**FEMA Risk Rating 2.0 for Flood Insurance**

The **FEMA Risk Rating 2.0** methodology provides a framework for determining premiums for the **National Flood Insurance Program (NFIP)**. This new rating system replaces legacy rating methods with a more **granular, risk-based approach**.

**1. Factors Affecting Premium Calculations**

The premium for a flood insurance policy under Risk Rating 2.0 is determined by multiple factors, grouped into the following categories:

**A. Geographic Rating Factors**

These factors are related to the **location of the property** and include:

* **Distance to water sources** (e.g., rivers, lakes, coastlines)
* **Elevation relative to nearby water bodies**
* **Historical flood data for the area**
* **Local climate and rainfall patterns**
* **Flood risk modeling data from multiple sources**
* **Proximity to levees or other flood mitigation structures**​

**B. Property Characteristics**

These include:

* **Foundation type** (e.g., slab, crawlspace, basement)
* **First-floor height above ground level**
* **Building materials and structural features**
* **Number of stories**
* **Presence of flood mitigation measures** (e.g., elevated machinery)​

**C. Policy-Specific Characteristics**

These include:

* **Coverage amount for the building and contents**
* **Deductible chosen by the policyholder**
* **Community Rating System (CRS) discounts** for participating communities
* **Prior claims history (claims within the past 20 years impact rates)**​

**2. Rating Calculation Process**

The rating calculation follows a structured process that incorporates multiple variables. The steps include:

1. **Base Rate Determination**
   * The **SFH (Single-Family Home) base rate** is established by state and by flood peril (e.g., storm surge, inland flood).
2. **Application of Geographic and Property Rating Factors**
   * Factors related to **distance to water, elevation, foundation type, and prior flood events** are applied to adjust the base rate.
3. **Consideration of Community Discounts & Risk Reduction Efforts**
   * **CRS discounts** are applied based on community participation in flood mitigation efforts.
4. **Final Premium Calculation**
   * Adjustments for **deductibles, coverage limits, prior claims surcharges, and administrative fees** are incorporated​.

**3. Important Considerations**

* **Risk Concentration Adjustments**:
  + High-risk zones may be subject to additional loading factors to reflect increased exposure​.
* **Capping of Rating Factors**:
  + To prevent extreme variations, FEMA applies **caps on maximum rating factors** at the 95th percentile of exposure distributions​.
* **Impact of Prior Claims**:
  + A **surcharge is added for properties with prior claims** (e.g., $2 per $1,000 of coverage after the first claim)​.
* **Leveed Areas Considerations**:
  + Premiums in leveed areas are calculated differently due to **unique flood protection mechanisms** and levee failure risks​.

**Conclusion**

The **Risk Rating 2.0** approach replaces the older, zone-based system with a **property-specific, risk-based rating model**. This method **improves premium accuracy, ensures fairer pricing, and accounts for individual property risk more precisely**.

**General Insurance & Rating Terms**

* **NFIP** – National Flood Insurance Program
* **FEMA** – Federal Emergency Management Agency
* **SFH** – Single-Family Home
* **NSFH** – Non-Single-Family Home
* **CRS** – Community Rating System
* **ICC** – Increased Cost of Compliance
* **RCV** – Replacement Cost Value
* **AAL** – Average Annual Loss
* **ITV** – Insurance to Value
* **LAE** – Loss Adjustment Expense
* **NCOR** – Net Cost of Reinsurance

**Geographic & Risk Assessment Terms**

* **GIS** – Geographic Information System
* **DTC** – Distance to Coast
* **DTO** – Distance to Ocean
* **DTR** – Distance to River
* **HUC** – Hydrologic Unit Code (used to define watersheds)
  + **HUC12, HUC10, HUC8, HUC6, HUC4, HUC2** – Different levels of watershed classification
* **MSA** – Metropolitan Statistical Area
* **µSA** – Micropolitan Statistical Area
* **CSA** – Combined Statistical Area
* **NHD** – National Hydrography Dataset
* **TIGER** – Topologically Integrated Geographic Encoding and Referencing (a Census dataset)

**Flood & Catastrophe Modeling Terms**

* **MDI** – Mapping Data Integration Model
* **PFRA** – Preliminary Flood Risk Assessment Model
* **GLM** – Generalized Linear Model
* **KatRisk** – KatRisk SpatialKat and SoloKat Flood Models
* **AIR** – AIR Touchstone Version 5 Model
* **RQE** – Risk Quantification and Engineering Model (by CoreLogic)
* **Burn Rate** – AAL per thousand dollars of insured value

**State and Territory Abbreviations**

* **HI** – Hawaii
* **GU** – Guam
* **AS** – American Samoa
* **MP** – Northern Mariana Islands
* **PR** – Puerto Rico
* **VI** – U.S. Virgin Islands
* **AK** – Alaska

**Rate Order Calculation and Selection for FEMA Risk Rating 2.0**

The **Rate Order Calculation and Selection** process in **Risk Rating 2.0** involves multiple components that determine flood insurance premiums in a more **granular, risk-based** manner.

