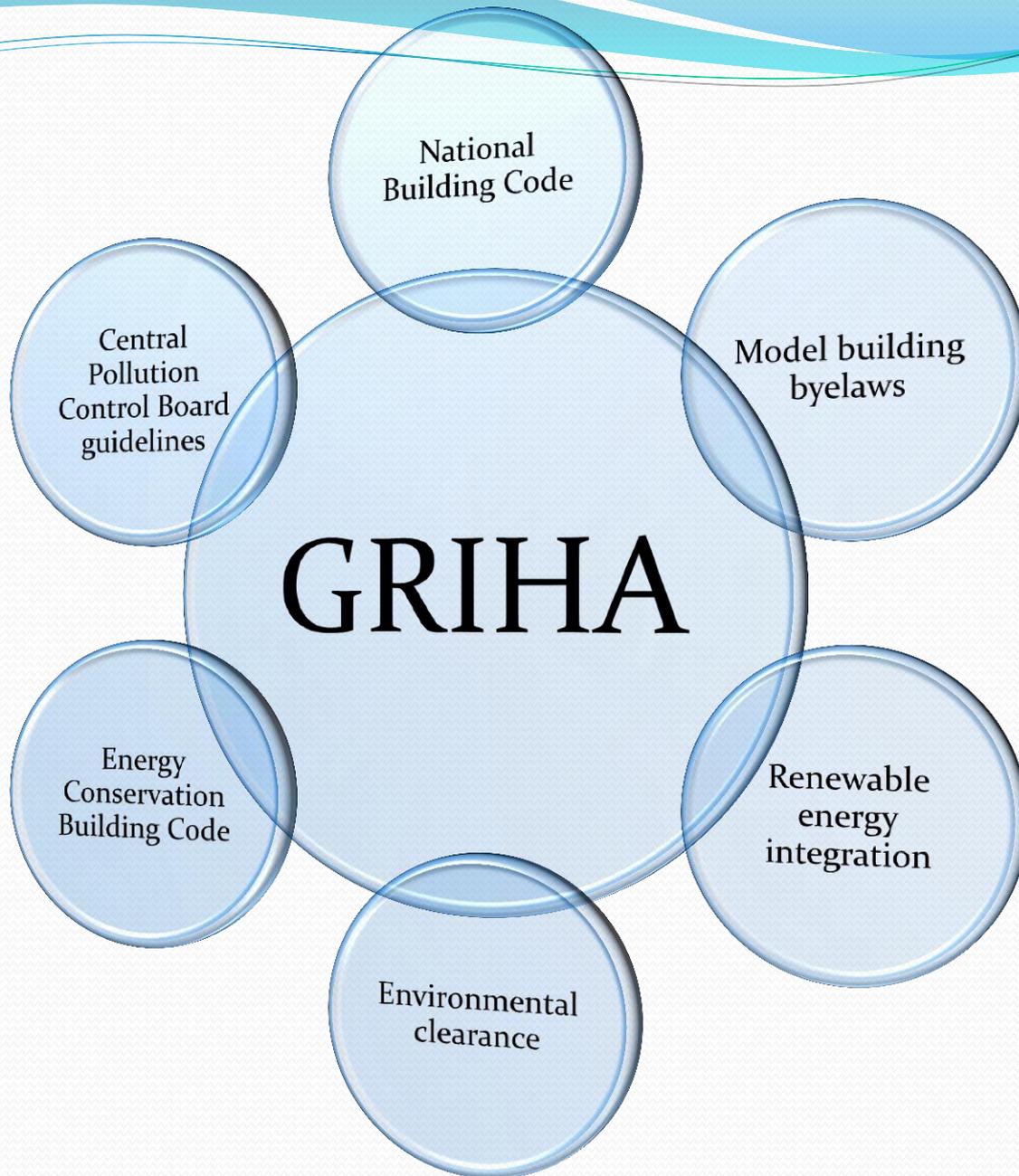
- National Mission on Sustainable Habitats
 - energy efficiency in buildings
 - management of solid waste
 - accelerating modal shift to mass transport

Pimpri Chinchwad Municipal Corporation, Maharashtra

- Partly mandatory to comply with GRIHA
- Incentives for GRIHA

Central Public Works Department/ Thiruvananthapuram PWD

- Mandatory to comply with GRIHA
- Revised specification, schedules and plinth area rates



GRIHA

National
Building Code

Model building
byelaws

Renewable
energy
integration

Environmental
clearance

Energy
Conservation
Building Code

Central
Pollution
Control Board
guidelines



Mechanisms for GRIHA implementation:
carrots, sticks & tambourines

Incentives

- For enhancing demand for GRIHA compliant projects
 - 10% property tax rebate for occupants of GRIHA compliant homes in Pimpri Chinchwad, Maharashtra
 - 30-40% reduction in operation cost with negligible impact on project cost.
 - Costs involved in registration and certification with GRIHA are about 3 to 4 lakhs lesser than other rating systems practiced in the country
- For enhancing supply for constructing GRIHA projects
 - Fast track environmental clearance for GRIHA pre-certified projects
 - Registration fee waiver for GoI & PSU projects by MNRE
 - Up to 50% rebate in 'premium' paid by developers in Pimpri Chinchwad, Maharashtra