**1. Components of Rate Order Calculation**

The premium calculation follows a step-by-step approach where **various rating factors** are applied in a specific order:

**A. Community Rating System (CRS) Discount**

* Under **Risk Rating 2.0**, the **CRS discount is applied to all policies**, removing the distinction between **Special Flood Hazard Areas (SFHA) and non-SFHA**.
* The CRS program rewards communities that take flood mitigation measures with **premium discounts**​.

**B. Elevated Machinery and Equipment**

* A **factor of 0.95** is applied if machinery and equipment are **elevated above the first floor**​.

**C. First Floor Height (FFH)**

* FEMA assigns **different factors based on foundation type**:
  + **Basements:** **1.30**
  + **Elevated with enclosure (not on posts, piles, or piers):** **1.25**
  + **Crawlspaces:** **1.20**
  + **All other foundation types:** **1.00**​.

**D. Maximum Rate Limitations**

* **Building Coverage:** Maximum of **$15 per $1,000 of building value**.
* **Contents Coverage:** Maximum of **$15 per $1,000 of contents value**​.

**E. Prior Claims Surcharge**

* If a property has a **prior flood claim within the last 20 years**, a **surcharge is applied**:
  + **$2 per $1,000 of insured value** for **each claim after the first claim**.
  + This surcharge is **not applied** to existing policies **until a new claim is filed under Risk Rating 2.0**​.

**F. Rating Factor Capping**

* To avoid extreme variations in premiums:
  + **Ceiling (upper cap):** 95th percentile of exposure distribution.
  + **Floor (lower cap):** 5th percentile of exposure distribution.
  + Applied separately for each **peril and rating segment**​.

**2. Base Rates Determination**

* **Base rates** are determined by **state/territory, coverage type, and peril**.
* Separate base rates exist for:
  + **Single-Family Non-Leveed**
  + **Single-Family Leveed**
  + **Non-Single-Family Homes (NSFH)**
* Base rates are adjusted to ensure that the **rerated premium is within 0.1% or $1,000 of the target premium**.
* In some cases, small states or territories with **low policy counts** had their **maximum base rate capped**​.

**3. Final Rating Factors and Selection Process**

* The final rating factors are derived from **multiple catastrophe models** (e.g., AIR, CoreLogic, KatRisk).
* FEMA selected risk factors **based on historical loss experience and catastrophe modeling results**.
* Adjustments were made for **perils such as storm surge, tsunami, and Great Lakes flooding**, using **storm surge models as proxies for tsunami risks**​.

**4. Rating Examples**

To illustrate how premiums are calculated, FEMA provides case studies in **Appendix E**:

* **Example 1:** South Carolina, **non-leveed SFH**
* **Example 2:** Michigan, **non-leveed SFH**
* **Example 3:** California, **leveed SFH**
* **Example 4:** South Carolina, **non-leveed residential unit**

For each case, premium calculation involves:

1. **Geographic inputs** – distance to coast, river proximity, elevation, CRS discount, etc.
2. **Property characteristics** – first floor height, structure type, replacement cost value.
3. **Policy inputs** – coverage amount, deductible selection.
4. **Calculation of rating factors** – geographic, structural, policy-related adjustments.
5. **Final premium determination** – applying **capped rating factors, prior claims surcharge, and administrative fees**​.

**5. Summary**

The **Rate Order Calculation and Selection** ensures that:

* **Fair and risk-based premiums** are charged for flood insurance.
* **Discounts for mitigation efforts** (CRS) are applied consistently across **all policies**.
* **Prior claims are penalized**, ensuring higher-risk properties pay appropriately.
* **Rate capping** prevents extreme variations in premium costs.
* **Geographic and property-specific risk factors** are accounted for, improving **pricing accuracy**.

**Example Premium Calculation under FEMA Risk Rating 2.0**

Let's go through a **step-by-step example** of how flood insurance premiums are calculated for a **Single-Family Home (SFH) in South Carolina (Non-Leveed Area).**

**1. Property and Policy Inputs**

* **Location:** South Carolina
* **Distance to River:** **111 meters**
* **Distance to Coast:** **231 meters**
* **Elevation Relative to River:** **5 meters**
* **Community Rating System (CRS) Class:** **Class 7 (15% Discount)**
* **Building Characteristics:**
  + **First Floor Height:** **5.5 feet**
  + **Foundation Type:** **Crawlspace** (Rating factor: **1.20**)
  + **Coverage A (Building):** **$250,000**
  + **Coverage C (Contents):** **$100,000**
* **Deductible:** **$1,250**
* **Prior Claims:** **None**

**2. Step-by-Step Premium Calculation**

**Step 1: Base Rates**

* **Base rate for South Carolina (per $1,000 of coverage)**
  + **Building Coverage:** **$1.50**
  + **Contents Coverage:** **$1.20**

**Step 2: Apply Geographic Rating Factors**

* **Distance to Coast (231m):** **Factor = 1.10**
* **Distance to River (111m):** **Factor = 1.05**
* **Elevation Relative to River (5m):** **Factor = 1.15**

**Geographic Rate Calculation:**

Building Rate=1.50×1.10×1.05×1.15=1.98

Contents Rate=1.20×1.10×1.05×1.15=1.58

**Step 3: Apply Property Characteristics Rating Factors**

* **First Floor Height (5.5 feet) Factor:** **1.05**
* **Foundation Type (Crawlspace) Factor:** **1.20**

Adjusted Building Rate=1.98×1.05×1.20=2.49

Adjusted Contents Rate=1.58×1.05×1.20=1.99

**Step 4: Apply Deductible & Insurance-to-Value (ITV) Factor**

* **Deductible Factor:** **0.95**
* **ITV Factor:** **1.02**

Final Building Rate=2.49×0.95×1.02=2.41

Final Contents Rate=1.99×0.95×1.02=1.92

**Step 5: Calculate Initial Premium**

Building Premium=2.41×(250,000/1,000)=2.41×250=602.50

Contents Premium=1.92×(100,000/1,000)=1.92×100=192.00

Initial Premium=602.50+192.00=794.50

**Step 6: Apply CRS Discount (15%)**

Discounted Premium=794.50×(1−0.15)=794.50×0.85=675.33

Discounted Premium=794.50×(1−0.15)=794.50×0.85=675.33

**Step 7: Apply Expense Constant and Fees**

* **Expense Constant:** **$50**
* **Reserve Fund Fee (18%):** Reserve Fund Fee=675.33×0.18=121.56

Final Premium=675.33+50+121.56=846.89

**Final Annual Flood Insurance Premium**

846.89

Thus, the **total annual flood insurance premium** for this **Single-Family Home in South Carolina** under **Risk Rating 2.0** would be **$846.89**.

**Summary of Calculations**

| **Step** | **Factor Applied** | **Value** |
| --- | --- | --- |
| **Base Rates** | Building: $1.50, Contents: $1.20 |  |
| **Geographic Factors** | Distance to Coast: 1.10, Distance to River: 1.05, Elevation: 1.15 |  |
| **Adjusted Rates** | Building: $2.49, Contents: $1.99 |  |
| **Property Factors** | FFH: 1.05, Crawlspace: 1.20 |  |
| **Deductible & ITV** | 0.95 and 1.02 applied |  |
| **Final Rates** | Building: $2.41, Contents: $1.92 |  |
| **Initial Premium** | Building: $602.50, Contents: $192.00 | **$794.50** |
| **CRS Discount (15%)** | -$119.17 | **$675.33** |
| **Expense Fees & Reserve Fund (18%)** | $50 + $121.56 | **$846.89** |

**Rate Explanation Guide**

The **FEMA Risk Rating 2.0: Equity in Action** introduces a more **individualized and equitable** flood insurance rating system. It considers three main factors when determining flood insurance premiums:

**1. WHERE It Is Built (Location-Based Risk Factors)**

* **Proximity to flood sources** (coast, ocean, rivers, Great Lakes).
* **Ground elevation** relative to surrounding land and nearby water bodies.
* **Community Rating System (CRS) discounts** for flood mitigation efforts.
* **Barrier island status**, which affects flood exposure.

**2. HOW It Is Built (Building Characteristics)**

* **Building Occupancy:** Type of building (residential, commercial) affects coverage.
* **Foundation Type:** Determines where flood risk begins (e.g., slab, crawlspace, elevated).
* **First Floor Height:** Higher elevations reduce flood risk.
* **Number of Floors:** Spreading risk across multiple levels lowers individual exposure.
* **Unit Location:** Higher floor units have lower risk.
* **Construction Type:** Masonry performs better in floods than wood frames.
* **Flood Openings:** Allowing water to flow through reduces structural damage risk.
* **Machinery & Equipment:** Elevating items like HVAC systems reduces potential losses.