Mandates and generating awareness

- Mandates
 - Minimum 3 Star GRIHA compliance mandatory for new buildings of GoI and PSUs
 - Mandatory for new government projects in Pimpri Chinchwad to comply with GRIHA
 - Mandatory for all new projects of CPWD across the country
 - Regular due diligence site visits by ADaRSH
- Raising awareness
 - GRIHA on line tool, 5 volume GRIHA Manual
 - Large scale capacity building with MNRE support through TERI, GRIHA Patrons, IIA, CREDAI, SNAs, CPWD, practicing architects, consultants and TERI-BCSD
 - Campaigns with stakeholders
 - LAUNCH OF GREEN BUILDING QUIZ ON TERI FACEBOOK

[GO TO WALL](#)[HOME](#)[QUIZ](#)[RULES](#)[ANSWERS](#)[WINNERS](#)[INVITE](#)

Why build GREEN buildings?

Find out. Take this quiz and win exciting prizes.

"Buildings around us are turning GREEN. But are they energy efficient? Are they cost-effective? Let's explore."



About Green building Quiz

The quiz is an attempt to create awareness about Green Buildings and encourage people to participate and join our efforts in building a sustainable future.

Come, participate, and

- Win a pen drive every week
- Flipkart gift voucher every month
- An exciting trip to TERI's heaven in the hills (Himalaya Mukteshwar Centre)

Answer 10 questions in 02:00 minutes and win exciting prizes.

Win a trip to TERI Mukteshwar, the ultimate eco-tourism destination in the Himalayas.

Grand Prize

Trip to TERI's Himalyan Resort
Mukteshwar
3 Days 2 Night

flipkart Coupon
Monthly Prize
Gift Voucher ₹2000

Weekly Prize

8 GB Pen Drive

GRIHA

GRIHA

<http://www.facebook.com/TERIIN>

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to Join us

The logo for TERI (The Energy and Resources Institute) features the word "teri" in a stylized, lowercase font. The letters are filled with a red-to-orange gradient and have a diagonal hatched pattern. The 'i' has a red dot.

Creating Innovative Solutions
For a Sustainable Future

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Dr. Har S. Gohil
1929-1998
Founder TERI



Play



Timeline: Journey over 3 decades

Select
Year ▶

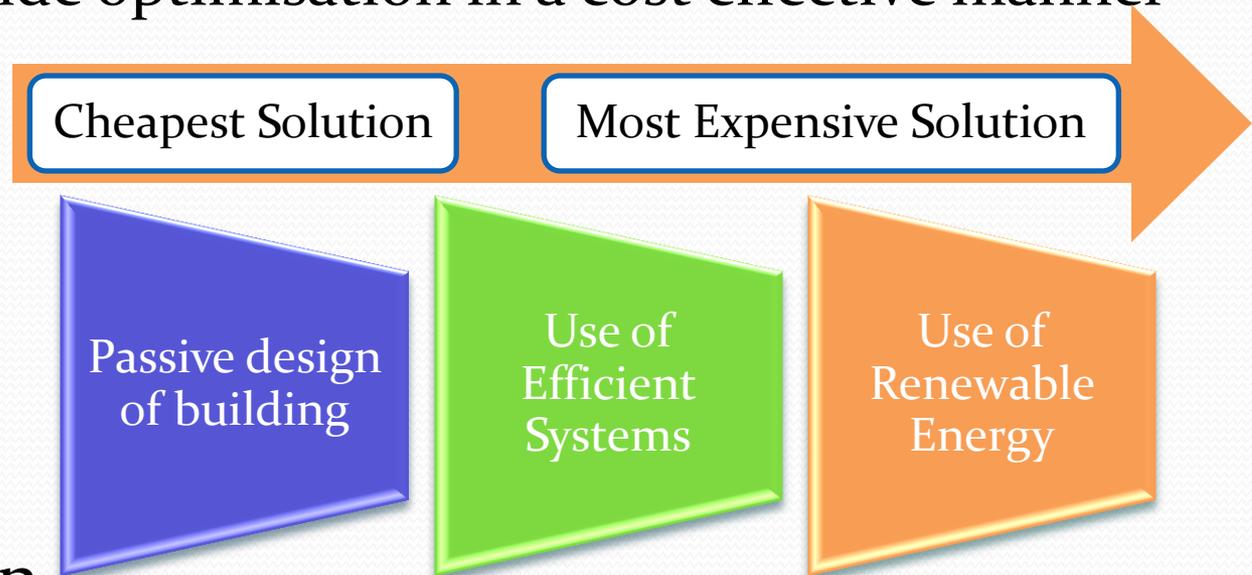
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Shaping a sustainable INDIA

GRIHA: A driver to Green Economy

- Climate change mitigation
- Energy and natural resource security
 - Demand side optimisation in a cost effective manner



- Job creation
- Market transformation

Future landscape of sustainable habitats in India





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