**3. WHAT Is Built and Covered (Policy & Coverage Selections)**

* **Building Replacement Cost:** Higher costs lead to **higher premiums**.
* **Building & Contents Coverage:** Higher coverage limits increase potential payouts.
* **Deductibles:** Higher deductibles lower premiums but increase **out-of-pocket expenses** during a flood claim.

**Conclusion**

The **Risk Rating 2.0** system ensures **more accurate, fair, and property-specific** premium calculations by considering **location, structural characteristics, and coverage choices**.

**FEMA Discount Explanation Guide**

The **FEMA Risk Rating 2.0: Equity in Action** introduces various **discounts and mitigation incentives** that can reduce flood insurance premiums. These discounts are based on **property characteristics, mitigation measures, and statutory provisions**.

**1. Foundation Type Discounts**

* Buildings **elevated on posts, piles, or piers** receive **greater discounts** compared to buildings with basements or enclosures.
* Foundation type determines **where flood risk begins**, impacting premium rates.

**2. First Floor Height (FFH) Discounts**

* Buildings **higher off the ground** face lower flood risk.
* Discounts range from **-8% (1 ft FFH) to -88.9% (25 ft FFH)**, depending on **foundation type**.

**3. Flood Openings Discounts**

* Buildings with **proper flood openings** in crawlspaces or enclosures receive additional discounts.
* These discounts range from **-0.5% to -27.1%**, depending on **first floor height and foundation type**.

**4. Machinery & Equipment (M&E) Elevation Discount**

* A **5% discount** applies if **essential machinery and equipment** (e.g., HVAC, electrical systems) are **elevated above the first floor**.

**5. Number of Floors Discounts**

* Buildings with **more floors** receive **greater discounts** due to risk spread.
* **Examples**:
  + **2 floors:** **-10% discount**
  + **3 floors:** **-30% discount**
  + **8+ floors:** **-51% to -69% discount**

**6. Floor of Unit (For Multi-Floor Buildings)**

* **Residential or non-residential units** located on higher floors receive significant discounts.
* **Examples**:
  + **2nd floor unit:** **-71.8% discount**
  + **3rd floor unit:** **-88.4% discount**
  + **4+ floors:** **-88.9% discount**

**7. Statutory Discounts**

Certain properties are eligible for **statutory discounts** on the **first $35,000 of building coverage** and **$10,000 of contents coverage**:

| **Category** | **Discount** |
| --- | --- |
| Newly Mapped Properties | **70%** |
| Pre-FIRM Primary Residences | **60%** |
| Emergency Program Properties | **60%** |
| AR Zone Properties | **60%** |

**8. Community Rating System (CRS) Discounts**

* Under **Risk Rating 2.0**, **CRS discounts (5% to 45%)** apply **uniformly** across **all flood zones** in a participating community.
* Communities with better **flood mitigation efforts** receive **higher CRS discounts**.

**Key Takeaways**

* **Higher first floors, flood openings, elevated equipment, and additional building floors** lead to **lower premiums**.
* **Statutory and CRS discounts** can significantly reduce policy costs.
* **Certain mitigation actions can further decrease premiums, making flood insurance more affordable**.

**Example:**

| **Discount Type** | **Discount Applied** | **Premium After Discount** |
| --- | --- | --- |
| **Base Premium** | N/A | **$3,000** |
| **First Floor Height (5 ft)** | -34.1% | **$1,977** |
| **Flood Openings** | -2.6% | **$1,925.60** |
| **Machinery & Equipment Elevation** | -5% | **$1,829.32** |
| **Number of Floors (2 floors)** | -10% | **$1,646.39** |
| **CRS Discount (Class 7 - 15%)** | -15% | **$1,399.43** |

**Database Schema for Flood Insurance Premium Calculation Website**

-- Users Table (Stores user information)

CREATE TABLE users (

user\_id INT PRIMARY KEY AUTO\_INCREMENT,

name VARCHAR(255) NOT NULL,

email VARCHAR(255) UNIQUE NOT NULL,

password\_hash VARCHAR(255) NOT NULL,

phone VARCHAR(20),

address TEXT,

created\_at TIMESTAMP DEFAULT CURRENT\_TIMESTAMP

);

-- Locations Table (Stores geographic factors)

CREATE TABLE locations (

location\_id INT PRIMARY KEY AUTO\_INCREMENT,

state VARCHAR(50),

county VARCHAR(100),

zip\_code VARCHAR(10),

distance\_to\_river DECIMAL(10,2),

elevation\_relative\_to\_river DECIMAL(10,2),

drainage\_area DECIMAL(10,2),

distance\_to\_coast DECIMAL(10,2),

distance\_to\_ocean DECIMAL(10,2),

elevation DECIMAL(10,2),

river\_class ENUM('A', 'B', 'C', 'D', 'E'),

is\_barrier\_island BOOLEAN DEFAULT FALSE

);

-- Properties Table (Stores property details)

CREATE TABLE properties (

property\_id INT PRIMARY KEY AUTO\_INCREMENT,

user\_id INT,

location\_id INT,

foundation\_type ENUM('Slab', 'Crawlspace', 'Elevated with Enclosure', 'Elevated without Enclosure'),

first\_floor\_height DECIMAL(5,2),

num\_floors INT,

flood\_vents BOOLEAN DEFAULT FALSE,

machinery\_above\_first\_floor BOOLEAN DEFAULT FALSE,

property\_type ENUM('Single-Family Home', 'Condo', 'Commercial'),

FOREIGN KEY (user\_id) REFERENCES users(user\_id),

FOREIGN KEY (location\_id) REFERENCES locations(location\_id)

);

-- Insurance Policies Table (Stores policy details)

CREATE TABLE insurance\_policies (

policy\_id INT PRIMARY KEY AUTO\_INCREMENT,

user\_id INT,

property\_id INT,

coverage\_building DECIMAL(10,2),

coverage\_contents DECIMAL(10,2),

deductible\_building DECIMAL(10,2),

deductible\_contents DECIMAL(10,2),

prior\_claims INT DEFAULT 0,

is\_primary\_residence BOOLEAN DEFAULT TRUE,

created\_at TIMESTAMP DEFAULT CURRENT\_TIMESTAMP,

FOREIGN KEY (user\_id) REFERENCES users(user\_id),

FOREIGN KEY (property\_id) REFERENCES properties(property\_id)

);

-- Community Discounts Table (Stores CRS discount data)

CREATE TABLE community\_discounts (

community\_id INT PRIMARY KEY AUTO\_INCREMENT,

location\_id INT,

crs\_class INT CHECK (crs\_class BETWEEN 1 AND 10),

discount\_percentage DECIMAL(5,2),

FOREIGN KEY (location\_id) REFERENCES locations(location\_id)

);

-- Premium Calculations Table (Stores premium calculations)

CREATE TABLE premium\_calculations (

premium\_id INT PRIMARY KEY AUTO\_INCREMENT,

policy\_id INT,

base\_premium DECIMAL(10,2),

geographic\_adjustment DECIMAL(10,2),

property\_adjustment DECIMAL(10,2),

deductible\_discount DECIMAL(10,2),

crs\_discount DECIMAL(10,2),

fees DECIMAL(10,2),

final\_premium DECIMAL(10,2),

calculated\_at TIMESTAMP DEFAULT CURRENT\_TIMESTAMP,

FOREIGN KEY (policy\_id) REFERENCES insurance\_policies(policy\_id)

);

-- Fees and Surcharges Table (Stores FEMA fees and surcharges)

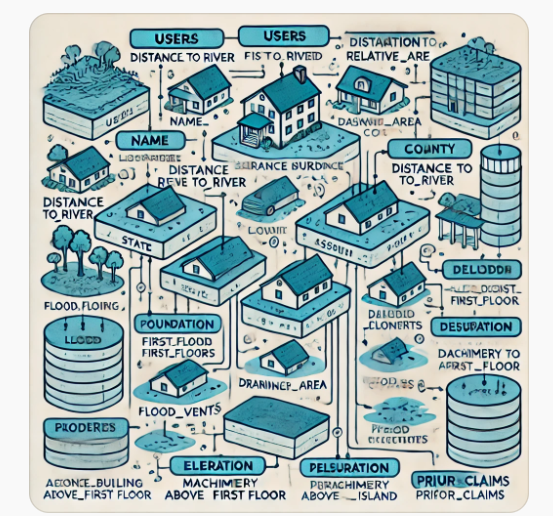
CREATE TABLE fees\_and\_surcharges (

fee\_id INT PRIMARY KEY AUTO\_INCREMENT,

fee\_name VARCHAR(255),

amount DECIMAL(10,2)

);



**Database ER Diagram**

